Volume I

TA-21 Operable Unit RFI Work Plan for Environmental Restoration

May 1991

A Department of Energy environmental clean-up program

Los Alamos
NATIONAL LABORATORY

LAUR-91-962

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APPENDICES

TABLES

FIGURES

ABBREVIATIONS AND ACRONYMS USED IN THE TA-21 OU RFI WORK PLAN

ADS	Activity data sheet
AEC	US Atomic Energy Commission
ALARA	As low as reasonably achievable
ASTM	American Society of Testing Materials
BTX	Benzene, toluene, o-xylene, m-xylene
CA	Corrective activities
CEARP	Comprehensive Environmental Assessment and Response Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CMP	Corrugated metal pipe
CMS	Corrective measures study
COLIWASA	COmposite LIquid WAste SAmpler
CY	Calendar Year
D&D	Decontamination and decommissioning
DCG	DOE-derived concentraton guide
DOE/AL	US Department of Energy Albuquerque Operations Office
DOE/HQ	US Department of Energy Headquarters
DOE/LAAO	US Department of Energy Los Alamos Area Office
DOT	Department of Transportation
DP Site	D Prime, where D was D Building in the Former TA-1 (now part of the current townsite)
DP East	Eastern part of TA-21
DP West	Western part of TA-21
DQO	Data quality objectives
EA	Environmental assessment
EES-1	Geology and Geochemistry Group
EIS	Environmental impact statement
EP toxicity	Extraction Procedure Toxicity
EPA	US Environmental Protection Agency
ER	Environmental restoration
ES&H	Environment, safety, and health
ESG	Environmental Surveillance Group
FID	Flame ionization detector
FIMAD	Facility for Information Management, Analysis, and Display
FSP	Field Sampling Plan
FY	Fiscal year
FYP	Five Year Plan
GIS	Geographical Information System
GM	Geiger-Mueller
H&S	Health and Safety
HPIC	High pressure ion chamber
HSE	Health, Safety, and Environment (Division)
HSE-7	Waste Management Group
HSE-13	Environmental Restoration Group
HSWA	Hazardous and Solid Waste Act Amendments

ICP-MS	Inductively Coupled Plasma-Mass Spectroscopy
INC	Isotope and Nuclear Chemistry (Division)
INC-4	Isotope and Structural Chemistry Group
IRM	Interim remedial measure
IWP	Installation Work Plan
K_d	Distribution coefficient
LANL	Los Alamos National Laboratory; the Laboratory
LAMPF	Los Alamos Meson Physics Facility
LASL	Los Alamos Scientific Laboratory (LANL before 1979)
MCL	Maximum concentration level
MDA	Material Disposal Area
MDL	Minimum detection limit
MST-3	Tritium Science and Technology Group
NaI detector	Sodium Iodide detector
NEPA	National Environmental Policy Act
NFA	No further action
NIST	National Institute of Standards and Technology
NMED	New Mexico Environmental Division
NPDES	National Pollutant Discharge Elimination System
OSHA	Occupational Safety and Health Administration
OU	Operable unit
OUPL	Operable unit project leader
PCB	Polychlorinated biphenyl
PID	Photoionization detector
PL	Project leader
PM	Program Manager (ER)
PMP	Program Management Plan
QAPjP	Quality assurance project plan
QA	Quality assurance
QP	Quality administrative procedure
QPP	Quality Program Plan
QPPL	Quality Program Project Leader
RA.	Remedial action
RD	Remedial design
RFA	RCRA facility assessment
RCRA	Resource Conservation and Recovery Act
RFI	RCRA facility investigation
RI	Remedial investigation
RMP	Records management plan
RPF	Records Processing Facility
RWS	Raw waste storage
SARA	Superfund Amendment Reauthorization Act
SOP	Standard operating procedure
SSP	Site-specific plan
STP	Sewage Treatment Plant
SWMU	Solid waste management unit
TA	Technical area
TAL	Target analyte list
TCLP	Toxicity Characteristic Leaching Procedure
TLD	Thermoluninescent dosimeter
TLV	Threshold limit value
TRU	Transuranic (waste)

TSTA	Tritium Systems Test Assembly
UC	University of California
USC	United States Code
USGS	US Geological Survey
UST	Underground storage tanks
VCP	Vitrified clay pipe
VOA	Volatile organic analyses
WBS	Work Breakdown Structure
WIN	Waste Information Network

RADIONUCLIDES[a]

^{227}Ac	Actinium-227
^{241}Am	Americium-241
^{137}Cs	Cesium-137
^{238}Pu, $^{239/240}Pu$	Plutonium
^{210}Po	Polonium
^{226}Ra	Radium-226
^{90}Sr	Strontium-90
^{232}Th	Thorium-232
^{3}H	Tritium
^{234}U, ^{235}U, ^{238}U	Uranium

[a]Numbers refer to specific isotopes of these radionuclides.

- Mesa Top Characterization
- Surface Units
- Outfalls and Associated Septic Systems
- MDAs
- Subsurface Units
- SWMUs to be Coordinated with D&D
- Areas of Concern
- Units Proposed for No Further Investigation

1.2.3 Analytical Strategy

Radiological contamination is a general characteristic of TA-21 and a primary focus of SWMU-specific investigations. For most SWMUs, the release of any hazardous constituents would have been associated with the release of radioactive materials. Field instrument surveys and field screening of samples, using instruments such as gross gamma detectors and organic vapor analyzers, can be used to identify gross contamination and to serve as Level I/II data. Field laboratory analyses can be used to provide rapid Level II data to help guide field operations and to support field decisions. An analytical laboratory will be used to provide Level III/IV data for verification of field data. The full suite of analytes for analytical laboratory analysis typically includes

- gamma spectrometry,
- tritium,
- total uranium,
- isotopic plutonium,
- strontium-90,
- volatile organic compounds (by Method SW 8240),
- semivolatile organic compounds (by Method SW 8270), and
- the RCRA-regulated metals (by Method 6010).

1.2.4 Scope of the Efforts

The RFI field work described herein is expected to require five years for completion. During the initial investigation, 7,858 linear ft of drilling will be required, and a total of 3,409 samples will be collected (2,171 samples will be collected for chemical characterization, 2,168 for radiological, and 502 for geohydrological). For the subsequent investigations, it is estimated that 7,950 linear ft of drilling will be required and a total of 2,316 samples will be collected. A summary of the scope of the investigations is given in Table 1.2-I, organized by the section of the work plan where the investigation is described. Figure 1.2-1 shows the schedule for the planned investigations.

1.3 Reports

Reports generated in the implementation of this work plan will be made available for review by the public at the Environmental Restoration Community Reading Room in downtown Los Alamos (2101 Trinity Drive). The Reading Room is open to the public from 9 a.m. to 4 p.m. on Laboratory business days.

1.3.1 Periodic Reports

The HSWA permit specifies certain periodic reports, including monthly programmatic status reports and quarterly technical progress reports. The execution of the TA-21 RFI will provide data for these reports.

1.3.2 Technical Memoranda/Work Plan Modifications

Because of the large number of SWMUs addressed in this work plan and the time required for completion of RFI field work, some interim reports will be generated and submitted as appropriate portions of the effort are completed. These technical memoranda will serve both 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). These technical memoranda/work plan modifications will be submitted for work conducted on individual SWMUs or aggregates of SWMUs. A summary of planned submission dates is given in Table 1.3-1.

TABLE 1.2-I SUMMARY OF SCOPE OF RFI INVESTIGATIONS.

Chapter/Section	Initial Investigations					Subsequent Investigations				
	Feet Drilled	Samples Collected	Chemical Analysis	Radiological Analysis	Geohydrological Analysis	Feet Drilled	Samples Collected	Chemical Analysis	Radiological Analysis	Geohydrological Analysis
12 Mesa Top										
12.4 Mesa Top Soil		230	230	230						
12.5 Mesa Top Boreholes	2875	593	43	43	184	1350	270			84
12.6 Water Sampling		25	25	25		400	160	160	160	
13 Surface Soil Contamination										
13.2 Surface Soil/Filter Blds	37.5	375	261	261			112	112	112	
14 Surface Units										
14.2 PCB Ctr. Stg Area		63	22	22		65	26	9	9	
14.3 Above Ground Tanks	10	12	7	6						
14.4 Active Ctr Stg Areas		8	8	8						
14.5 DP Tank Farm	100	42	22	20						
14.6 Inactive Ctr Stg Areas		8	8	8		15	12	3	3	
14.7 Surface Disposal Areas	270	324	62	62		30	36	6	6	
14.8 Sewage Treatment plant	30	59	20	20						
15 Outfalls										
15.2 Undetermined Locations	60	66	66	66						
15.3 Outfalls With Septic Tanks	100	47	47	47						
15.4 Direct Discharge Outfalls		35	35	35						
15.6 Septic Tanks	80	16	16	16						
15.7 Drainage South of TA-21-155		6	6	6						
15.8 Drainage North of TA-21-155	20	31	31	31						
15.9 Special Cases	30	23	23	23						
15.10 NPDES Discharge Systems		30	30	30						
16 Material Disposal Areas										
16.1 MDA Drainages		45	45	45						
16.2 MDA B	1030	326	312	312	93	375	105	100	105	
16.3 MDA T	850	238	238	238	67	2590	853	549	549	
16.4 TA-21-35	175	48	16	16		180	52	13	13	
16.5 TA-21-257	70	69	24	24		100	46	14	14	
16.6 MDA U	250	130	130	130	37	450	150	150	150	
16.7 MDA V	500	145	138	138	59	1225	320	295	295	
16.8 MDA A	615	209	200	200	62		130	130	130	
17 Subsurface Units										
17.2 Underground Seepage Pit	45	12	6	6		400	80	36	36	
17.3 Waste Treatment Laboratory	30	16	7	7		50	20	5	5	
17.4 Acid Lines and Sumps	200	40	24	24		720	144	42	42	
17.6 Acid Pit	10	4	2	2						
18 D&D Coordination Units										
18.8 Acid Waste Sumps	480	96	48	48						
18.9 South Side PU Complex	190	38	19	19						
Total	7857	3409	2171	2168	502	7950	2316	1624	1629	84

FIGURE 1.2-1. TA-21 OU RFI SCHEDULE

Chapter and Section	Start Date	Duratn (Days)	End Date
12 INITIAL INVESTIGATION	15/Oct/91	467	20/Aug/93
12.3 GEOMORPHOLOGY	15/Oct/91	158	29/May/92
12.4 SURFACE SOIL CHARACT.	16/Dec/91	168	12/Aug/92
12.4 ROUND 2 SURFACE SOIL CHAR	15/Mar/93	113	20/Aug/93
12.5 VADOSE ZONE CHARACT.	25/Mar/92	258	2/Apr/93
12.6 YEAR 1: SPRING SAMPLING	15/Oct/91	287	3/Dec/92
12 SUBSEQUENT INVESTIGATIONS	20/Nov/92	997	8/Nov/96
12.5 VADOSE ZONE CHARACT.	20/Jul/94	186	17/Apr/95
12.6 YEAR 2: WATER SAMPLING	20/Nov/92	997	8/Nov/96
12.6 YEAR 3-5: WATER SAMPLING	29/Nov/93	742	8/Nov/96
13 INITIAL INVESTIGATION	12/Mar/92	387	22/Sep/93
13.2 AIRBORNE EMISSIONS	12/Mar/92	147	7/Oct/92
13.2 ROUND 2 AIRBORNE EMISSION	15/Jan/93	174	22/Sep/93
13 SUBSEQUENT INVESTIGATIONS	10/Jan/94	141	29/Jul/94
13.2 AIRBORNE EMISSIONS	10/Jan/94	141	29/Jul/94
14 INITIAL INVESTIGATION	10/Mar/94	106	8/Aug/94
14.2 PCB CTR STORAGE	24/Mar/94	59	15/Jun/94
14.3 ABOVE GROUND TANKS	31/Mar/94	61	24/Jun/94
14.4 ACTIVE CTR STORAGE	5/Apr/94	47	9/Jun/94
14.5 DP TANK FARM	5/Apr/94	68	11/Jul/94
14.6 INACTIVE CTR STORAGE	11/Apr/94	46	14/Jun/94
14.7 SURFACE DISP AREAS	10/Mar/94	106	8/Aug/94
14.8 SEWAGE TREATMENT PLANT	22/Apr/94	71	2/Aug/94
14 SUBSEQUENT INVESTIGATIONS	8/May/95	108	10/Oct/95
14.2 PCB CTR STORAGE	8/May/95	107	6/Oct/95
14.6 INACTIVE CTR STORAGE	13/Jul/95	56	29/Sep/95
14.7 SURFACE DISPOSAL AREAS	17/Jul/95	60	10/Oct/95
15 INITIAL INVESTIGATION	20/Apr/94	126	18/Oct/94
15.2 UNKNOWN LOCATIONS	20/Apr/94	85	18/Aug/94
15.3 SEPTIC SYSTEM	29/Apr/94	77	17/Aug/94
15.4 DIRECT DISCHARGE	11/May/94	56	29/Jul/94
15.5 DRNG S TA-21-3	17/May/94	61	11/Aug/94
15.6 SEPTIC TANKS	16/May/94	64	15/Aug/94
15.7 S TA-21-155	23/May/94	45	26/Jul/94
15.8 N TA-21-155	23/May/94	69	29/Aug/94
15.9 SPECIAL CASES	25/May/94	65	25/Aug/94
15.10 NPDES	31/May/94	98	18/Oct/94

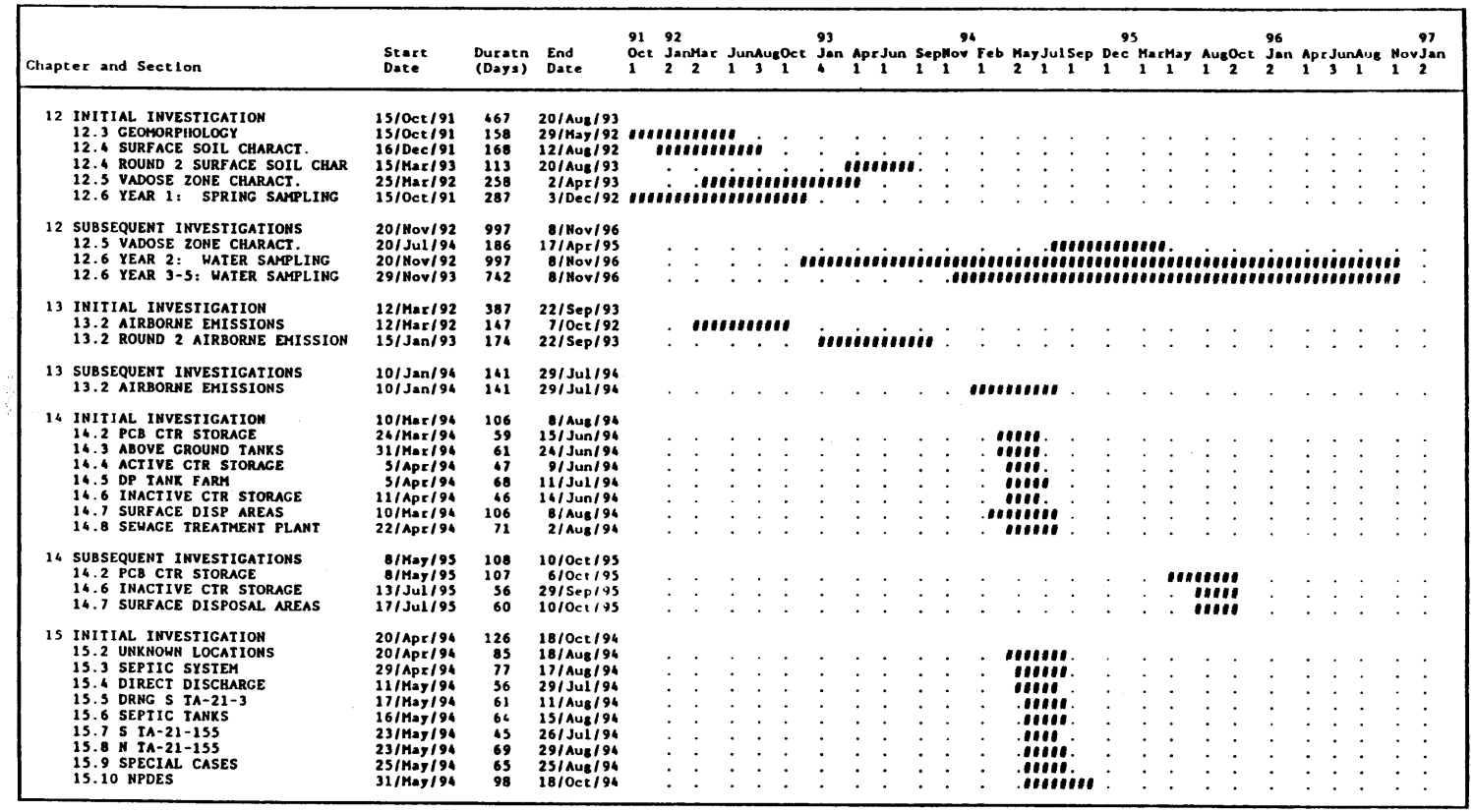
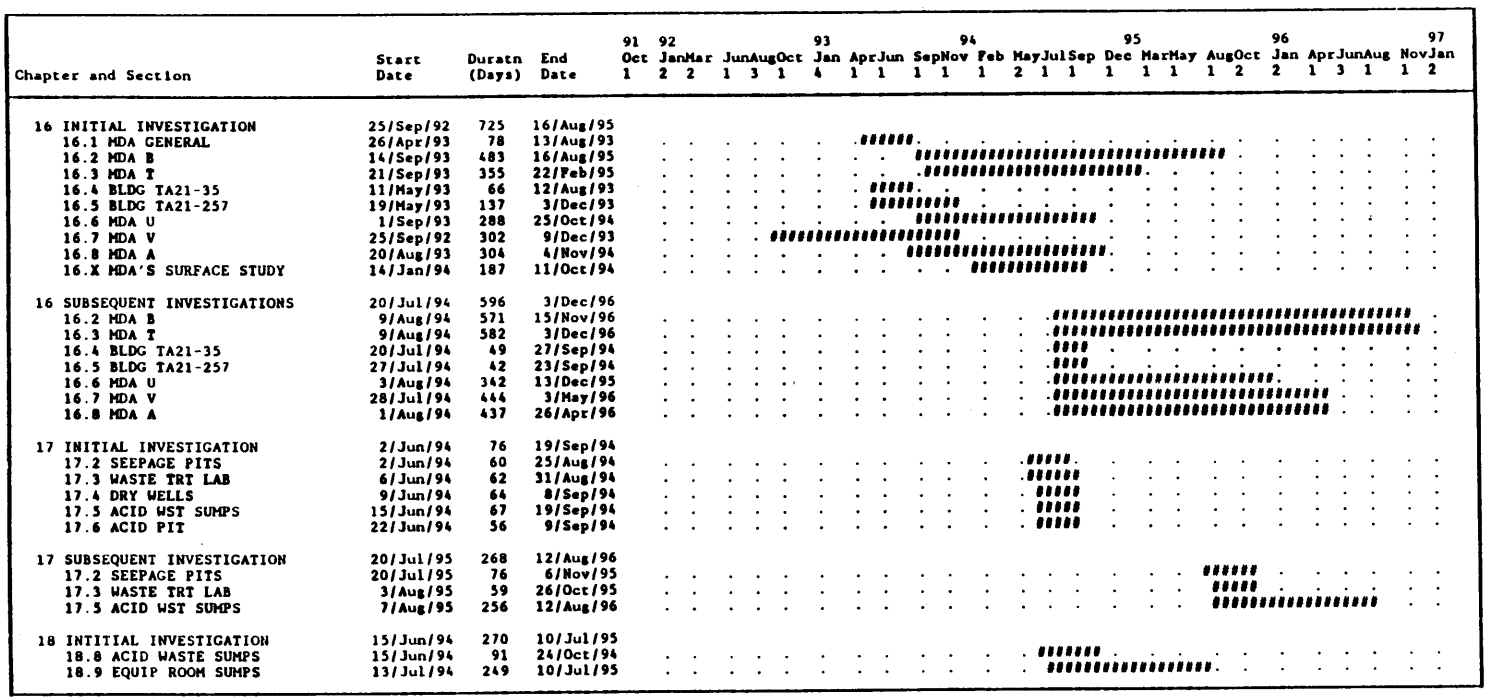


FIGURE 1.2-1. TA-21 OU RFI SCHEDULE (CONTINUED)



Chapter and Section	Start Date	Duratn (Days)	End Date
16 INITIAL INVESTIGATION	25/Sep/92	725	16/Aug/95
16.1 MDA GENERAL	26/Apr/93	78	13/Aug/93
16.2 MDA B	14/Sep/93	483	16/Aug/95
16.3 MDA T	21/Sep/93	355	22/Feb/95
16.4 BLDG TA21-35	11/May/93	66	12/Aug/93
16.5 BLDG TA21-257	19/May/93	137	3/Dec/93
16.6 MDA U	1/Sep/93	288	25/Oct/94
16.7 MDA V	25/Sep/92	302	9/Dec/93
16.8 MDA A	20/Aug/93	304	4/Nov/94
16.X MDA'S SURFACE STUDY	14/Jan/94	187	11/Oct/94
16 SUBSEQUENT INVESTIGATIONS	20/Jul/94	596	3/Dec/96
16.2 MDA B	9/Aug/94	571	15/Nov/96
16.3 MDA T	9/Aug/94	582	3/Dec/96
16.4 BLDG TA21-35	20/Jul/94	49	27/Sep/94
16.5 BLDG TA21-257	27/Jul/94	42	23/Sep/94
16.6 MDA U	3/Aug/94	342	13/Dec/95
16.7 MDA V	28/Jul/94	444	3/May/96
16.8 MDA A	1/Aug/94	437	26/Apr/96
17 INITIAL INVESTIGATION	2/Jun/94	76	19/Sep/94
17.2 SEEPAGE PITS	2/Jun/94	60	25/Aug/94
17.3 WASTE TRT LAB	6/Jun/94	62	31/Aug/94
17.4 DRY WELLS	9/Jun/94	64	8/Sep/94
17.5 ACID WST SUMPS	15/Jun/94	67	19/Sep/94
17.6 ACID PIT	22/Jun/94	56	9/Sep/94
17 SUBSEQUENT INVESTIGATION	20/Jul/95	268	12/Aug/96
17.2 SEEPAGE PITS	20/Jul/95	76	6/Nov/95
17.3 WASTE TRT LAB	3/Aug/95	59	26/Oct/95
17.5 ACID WST SUMPS	7/Aug/95	256	12/Aug/96
18 INTITIAL INVESTIGATION	15/Jun/94	270	10/Jul/95
18.8 ACID WASTE SUMPS	15/Jun/94	91	24/Oct/94
18.9 EQUIP ROOM SUMPS	13/Jul/94	249	10/Jul/95

TABLE 1.3-I REPORTS PLANNED FOR THE TA-21 OU RFI

Report Type and Subject	Draft Date	Final Date
Quarterly Technical Progress Reports		
Summary of Technical Activities/Data		15 Feb, Yearly 15 May, Yearly 15 Aug, Yearly 15 Nov, Yearly
Technical Memoranda/Work Plan Modifications		
1. Subsurface Investigations Mesa Top and MDA V (Initial)[a]	20 Sep 93	10 Dec 93
2. Surface Investigations Mesa Top and MDAs (Initial)	22 Jul 94	12 Oct 94
3. Surface/Subsurface Investigations MDAs Surface (Subsequent)[b] All Non-MDA Units (Initial)	20 Apr 95	11 Jul 95
4. Subsurface Investigations MDA A, MDA B (Initial)	30 May 95	17 Aug 95
5. Surface/Subsurface Investigations Non-MDA Units (Subsequent)	3 May 96	24 Jul 96
6. Subsurface Investigations MDA T, MDA U, MDA V (Initial and Subsequent)	12 Sep 96	4 Dec 96
7. Subsurface Investigations MDA A, MDA B (if needed)	27 Aug 96	18 Nov 96
RFI Report		
Final RFI Report	11 Dec 96	28 May 97

[a] Initial: Report of results from the planned initial investigation.

[b] Subsequent: Report of results from subsequent investigations, if any.

1. EXECUTIVE SUMMARY

TA-21 RFI Work Plan

1.1 Introduction

1.1.1 Purpose

The primary purpose of this document is to satisfy the regulatory requirements of Module VIII of the Los Alamos National Laboratory's (the Laboratory's) Resource Conservation and Recovery Act (RCRA) Part B operating permit. Module VIII of the permit which was issued by the Environmental Protection Agency (EPA), addresses Hazardous and Solid Waste Act Amendments (HSWA) requirements. At the Laboratory, these permit requirements are addressed by the Department of Energy's (DOE) Environmental Restoration (ER) Program. This document meets schedule requirements for May 23, 1991, to address a percentage of the Laboratory's solid waste management units (SWMUs; i.e., potential release sites) in a RCRA Facility Investigation (RFI) work plan. The second purpose of this document is to serve as a field sampling plan for personnel who will implement the RFI.

1.1.2 Installation Work Plan

The HSWA Module required that the Laboratory prepare an installation-wide work plan to describe the Laboratory-wide system for accomplishing all RFI/Corrective Measures Study (CMS) work. This requirement was satisfied by a Laboratory-wide Installation Work Plan (IWP) submitted to EPA on November 19, 1990. The IWP identifies the Laboratory's SWMUs and their aggregation into 24 operable units (OUs) and presents the Laboratory's overall management and technical approach for meeting the requirements of the HSWA Module. The TA-21 OU is the first OU through the process. This work plan, as with all OU work plans, is tiered to the IWP. Relevant information in the IWP is incorporated into this plan by reference.

The IWP and this work plan address radioactive materials and other hazardous substances not subject to RCRA. 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.

1.1.3 Background

The Laboratory's Technical Area (TA)-21, also known as "DP Site," is located on the northern edge of the laboratory, at an elevation of 7,140 ft. It is centrally located on the Pajarito Plateau, roughly midway between the flanks of the Jemez Mountains on the west and the White Rock Canyon of the Rio Grande to the east. It is sited on the Bandelier Tuff, which is approximately 800 ft of volcanic ash deposits, the bedrock throughout the OU. Groundwater lies at a depth of approximately 1,150 ft.

TA-21 centers on DP Mesa immediately east-southeast of the Los Alamos townsite. The TA-21 OU encompasses TA-21 and the areas extending to the stream channels in the canyons on either side of the mesa, DP Canyon to the north, and Los Alamos Canyon to the south. Figure 1.1-1 shows the location and extent of the TA-21 OU, which is approximately 311 acres in size and includes some 112 SWMUs. TA-21 has been used for both chemical research and plutonium metal production from 1945 to 1978. Subsequently, offices and other activities have occupied the facilities. Because the major industrial activity was related to plutonium production, the major waste disposal activities were plutonium-related as well. The SWMUs fall into four conceptual categories as follows:

- deep liquid releases, such as seepage pits and absorption beds into which plutonium- bearing liquids were discharged in large quantities;
- near-surface liquid releases, such as surface discharges from septic systems that may have contained industrial liquid wastes;
- subsurface solid waste disposal sites, such as Material Disposal Areas (MDAs), where contaminated industrial materials, stabilized process residues, and other solid or hazardous wastes were buried; and
- surface contamination areas, where limited quantities of contaminants were released at or to the land surface, such as stack release fallout and surface spills.

1.1.4 Contaminants and Pathways of Concern

Principal contaminants of concern are radiological in nature because of the dominant industrial activity that occurred at TA-21. Known contaminants are plutonium, tritium, uranium, volatile organic compounds (at a limited number of sites), and PCBs (at one site). However, knowledge of contaminants, in general, is limited because historical sampling was principally for radioactive constituents. Hazardous constituents are likely to be present at TA-21 because of plutonium processing. Thus, relatively broad-spectrum analyses are contemplated for selected samples

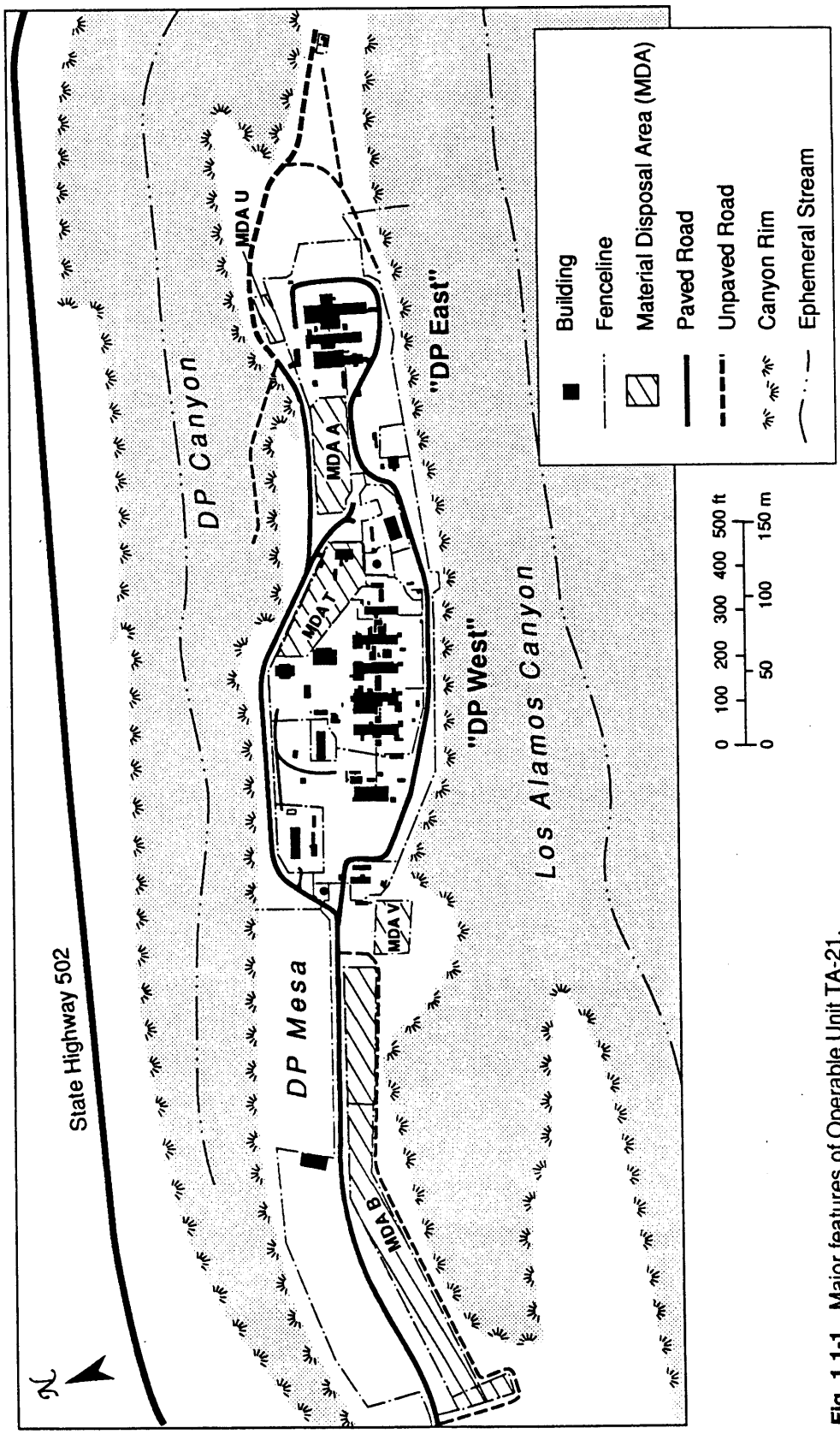


Fig. 1.1-1 Major features of Operable Unit TA-21.

across the TA-21 OU.

Under the current land use patterns in the vicinity of the TA-21 OU, no pathways or receptors are of concern. However, if land use patterns change in the future (i.e., loss of institutional control), the following primary exposure pathways of concern would be

- surface run-off and sediment transport and
- erosion and surface exposure.

Both unsaturated zone transport (in both the liquid and vapor phase) and the groundwater pathway are not of direct concern, based on the great depth and no known pathway to the main aquifer system.

1.2. Method of Approach

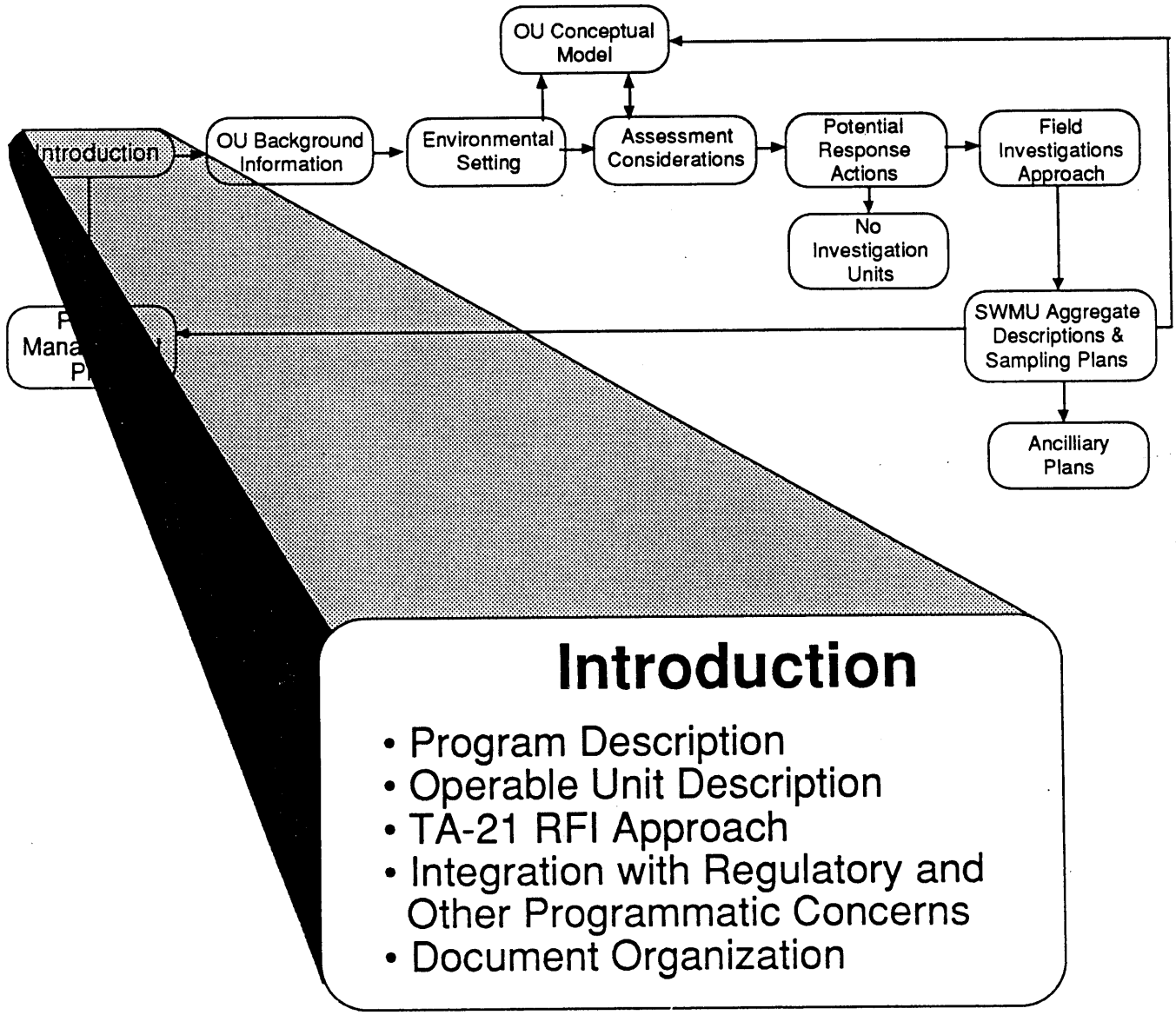
1.2.1 Technical Approach

The IWP provides for innovative use of the observational approach to select an eventual remedy in the face of continuing uncertainty. The technical approach also incorporates the use of action levels as criteria for identifying releases and determining the need for a CMS and a sequential sampling strategy wherein the results of each sample set guides the nature and location of subsequent sampling events.

1.2.2 Investigative Strategy

The ER Program will be conducting Laboratory-wide background studies of hydrology, geology, and geochemistry to support OU-specific investigations. Those studies, the results of which will have general applicability for all OUs' needs will only be done once. In addition, this work plan includes OU-wide surface and subsurface investigations that focus on general environmental characteristics and ambient levels of certain contaminants and provide data that serve as a context within which SWMU-specific contaminant data will be evaluated. The balance of the field sampling plans is directed toward groupings of SWMUs as appropriate, with specific studies of individual SWMUs as deemed necessary. These SWMU-specific characterizations focus on contaminant identification and nature and extent of contaminant migration. Investigation groups include the following:

CHAPTER 2


OU Conceptual Model
Introduction
OU Background Information
Environmental Setting
Assessment Considerations
Potential Response Actions
Field Investigations Approach
No Investigation Units
SWMU Aggregate Descriptions & Sampling Plans
Ancilliary Plans
Introduction
• Program Description
• Operable Unit Description
• TA-21 RFI Approach
• Integration with Regulatory and Other Programmatic Concerns
• Document Organization

2.0 INTRODUCTION

2.1 Program Description

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

The Laboratory's Resource Conservation and Recovery Act (RCRA) operating permit sets forth requirements that are implemented by the Laboratory's ER Program. In particular, the Hazardous and Solid Waste Act Amendments (HSWA) Module and schedules of the permit issued by the Environmental Protection Agency (EPA), gives specific requirements affecting the conduct of the ER Program. The HSWA Module became effective on May 23, 1990 (EPA 1990).

2.1.1 Installation Work Plan

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). It 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 solid waste management units (SWMUs) and their aggregation into a number of operable units, and presents the Laboratory's overall management and technical approach for meeting the requirements of the HSWA Module. The IWP is the document to which subsequent operable unit (OU) work plans will be tiered. Relevant information presented in the IWP will not be repeated in OU work plans.

2.1.2 TA-21 Operable Unit RFI

The HSWA Module also requires the Laboratory to prepare OU work plans for specific investigations. The Technical Area 21 (TA-21) work plan is one of 24 OU work plans that will be prepared. Within the ER Program, the TA-21 assessment task is identified as OU AL-LA-9, Activity

Data Sheet (ADS) 1106. Additional information regarding the ER Program, its implementation, and the guidance under which the TA-21 OU work plan was prepared, is given in Sec. 3 of the IWP.

The purpose of this document is twofold: first, to satisfy the regulatory requirements of the HSWA Module and second, to serve as the field sampling plan for personnel who will implement the RFI characterization activities detailed herein.

2.2 Operable Unit Description

The Laboratory's TA-21, also known as DP Site[1], has been used both for chemical research and production of plutonium metal from 1945 until 1978. Over the ensuing years, a number of other activities have been conducted there, as described in Chapter 3. TA-21 centers on DP Mesa immediately east-southeast of the Los Alamos townsite. Figure 2.2-1 shows the location of TA-21 with respect to the town of Los Alamos and other technical areas at the Laboratory. Figure 2.2-2 identifies the location and extent of the OU and indicates the areas referred to as DP East and DP West. The OU is approximately 311 acres in size with boundaries extending to the stream channels in the canyons to the north and south, DP Canyon and Los Alamos Canyon, respectively. Appendix G gives a detailed map of the TA-21 OU showing a 1000-ft buffer around the OU.

2.2.1 SWMUs Addressed in this OU

This plan addresses 10% of the Laboratory's SWMUs listed in Table A of the HSWA Module of the Laboratory's RCRA Part B Operating Permit (EPA 1990), including 20% of the SWMUs appearing on the HSWA Module's Table B list of priority SWMUs. By addressing these percentages of SWMUs, the Laboratory will meet the HSWA Module's schedule requirements for May 23, 1991. It includes 68 SWMU subunits grouped into 18 SWMU categories. Of these, 37 SWMU subunits are also in the HSWA Module's Table B list of priority SWMUs. Thus, this task incorporates 11% (68 of 603) of the SWMUs identified in the HSWA Module's Table A, and 20% (37 of 182) of the SWMUs identified in Table B.

Tables A and B of the HSWA Module were developed by EPA based on a SWMU Report prepared in 1988 (LANL 1988). Subsequent research and investigative effort culminated in a revised

[1] DP refers to D Prime, where D was D Building in the former TA-1 (now part of the current townsite). D Building was the wartime site where plutonium was purified in the early days at the Laboratory.

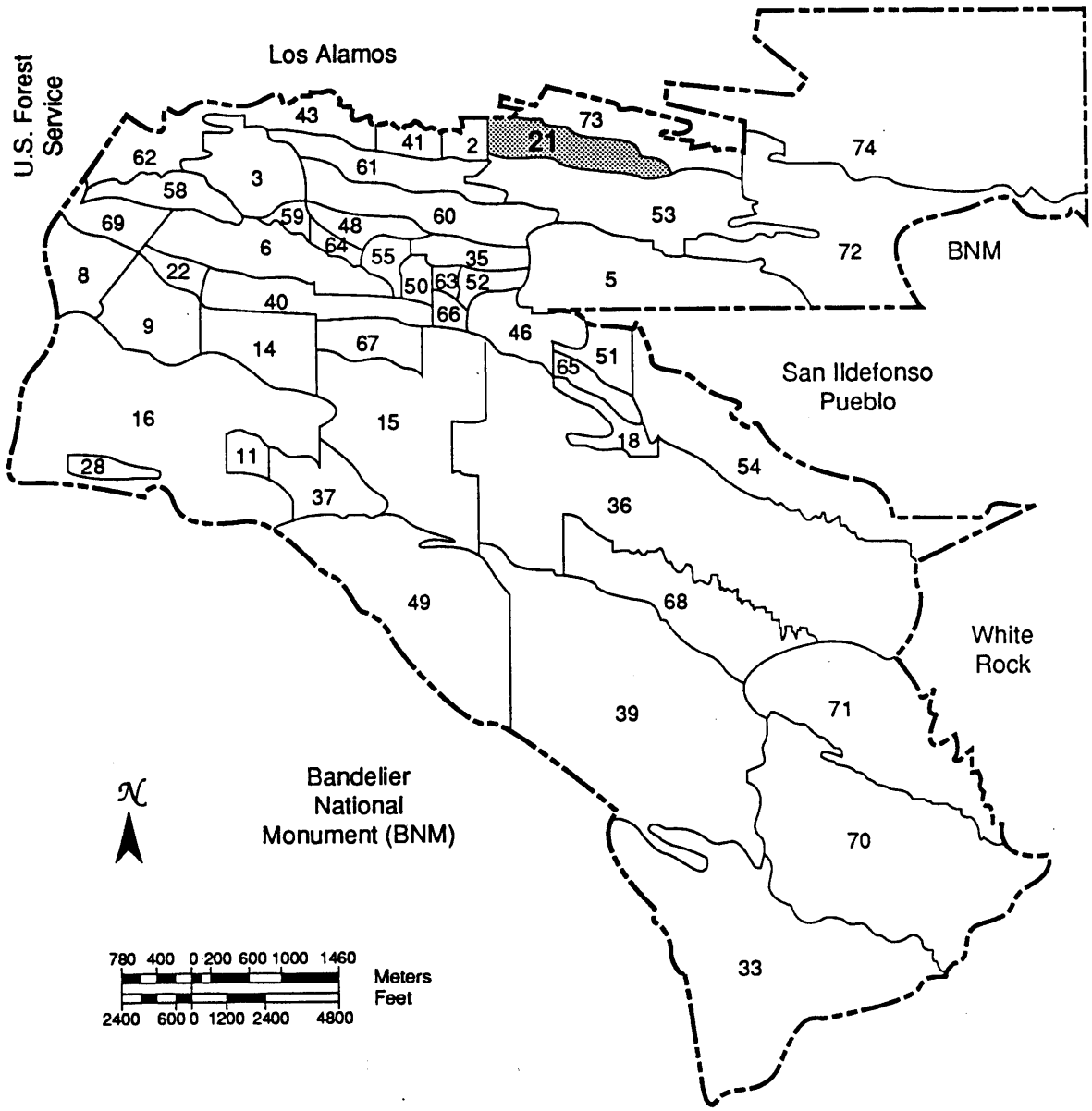


Fig. 2.2-1 Technical areas (TAs) of Los Alamos National Laboratory in relation to surrounding landholdings.

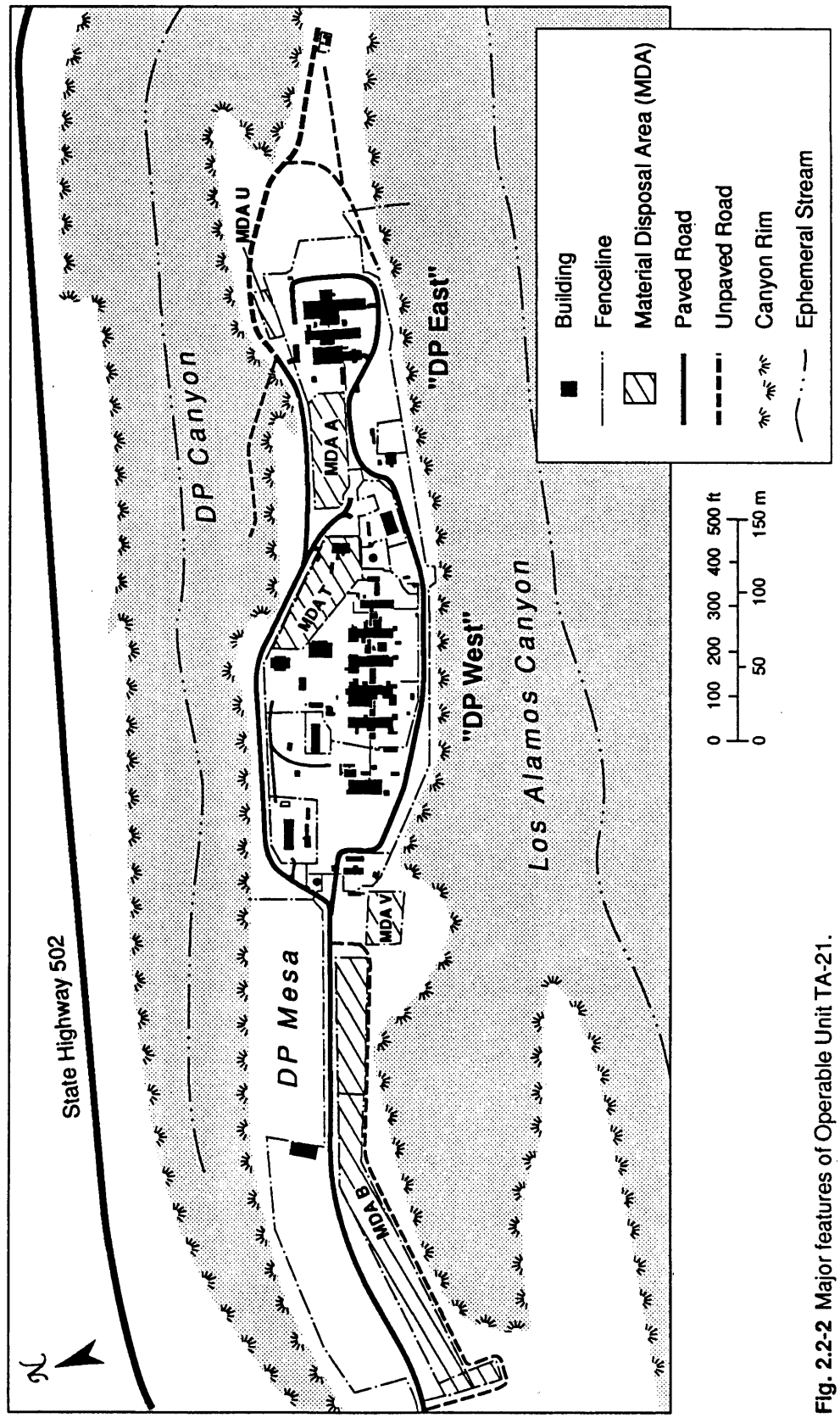


Fig. 2.2-2 Major features of Operable Unit TA-21.

SWMU Report submitted to EPA in November 1990 (LANL 1990b). As discussed in greater detail in Sec. 3.4.2 of the IWP, no sites were eliminated in the revisions leading to the new SWMU Report, but some were combined or added. The result, for the TA-21 OU, is a current list of 29 SWMUs including 112 SWMU subunits. The Laboratory's current SWMU list is presented in Appendix G of the IWP. Table 2.2-I summarizes the changes occurring in the SWMU list for TA-21. It identifies the original Table A and Table B SWMUs, indicates those that were combined and those that were added, tracks the renumbering that resulted from closing up the numbering gaps created by the combining of SWMUs, and presents the complete list of currently identified SWMUs.

2.2.2 Permit Modification

Section 3.5 of the IWP states that each OU work plan may propose a HSWA Module Class III permit modification to adjust the SWMUs listed in Table A of the HSWA Module. Such adjustments may be made to remove SWMUs determined not to need further investigation and to add SWMUs to the current SWMU Report. The basis for such a permit modification for TA-21 SWMUs is provided here as Table 2.2-II. It lists the currently identified SWMUs and proposes to delete five SWMU subunits based on information developed during the preparation of this RFI and discussed in Chapter 20, No Investigation Units.

2.2.3 Technical Memoranda and Work Plan Modification

Because the RFI is scheduled to take approximately five years at the TA-21 OU, the Laboratory is proposing to submit technical memoranda on site characterization activities on SWMU aggregates at the TA-21 OU to update the EPA on progress on RFI field work. As needed, these technical memoranda may also serve as work plan modifications to revise field sampling plans as appropriate reflecting initial characterization results. Therefore, technical memoranda are essentially partial RFI Phase I reports and partial RFI Phase II work plans. The schedule for these technical memoranda/work plan modifications is presented in Chapter 21, the Project Management Plan.

2.2.4 SWMU Investigation Groups

The large number of SWMUs and the wide diversity among them make it necessary to group the field investigations. The selected set of investigation groups by genre of SWMU (and the corresponding sections of this work plan) are identified below. Table 2.2-III identifies the work plan section in which each SWMU is addressed. Table 2.2-IV presents the same information in a

TABLE 2.2-I
TA-21 SWMU LIST

Original SWMU List in Table A, B of Permit	SWMUs Combined With Others	Renumbered SWMUs	Added SWMUs	Current SWMU List
			21-001	21-001
21-002		21-002 -> (a)	21-002(b)	21-002 (a),(b)
21-003				21-003
			21-004 (a)–(d)	21-004 (a)–(d)
21-005				21-005
21-006 (a-e)[a]	21-006(b)[b]	21-006(c) -> (b)	21-006 (e)–(l)	21-006 (a)–(l)[a]
		21-006(d) -> (c)		
		21-006(e) -> (d)		
21-007				21-007
			21-008	21-008
			21-009	21-009
21-010 (a-h)[a]				21-010 (a)–(h)[a]
21-011 (a-i)[a]		21-011(h) -> (i)	21-011(h)	21-011 (a)–(j)[a]
		21-011(i) -> (j)		
21-012[a]		21-012 -> (a)	21-012(b)	21-012 (a),(b)[a]
21-013 (a-c)			21-013 (d)–(g)	21-013 (a)–(g)
21-014[a]				21-014[a]
21-015[a]				21-015[a]
21-016 (a-g)[a]	21-016 (b)–(e)[c]	21-016(f) -> (b)		21-016 (a)–(c)[a]
		21-016(g) -> (c)		
21-017 (a-c)[a]				21-017 (a)–(c)[a]
21-018 (a,b)				21-018 (a),(b)[a]
			21-019 (a)–(m)	21-019 (a)–(m)
			21-020 (a), (b)	21-020 (a),(b)

TABLE 2.2-I (continued)

Original SWMU List in Table A, B of Permit	SWMUs Combine With Others	Renumbered SWMUs	Added SWMUs	Current SWMU List
21-021				21-021
21-022 (a-h)			21-022 (i), (j)	21-022 (a)–(j)
21-023 (a-d)				21-023 (a)–(d)
21-024 (a-k)			21-024 (l)–(o)	21-024 (a)–(o)
			21-025 (a)–(b)	21-025 (a),(b)
			21-026 (a)–(c)	21-026 (a)–(c)
			21-027	21-027
			21-028 (a)–(e)	21-028 (a)–(e)
			21-029	21-029

[a]SWMUs listed in Table B of the RCRA Part B Permit as priority SWMUs.
[b]SWMU 21-006(b), a gravel seepage pit, was determined to be the same as MDA T (SWMU 21-016(c)). The remaining subunits of 21-006 were renumbered.
[c]SWMUs 21-016(b-e), four concrete sumps, each 2 ft by 6 in. by 4 ft by 8 ft, associated with the four absorption beds within MDA T, were combined based on the determination that they were actually components of MDA T, rather than separate entities. They thus become part of SWMU 21-016(c), after renumbering of the remaining subunits.

TABLE 2.2-II
TA-21 OU'S SWMUS PROPOSED FOR NO FURTHER INVESTIGATION

SWMU Number	Basis for no further investigation
21-012(a)	This dry well inside the existing steam plant (TA-21-357) does not exist. Only a dry well associated with the former steam plant (TA-21-9) exists and is addressed in Sec. 17.4 as SWMU 21-012(b).
21-025(a)	Off-gas system located inside building TA-21-155 has had no documented releases to the environment and is covered under routine Laboratory operations. The off-gas system is separate from the exhaust stack, covered with stack emission sampling in Chapter 13.
21-025(b)	Off-gas system located inside building TA-21-209 has had no documented releases to the environment and is covered under routine Laboratory operations. The off-gas system is separate from the exhaust stack, covered with stack emission sampling in Chapter 13.
21-028(e)	Parts of this SWMU inside Building 210 are considered here. These are product storage areas with no evidence of routine releases. That part of 21-028(e) outside of the building, north of the loading dock is covered in Section 14.4.
21-029(b)	Three satellite container storage areas located inside building TA-21-150 are product storage areas with no evidence of routine releases.

Table 2.2-III TA-21 SWMU LOCATION IN DOCUMENT

SWMU No.	Title/Description	Where Addressed	Physical Location (Fig. No.)
21-001	Radioactive Waste Container Storage Area	Section 16.5	2.2-3
21-002(a),(b)	Container Storage	Sections 18.4, 14.6	(a) Not shown
		Section 14.1	(b) 2.2-3
21-003	PCB Storage Area	Section 14.2	2.2-4
21-004(a),(b),(c)	Aboveground Tanks	Section 14.3	(a) 2.2-3
		Section 14.3	(b),(c) 2.2-4
21-004(d)	Above ground Tanks	Sections 14.3, 15.8	2.2-4
21-005	Acid Pit	Section 17.6	2.2-3
21-006(a),(c)–(f)	Underground Seepage Pits	Section 18.2	(a),(c),(d),(f) 2.2-3
		Section 18.2	(e) Not shown
21-006(b)	Underground Seepage Pits	Sections 15.9, 17.2	2.2-3
21-007	Salamanders	Section 13.1	Not shown
21-008	Incinerator	Section 13.1	Not shown
21-009		Section 17.3	2.2-3
21-010(a)–(h)	Industrial Liquid Waste Treatment Facility	Section 16.4	2.2-3
21-011	New Industrial Waste Treatment Plant	Section 16.5	(a),(c)–(j) 2.2-3
			(b) 2.2-4
21-011(c)		Section 16.3	
21-012(a),(b)	Dry Wells	Section 17.4, 20.4	2.2-3
21-013(a)	Surface Disposal	Section 14.8	2.2-4
21-013(b)–(f)	Surface Disposal	Section 14.7	(b),(d) 2.2-3
			(c),(f) 2.2-4
			(e) Not shown
21-013(g)	Surface Disposal	Section 14.7	2.2-3
21-014	Material Disposal Area A	Section 16.8	2.2-4
21-015	Material Disposal Area B	Section 16.2	2.2-3
21-016(a)–(c)	Material Disposal Area T	Section 16.3	2.2-3
21-017(a)–(c)	Material Disposal Area U	Section 16.6	2.2-4
21-018(a),(b)	Material Disposal Area V	Section 16.7	2.2-3
21-019(a)–(m)	Filter Houses/ Exhaust Stacks	Section 13.1	(a)–(d),(g)–(j),(m) 2.2-3
			(e),(f),(k),(l) 2.2-4
21-020(a),(b)	Decommissioned Filter Houses	Section 13.1	(a) 2.2-3
			(b) 2.2-4
21-021	Stack Emissions	Section 13.1	Not shown
21-022(a),(f)	Acid Waste Lines and	Section 17.5	(a)–(e),(g)–(j) 2.2-3
(b)–(e);(g) (h)–(j)	Sumps	Sections 4, 15,18.5, 18.8 and 18.9	(f) 2.2-4
21-023(a),(b),(d)	Decommissioned Septic Systems	Section 18.3	2.2-3
21-023(c)	Decommissioned Septic Systems	Section 15.2	2.2-3
21-024(a)–(o)	Septic Systems/Outfalls	Sections 15.2, 15.3,	(a),(b),(d)–(g),(l),(o) 2.2-3
		15.4, 15.6, 15.8, 15.9	(c),(h)–(k),(m),(n) 2.2-4
21-025(a),(b)	Off-gas System	Section 20.1	2.2-4

Table 2.2-III TA-21 SWMU LOCATION IN DOCUMENT (cont'd)

SWMU No.	Title/Description	Where Addressed	Physical Location (Fig. No.)
21-026(a)	Outfall/Treatment Plant	Section 14.8	2.2-4
21-026(b),(c)	Outfall/Treatment Plant	Section 14.8	2.2-4
21-027	Surface Discharge	Sections 15.2, 15.5, 15.7	Not shown
21-028(a)	Active Container Storage Areas	Section 16.3	2.2-3
21-028(b),(c)	Active Container Storage Areas	Sections 18.4, 20.2	2.2-3
21-028(d),(e)	Active Container Storage Areas	Section 14.4	(d) 2.2-4 (e) 2.2-3
21-029	DP Tank Farm	Section 14.5	Not shown

TABLE 2.2-IV
TA-21 OPERABLE UNIT SWMU AGGREGATION

SWMU Aggregation	Document Section	SWMU numbers included
Stack Emissions	Chapter 13	
	Section 13.1	21-007, -008, -019, -020, -021
Surface Units	Chapter 14	
	Section 14.2	21-003
	Section 14.3	21-004(a)–(d)
	Section 14.4	21-028(d),(e)
	Section 14.5	21-029
	Section 14.6	21-002(b)
	Section 14.7	21-013(b)–(g)
	Section 14.8	21-013(a), -026(a)–(c)
Outfalls	Chapter 15	
	Section 15.2	21-023(c), -024(a),(g),(l), -027(c),(d)
	Section 15.3	21-024(b)–(e),(i)
	Section 15.4	21-011(k), -022(h), -024(n),(o), -026(d)
	Section 15.5	21-027(a)
	Section 15.6	21-024(j),(k)
	Section 15.7	21-024(m), -027(b)
	Section 15.8	21-024(h)
	Sections 15.8 and 14.3	21-004(d)
	Section 15.9	21-024(f)
	Sections 15.9 and 17.2	21-006(b)

TABLE 2.2-IV
TA-21 OPERABLE UNIT SWMU AGGREGATION (cont'd)

SWMU Aggregation	Document Section	SWMU numbers included
Material Disposal Areas	Chapter 16	
	Section 16.2	21-015
	Section 16.3	21-016,-028(a), -011(c)
	Section 16.4	21-010(a)-(h)
	Section 16.5	21-001, -011(a)–(j)
	Section 16.6	21-017
	Section 16.7	21-018
	Section 16.8	21-014
Subsurface Units	Chapter 17	
	Sections 17.2 and 15.9	21-006(b)
	Section 17.3	21-009
	Section 17.4	21-012(b)
	Section 17.5	21-022(a),(f)
	Section 17.6	21-005
SWMUs for Coordination with Building D&D	Chapter 18	
	Section 18.2	21-006(a),(c),(d),(e),(f)
	Section 18.3	21-023(a),(b),(d)
	Section 18.4	21-002(a), -028(c)
	Sections 18.5 and 18.8	21-022(b)–(e),(g)
	Section 18.9	21-022 (h)–(j)
No-investigation Units	Chapter 20	
	Section 20.1	21-025
	Section 20.2	21-028(b)
	Section 20.3	21-028(e)
	Section 20.4	21-012(a)

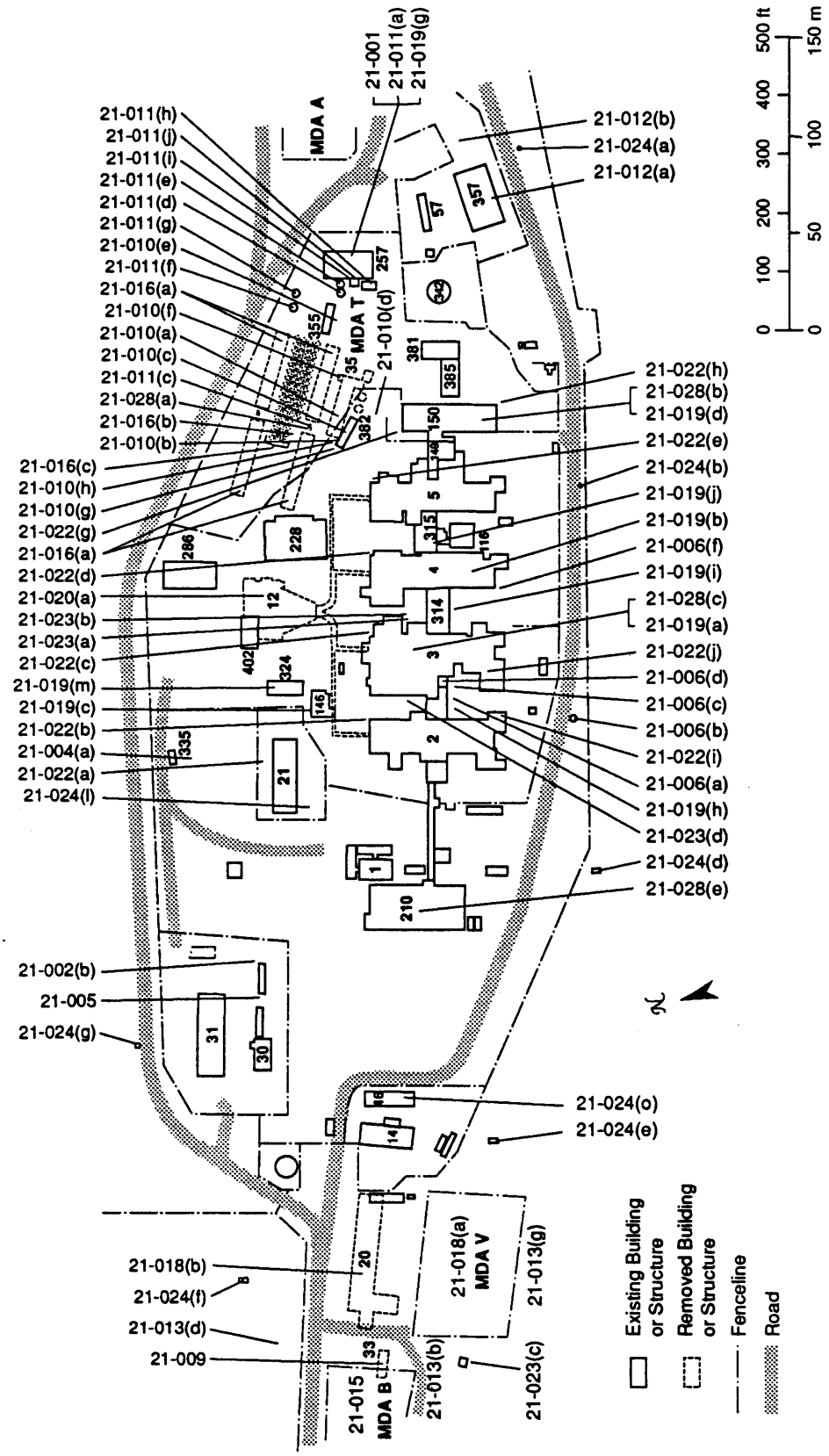


Fig. 2.2-3 Location of SWMUs at DP West.

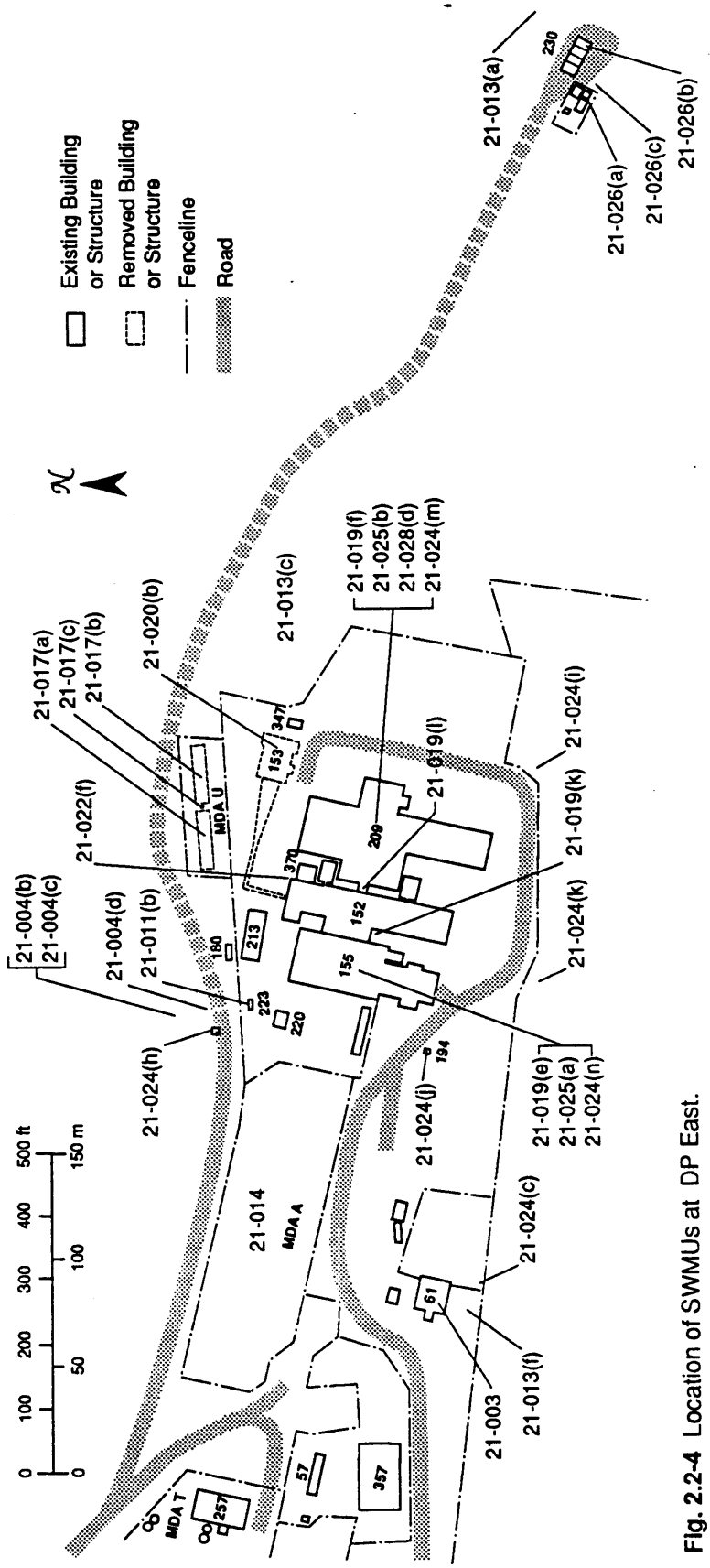


Fig. 2.2-4 Location of SWMUs at DP East.

reverse form: it identifies the SWMUs included in each field investigation section of this work plan. Figures 2.2-3 and 2.2-4 locate SWMUs at the TA-21 OU. The "Location" column of Table 2.2-III gives the figure number where each SWMU may be found. Appendix G shows all SWMUs on a larger-scale map.

Investigation groups:

Mesa top characterization (Chapter 12). Surface and subsurface characterization of the environmental setting of the entire OU is detailed. Unit-wide investigations will be used to determine geophysical and geochemical properties important to an understanding of the environmental and hydrologic processes affecting contaminant migration at the TA-21 OU.

Surface units (Chapters 13 and 14). These are SWMUs for which releases and potential contamination are expected to be confined to the soil surface. Atmospheric releases and routine and systematic surface spills are included in this category.

Outfalls and associated septic systems (Chapter 15). Near-surface and surface releases of potentially contaminated liquids are included. These are commonly floor drains and sanitary waste systems with discharges over the canyon rims of DP Mesa.

Material Disposal Areas (MDAs) (Chapter 16). This group covers Laboratory-designated liquid and solid waste disposal areas from past operations, typically large landfills and liquid absorption beds. It also includes waste treatment facilities associated with the MDAs.

Subsurface units (Chapter 17). SWMUs not addressed in a group above with primarily subsurface releases or leakage of potentially contaminated liquids are included in this group. Liquid waste sumps, seepage pits, dry wells for liquid disposal, and underground liquid waste-handling systems are example units.

SWMUs to be coordinated with building decontamination and decommissioning (D&D) (Chapter 18). Investigations of some SWMUs are precluded by the presence of buildings that have been built upon or in immediate proximity to the units. Coordination with the Laboratory's D&D program is necessary (see Sec. 2.4.1).

Areas of Concern (Chapter 19). An additional group of sites not qualifying as SWMUs will be investigated concurrently. These are called "areas of concern" herein and consist principally of past spill locations.

No Investigation Units (Chapter 20). As anticipated in Secs. 3.5 and 3.6 of the IWP, some

units identified as potential SWMUs have proven, upon review of historical information, either to have been inappropriately listed as SWMUs or to require no further action. This Chapter presents information judged sufficient to remove the sites from the SWMU list (see Table 2.2-II).

2.3 TA-21 RFI Approach

The DOE/UC IWP (LANL 1990a) specifies the ER Program's technical and management approaches for compliance with the HSWA Module of the RCRA Part B operating permit (EPA 1990) and other regulatory obligations. Those approaches define the framework within which the TA-21 OU RFI work plan must function. The OU application of those program-wide approaches is discussed in this section. In addition, this section details the particular investigation concepts and objectives guiding the individual field investigation plans presented in this document.

2.3.1 Technical Approach

The DOE/UC approach for all ER Program activities is detailed in the IWP. In addition to detailing the management approach in the Program Management Plan (IWP, Annex I), the IWP presents several technical approaches that characterize the ER Program. These include

- use of action levels as criteria to trigger a corrective measure study (CMS);
- sequential sampling approach to site characterization, decision analysis and cost-effectiveness 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.

Several of these approaches are discussed below in terms of specific application to the TA-21 OU RFI work plan. For detailed discussions, however, the IWP sections cited should be referenced.

Action Levels. The use of action levels (in EPA's proposed Subpart S regulations) as criteria for identifying releases from SWMUs and for determining the need for a CMS is discussed in IWP Appendix F and in Chapter 11 of this work plan.

Sequential Sampling. Each field sampling plan presented in this document is based on sequential sampling as discussed in IWP Appendix H. The results of measurements from each set of samples are used to determine if additional sets of samples are required and to guide selection of the subsequent sample set. Each incremental set of samples aids in determining the required

number of additional samples and their optimal locations. This process is intended to be repeated as many times as necessary, and in this work plan each field sampling plan provides guidance for subsequent sampling events based on assumptions regarding the results expected from initial sampling events. The process is described in Chapter 11 of this work plan.

Observational Approach. The essence of the observational approach is based on the philosophy that remedial action can and often should be initiated without "full" characterization of the nature and extent of contamination (IWP Appendix K). For many SWMUs, clear concepts for remedial action can be formulated before sufficient information has been collected to firmly define all uncertainties related to unit conditions. In some cases, there may be clear benefits to be obtained from focusing on particular remedial actions early in the characterization process. For a number of SWMUs, a clearly appropriate remedial action will involve stabilization-in-place and long-term monitoring. In this case, characterization sufficient only for leaving waste in place is required. For other SWMUs, removal will be the clearly appropriate remedial alternative. In these cases, characterization to determine the extent of contamination may be curtailed in preference to monitoring during removal. Probable remedial alternatives by SWMU are presented in Chapter 10 of the work plan.

Cost-effectiveness Analysis. Cost-effectiveness analysis involves comparison of costs of alternative strategies for achieving remedial action goals and selection of the least cost alternative if appropriate (IWP Appendix J). Coupled with the observational approach, the application of this philosophy during facility investigation activities may lead to a decision that additional characterization for a SWMU is less cost-effective than proceeding to a remedial action, assessing both the uncertainties that are left by incomplete characterization and the probable costs and benefits of the additional characterization effort.

Decision Analysis. The decision analysis framework discussed in IWP Appendix I provides a quantitative technique for implementing the observational approach and the cost-effectiveness analysis in an effort to streamline the characterization and remediation process. This methodology links the top level standards and criteria for selecting remediation alternatives to the technical requirements for characterization. The analysis supports decision making in situations with tradeoffs between objectives, uncertainties, and multiple-interested stakeholders, including those concerned with cost. The decision analysis approach provides a quantitative basis for defensible "early" decisions.

Table I-1 in the IWP describes the schedule for implementing the decision analysis methodology. As this RFI work plan is being prepared, the decision analysis implementation is in the early

stages of Phase I, the formulation of the objective hierarchy for the overall ER effort. This RFI work plan is well ahead of the development of the decision analysis framework. As that framework develops, it will be implemented within the TA-21 RFI/CMS process.

2.3.2 TA-21 Objectives and Approach

The technical objectives of the TA-21 RFI, incorporating the technical approaches discussed above, are summarized below:

- Identify contaminants present at each SWMU, applying a sequential sampling approach.
- Determine the vertical and lateral extent of the contamination at each SWMU.
- Identify pathways of contaminant migration operable unit-wide and from each SWMU.
- Acquire sufficient information, guided by the observational approach and decision analysis, to allow quantitative migration pathway and risk assessment analyses, as necessary.
- Provide necessary data for the assessment of potential remedial alternatives.
- Provide the basis for planning detailed corrective measures studies.

Certain management objectives can be identified as well. These include the achievement of the technical objectives in an efficient and cost-effective manner and a proper coordination of the RFI process with other institutional constraints of the Laboratory. The following approaches are adopted in this work plan to attain the above objectives.

OU-wide Mesa Top Characterization. A fundamental understanding of the physical and chemical environment within which the TA-21 OU and its associated SWMUs lie is necessary as the basic level of information to support assessment and remediation activities. A mesa top characterization effort is planned to provide OU-wide soil, mineralogic, geologic, hydrologic, and geochemical data that will be applicable to all SWMUs. This investigation will aid in allowing each SWMU to be addressed within the hydrogeological framework of the entire OU. Further, the data collected will help define the OU conceptual model. Hydrogeologic characterization is required in the HSWA Module (Sec. P, Task III) (EPA 1990) to support investigations at each SWMU. The OU-wide characterization approach is an efficient means for providing these data. This effort will be integrated with regional characterization activities developed in the future as part of the ER Program and detailed in annual IWP updates.

A three-dimensional OU conceptual model of the geohydrologic framework is proposed in Chap-

ter 6. The mesa top characterization data will support the development of the model by determining vertical and lateral changes in stratigraphy, lithology, and mineralogic and hydrologic characteristics beneath the OU. These data are necessary for hydrologic and contaminant transport calculations for either the OU as a whole or for individual SWMUs. Additionally, these studies will define the heterogeneity (variance) in various properties for the entire OU, and this variance can be used to determine the required SWMU-by-SWMU sampling intensity for certain properties, thereby minimizing the required sampling.

The mesa top characterization plans include the determination of contaminant levels in surficial materials on an OU-wide basis. As discussed in further detail below, concern for being able to distinguish SWMU-related contaminants from OU-wide contamination is an important motivation for the OU-wide investigation plan. Additional discussion of the mesa top characterization plan and its rationale is given in Chapter 12.

SWMU Characterization. The approach to individual SWMU characterization herein is typified by the sequential sampling approach described in Sec. 2.3.1. The investigations at individual SWMUs are limited primarily to defining contaminants, areas and depths of contamination, and affected migration pathways. Little emphasis is given to more general geologic and hydrologic material properties, which are planned to be obtained on an OU-wide basis as described above.

There is some concern for low-concentration, OU-wide contamination of portions of the TA-21 OU. In order to assess sampling results for each SWMU, a review of OU-wide contaminant levels must be made to establish "background" contaminant levels for the local area of the SWMU. Comparison of SWMU contaminant levels to such local background levels will be used to aid in determining the presence of SWMU-related contaminants and to limit the chance that an error will be made in determining that a particular SWMU has caused a release to the environment.

Existing Data. Available existing environmental data for TA-21 were acquired using standard practices and methods of the day. No attempt has been made to validate the data, in the EPA sense of the term. These data are used in this document solely to guide RFI characterization and sampling.

Field Investigation Methods. Due to the large number of SWMUs addressed in this work plan, common elements applying to the conduct of all field investigations at TA-21 are discussed once in Chapter 11 and not repeated in the field sampling plans. Field screening, field laboratory measurements, and analytical laboratory measurements will be used as appropriate for individual

SWMUs as determined using a decision process detailed in Chapter 11.

Risk Assessment. In general, RFI characterization leads to risk assessment. The OU-wide and SWMU-specific investigations are designed to provide the site characterization data needed for risk assessments for the entire OU or for the contributing SWMUs. Certain characterization data also may serve as input to the Canyon's Assessment OU RFI work plan, another of the OU work plans to be prepared under the umbrella of the IWP. Risk assessment results are part of the decision analysis input, and together with the observational approach are important in determining the need for remedial action. For the TA-21 RFI, risk assessment will be conducted for both radiological and nonradiological contaminants.

Coordination with D&D Program. From a management perspective, investigations of certain SWMUs, as well as potential remedial alternatives for those SWMUs, are tied closely to the Laboratory's long range plans for particular facilities (primarily at DP West). Investigations for SWMUs beneath or immediately adjacent to some buildings are impeded, and will, to the extent possible, be coordinated with plans for building D&D. The D&D Program is discussed further in Sec. 2.4.1. In the interim before full access to the SWMUs is possible, the lateral and vertical extent of potential contaminant plumes around DP West will be bounded and monitored to confirm that neither unknown nor uncontrolled contaminant migration is occurring. Chapter 18 provides the detailed approach for SWMUs in this category.

2.4 Integration with Other Programmatic Concerns

The Program Management Plan (Annex I) of the IWP (LANL 1990a) discusses the integration of the RCRA-based ER Program with other applicable requirements of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the National Environmental Policy Act (NEPA). It is the Laboratory's intent that the RCRA corrective action process comply with applicable requirements of CERCLA and NEPA, in addition to RCRA. Additionally, the ER Program will comply with all other applicable federal acts, state statutes, and DOE orders and policy statements as identified in the IWP Program Management Plan (Annex I). Two specific requirements affecting the planning and conduct of the RFI/CMS process for the TA-21 OU are discussed in greater detail below.

2.4.1 D&D Program

The DOE's Decontamination and Decommissioning Program (D&D Program) is managed by the DOE Office of Environmental Restoration and Waste Management, as is the DOE's ER Program.

The purpose of the D&D Program is the cleanup and either remediation or demolition of facilities contaminated with radioactive, hazardous, or mixed waste. The process for placing a facility in the D&D Program is described in the DOE's Draft Policy for Acceptance of Facilities for Decontamination and Decommissioning (DOE 1990). After a facility is accepted for D&D, DOE policy identifies a three-year period for integration into the planning and funding cycle for the D&D Program. TA-21 DP West has not yet been formally accepted for D&D. However, for SWMUs immediately adjacent to or underneath existing structures at DP West, both site investigation and site remediation will be addressed in the context of D&D (see Chapter 18).

2.4.2 DOE Orders

A number of DOE Orders applicable to the Laboratory's ER Program are identified in the IWP Program Management Plan (Annex I) (LANL 1990a). Compliance with the requirements of those orders is an integral part of operations at the Laboratory and is ensured through the documented polices, planning, auditing, and work review procedures of the Laboratory. However, for the TA-21 OU, it is important to recognize two aspects of DOE Order 5820.2A, Radioactive Waste Management (DOE 1988): (1) at the site characterization and (2) site assessment phase represented by this RFI work plan. First, in regard to buried transuranic waste (which may exist at the TA-21 OU in a few SWMUs), DOE Order 5820.2A Sec. II.3.i. identifies site characterization and closure planning requirements. Second, in regard to low-level radioactive waste, Chapter III of DOE Order 5820.2A specifies requirements that are applicable to some situations at the TA-21 OU or which provide useful guidance for assessments to be made as part of this RFI process. This RFI work plan incorporates elements that will provide data allowing both the assessment of options for site closure or disposal of any buried transuranic waste at TA-21 and the assessment of low-level waste disposal guidance and requirements.

2.5 Document Organization

This RFI work plan is prepared pursuant to both the HSWA Module (EPA 1990) and the IWP (LANL 1990a). The HSWA Module sets out the general scope of the work plan for the RFI, establishes the expected correspondence between the RFI tasks identified in EPA guidance documents (EPA 1989) and the equivalent ER Program tasks, specifies the requirements to be fulfilled by the IWP and the contents expected in the OU work plans such as this document.

TABLE 2.5-I
RFI GUIDANCE FROM THE LABORATORY'S RCRA PART B PERMIT

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

These expectations are summarized in Table 2.5-I, extracted from page 32 of the HSWA Module. In addition to the expectations defined in the HSWA Module, the IWP presents a proposed outline for OU work plans such as this. The organization of this TA-21 OU work plan with regard to these expectations is described in the following sections.

2.5.1 Correspondence with RFI Scope from the HSWA Module.

EPA defines five general tasks within the RCRA facility investigation process (EPA 1989; EPA 1990). Each of these tasks is discussed separately below, and the corresponding sections of this document are identified.

RFI Task I, Description of Current Conditions. This task consists of a presentation of facility background information and a discussion of the nature and extent of contamination. A TA-21 history and operations summary is presented in Chapter 3. The environmental setting is presented in Chapter 4, and the known data concerning the nature and extent of contamination are presented in the sections discussing the individual SWMUs, Chapters 13 through 20.

RFI Task II, RFI Work Plan. This task requires plans for Data Collection Quality Assurance, Data Management, Health and Safety, and Community Relations. These plans are presented as Appendices A through D of this document.

RFI Task III, Facility Investigation. This task sets out requirements for further characterization of the environmental setting, source, contamination, and potential receptors. This work plan describes these efforts as follows:

- environmental setting — mesa top sampling plan (Chapter 12);
- source characterization — individual SWMU sampling plans (Chapters 13–19);
- contaminant characterization — individual SWMU sampling plans (Chapters 13–19), mesa top sampling plan (Chapter 12); and
- potential receptor identification — migration pathways are assessed in the mesa top sampling plan (Chapter 12), and in certain individual SWMU sampling plans. Existing information is presented in Chapters 5 through 7.

RFI Task IV, Investigative Analysis. This task contains subsets of Data Analysis and Protection Standards. These considerations are addressed in the IWP.

RFI Task V, Reports. This task calls for preliminary, work plan, progress, draft, and final reports.

Work plans are provided on an installation-wide basis (the IWP) and for specific ER Program activities. This document is the RFI work plan for the TA-21 OU. It contains the Field Sampling Plans, Project Management Plan, Quality Assurance Project Plan, Records Management Plan, Health and Safety Plan, and Community Relations Plan.

Monthly progress reports for the entire ER Program will be submitted as described in the IWP, as will draft and final RFI Reports.

2.5.2 Correspondence with RFI Outline Proposed in IWP

A proposed outline for a OU RFI work plan is presented in Table 3.2 of the IWP (LANL 1990). This work plan has not adhered explicitly to that outline but incorporates all of the elements of that outline. Although the HSWA Module requires that the IWP present an OU RFI outline for approval by the Administrative Authority, the IWP reserved the option to modify the outline as necessary for individual activities (IWP Sec. 3.5.1). This work plan exercises that option and consolidates common elements and eliminates excessive repetition.

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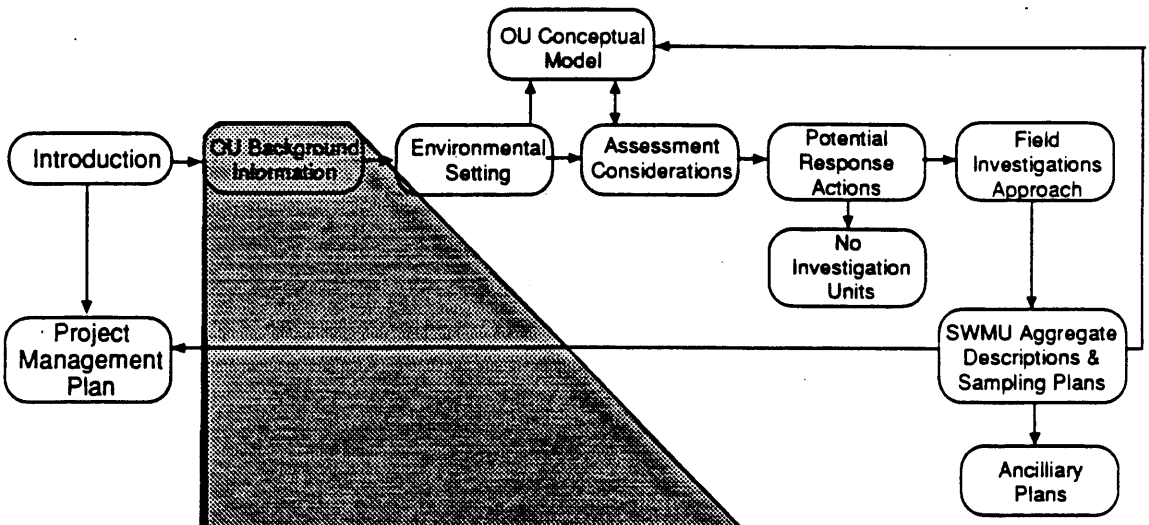
LANL (Los Alamos National Laboratory), November 1990b. "Solid Waste Management Units Report," Volumes I through IV, Los Alamos National Laboratory Report No. LA-UR-90-3400, prepared by International Technology Corporation under Contract Number 9-XS8-0062R-1, Los Alamos, New Mexico.

CHAPTER 3



OU Background Information

- History of TA-21
- Past Waste Management Practices
- Present Operations and Site Conditions

3. TA-21 OPERABLE UNIT BACKGROUND INFORMATION

3.1 History of TA-21

During World War II, Los Alamos National Laboratory was established with the responsibility for the research, development, and testing of the first deliverable nuclear weapon. In order to achieve this goal, much research was required to establish the chemical and metallurgical properties of the nuclear material necessary to achieve and sustain the required nuclear fission reaction. The Laboratory's Chemistry Division was created in 1943 and was given the responsibility for purifying the plutonium received from other production facilities. In 1945, these operations were transferred to the newly built facilities at TA-21. These facilities were located in the areas DP West and DP East. (DP West and DP East are historical designations for parts of TA-21 as shown in Fig. 2.2-2, Chapter 2.) The following subsections describe, in general, the activities and materials used at DP West and DP East.

3.1.1 DP West

DP West (Fig. 3.1-1) began operations in September 1945. Its main purpose was to provide the capability to produce metal and alloys of plutonium from the nitrate solution feedstock provided by other production facilities. This involved several acid dissolution and chemical precipitation steps to separate the plutonium and other valuable actinides from the feed stocks. A major research objective at DP West was the development of new purification techniques that would increase the efficiency of the separation processes (Christensen and Maraman 1969). Table 3.1-I lists the major separation processes used at the DP West facilities and the years each process was first employed. These separation techniques used a wide range of chemicals from the periodic table. In conjunction with improving purification techniques in the main process lines, research was conducted into reprocessing the waste produced to further enhance recovery. In addition, other operations, such as nuclear fuel reprocessing, were performed on occasion at DP West. Activities unrelated to plutonium processing also occurred at DP West; however, they are not detailed herein because they did not result in the SWMUs addressed in this document.

The main plutonium purification processes were contained in Buildings TA-21-2, 3, 4, 5, and later 150. Uranium and plutonium metal produced in these buildings was secured and stored in Building TA-21-21, the old vault. Research into methods of recovering additional plutonium from waste streams was conducted at Building TA-21-33. Additional research on the properties and uses of plutonium was conducted at Building TA-21-210, the plutonium research building.

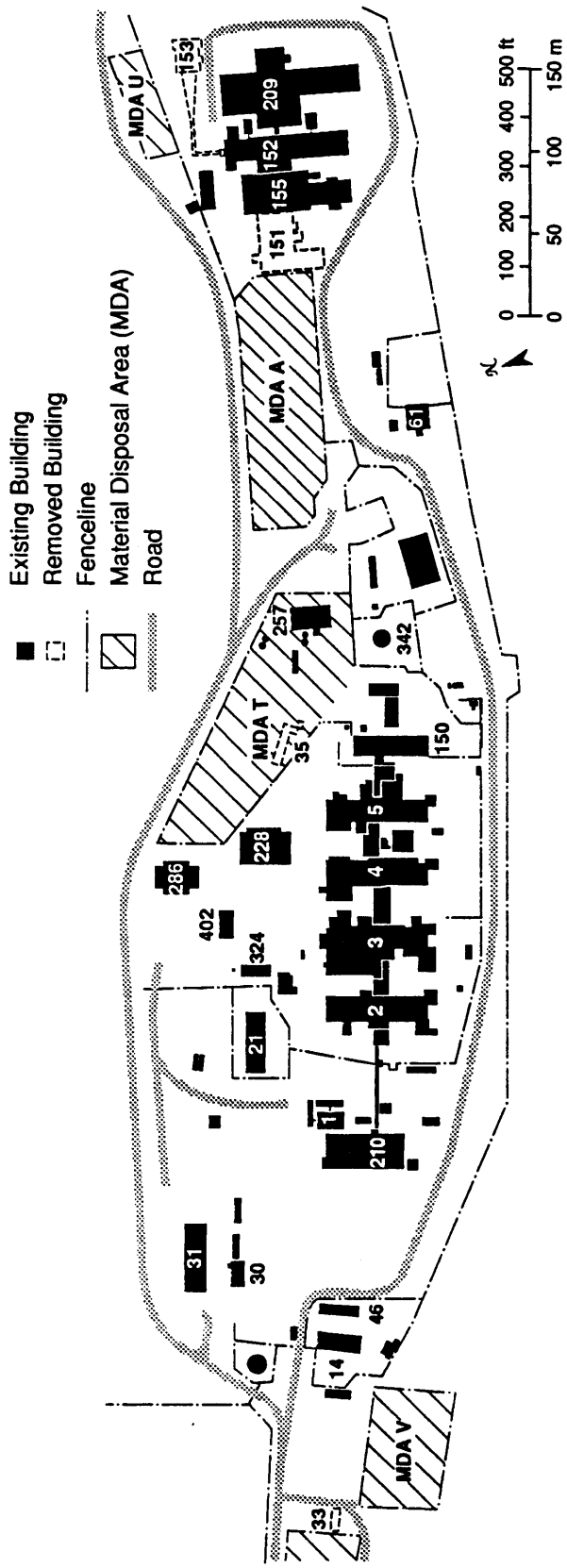


Fig. 3.1-1 Historical and current locations of major structures at TA-21. (LASL 1964)

TABLE 3.1.-I MAJOR PLUTONIUM SEPARATION TECHNIQUES AND ASSOCIATED CHEMICALS[a]

Year Process was first used	Separation Technique[b]
1945	HCl Dissolution
	Oxalate Precipitation
	Fluoride Precipitation
	Ethyl Ether Extraction
1947	HI Dissolution
	Ammonium nitrate Precipitation
	Sodium nitrate Precipitation
	Sodium bromotrioxide Precipitation
	Aluminum nitrate Precipitation
	Ammonium hydroxide Precipitation
	Sulfur dioxide Precipitation
	Sodium hydroxide Precipitation
	Thenoyl-tri-fluoracetone Extraction
1951	HNO_3-HF Dissolution
1953	Tri-n-butyl phosphate Extraction

[a]Christensen and Maraman (1969).
[b]All of these separation techniques used a wide range of chemicals from the periodic table.

In 1977, a transfer of work to the new plutonium facility at TA-55 began, and much of the DP West complex was vacated. At that time, cleanup of the old process lines was initiated. This included removing contaminated equipment and material from Buildings 2, 5, and 150 and from parts of Buildings 3 and 4 (Garde 1982). The buildings were then remodeled for use by other groups at LANL.

3.1.2 DP East

DP East is somewhat smaller than DP West. It began operation in September 1945 at Buildings TA-21-151, 152, 153. Building 155 was completed in December 1949 (LANL no date) (see Fig. 3.1-1). These facilities were used to process polonium and actinium and to produce initiators (a nuclear weapons component). In 1964, Building TA-21-209 was built to house research in high-temperature and actinide chemistry. TA-21-155 currently houses the Tritium Systems Test Assembly (TSTA) for developing and demonstrating effective technology for handling and processing deuterium and tritium fuels for use in fusion reactors.

3.2 PAST WASTE MANAGEMENT PRACTICES

The major contributor to waste streams at the TA-21 OU were plutonium-processing activities. Because of the scarcity of plutonium, much emphasis was placed on recovery of this material from process waste streams. Thus, waste stream recycling became a common practice.

3.2.1 Process Waste

Process waste consisted of the solid and liquid waste streams produced in the various research and production activities at TA-21. These waste streams were generally contaminated with radioactive and chemical waste. Process wastes from the early 1940s until the late 1970s were largely disposed of at five Material Disposal Areas (MDAs). These areas are known as MDAs A, B, T, U, and V (see Fig. 2.2-2). Estimates of the volumes and activity of waste disposed of in the MDAs are given in Table 3.2-I. The methods used in disposing of solid and liquid wastes at these MDAs differ and have evolved over the years. Chapter 16, Material Disposal Areas Description and Sampling Plan, contains detailed information on each MDA.

Solid wastes were, in general, either buried or incinerated. Burial of solid wastes was performed in pits at MDAs A and B. Transuranic (TRU) wastes were placed in corrugated metal pipes and placed in a pit at MDA T from which they could be retrieved. Debris produced from the destruction or remodeling of buildings at TA-21 was either buried at MDA A, occasionally pushed over

TABLE 3.2-I
ESTIMATES OF THE VOLUME AND ACTIVITY OF WASTES DISPOSED OF IN TA-21 MDAs.

MDA	Area (acres)	Solid/ liquid waste disposal	Estimated Volume of waste (cubic yards)[a]	Activity	Date Ceased Operation	Potential Contaminants
A	1.25	Solid	7,007	unknown	1978	radionuclides, organics, inorganics, metals, solvents
B	6.03	Solid	210,473	unknown; estimated 100 gm Pu (Walker et al. 1981)	1948	radionuclides, organics, inorganics, metals, solvents
T	2.21	Liquid/ Solid[b]	71,962	absorption beds 1945-1951 Pu 9.8 Ci and ^{3}H 14.0 Ci disposal shafts 1968-1983 ^{241}Am 3743 Ci, ^{238}Pu 31 Ci, ^{239}Pu 151 Ci, and ^{233}U 6.9 Ci	1983	radionuclides, organics, inorganics, metals, acids
U	0.20	Liquid	60,558	2.5 Ci ^{227}Ac released in 1953	1968	radionuclides, organics, inorganics, metals, PCB
V	0.88	Liquid	241,939	small quanitites ^{90}Sr and ^{239}Pu	1961	radionuclides, organics, inorganics, metals, solvents

[a]Estimates from WIN data base 12/17/90.
[b]Liquid waste went into absorption beds and solid cement paste went into disposal shafts.

the edge of the mesa south of MDA V, piled up northeast of DP East, or abandoned in other places at TA-21(See Chapter 14, Surface Units Description and Sampling Plan).

Liquid wastes produced at TA-21 were carried to the various disposal and treatment sites via a system of waste lines and sumps that may have leaked. Virtually every building at TA-21 that contained processing or research operations was served by this system. Over the years, this system was altered many times as the waste disposal and reprocessing operations changed. Chapter 18, SWMUs for Coordination with building D&D, contains detailed information on the waste lines and sumps.

Initially, liquid wastes were stored in tanks pending future improvements in the extraction processes. In the late 1940s and early 1950s, it was found that the natural soils and clays at TA-21 were effective in removing radioactive contaminants from waste liquids (LASL 1955). Therefore, absorption beds began to be used in which process effluent was emptied into a trench filled with absorption material consisting of cobble, gravel, and fine sand. These absorption beds were located at MDAs T, U and V. By 1952, sufficient progress had been made in research for recovering additional plutonium from waste liquids to make reprocessing the liquid waste viable. This reprocessing of liquid effluent was initially performed at a specially built waste treatment laboratory, TA-21-35. TA-21-35 began reprocessing waste in 1952. In 1967, liquid waste treatment operations were transferred to a newly built waste treatment facility, TA-21-257. Waste treatment operations at TA-21-35 and 257 are discussed in Chapter 16, Material Disposal Area Description and Sampling Plan. Treated liquid wastes from these operations were occasionally discharged to the absorption beds in MDA T until 1967. From 1968 to 1976, wastes were mixed with cement and pumped down asphalt-coated shafts augured between two absorption beds at MDA T. From 1975 to 1983, TRU wastes were mixed with cement and pumped into corrugated metal pipes, which were stored in the retrievable storage pit dug between two absorption beds at MDA T. These wastes were retrieved from 1984 to 1986 and relocated to MDA G.

3.2.2 Sanitary Waste

In the early period of operations at TA-21, a separate sewer system was not available. Therefore, sanitary waste was mixed with liquid waste from floor drains, laboratory sinks, and cooling tower blowdown. Buildings at TA-21 were built with drain lines to carry this waste away from the buildings. These lines led to the mesa edge where they discharged. Some drain lines led to septic tanks, which then discharged overflow to the mesa edge. The discharge points are known as outfalls. These outfall lines were not intended to discharge radioactive or otherwise contaminated waste, but occasionally contaminated material would be washed down a floor drain or

poured into a sink. The majority of the outfall system was abandoned in 1966 when the sewage treatment plant located at the east end of DP Mesa came on line. Some outfall lines discharging cooling water blowdown are still in operation and are NPDES-permitted. Outfalls and septic systems are discussed in Chapter 15, Outfalls Description and Sampling Plan. The sewage treatment plant is discussed in Sec. 14.7.

3.2.3 Airborne Effluents

Air from the process areas and some rooms at DP West and DP East were cleaned by using filters and electrostatic precipitators. These cleaning processes were principally contained in filter houses TA-21-12 and TA-21-153. TA-21-12, which served DP West, was decommissioned in 1972, and TA-21-153, which served DP East, was decommissioned in 1970. Building areas that were not served by these two filter houses exhausted air through stacks located at each area being served. These stacks generally contained HEPA filters or scrubbers and were monitored for the particular radionuclide associated with operations in the rooms the stack served. HEPA filtered exhausts are still in operation at TA-21 for various radionuclides (see Chapter 13).

In the 1960s and 1970s, several incinerators called salamanders were used to burn organic transuranic solvents and oils contaminated with radionuclides. The salamanders were long trays used for the open burning of solid waste and were associated with the waste treatment facilities at TA-21-35 and TA-21-257. Detailed information on air discharge systems is contained in Chapter 13, Surface Contamination from Airborne Emissions Description and Sampling Plan.

3.3 PRESENT OPERATIONS AND SITE CONDITIONS

This section discusses ongoing research activities at TA-21 facilities, the waste management practices to support these activities and the planned D&D of DP West.

3.3.1 Current Operations

The three major current operations at TA-21 involve the Isotope and Structural Chemistry Group (INC-4) at DP West, the Tritium Science and Technology Group (MST-3) at DP East, and the Laboratory's operations and maintenance contractor, Johnson Controls, at both DP East and DP West. The Radiation Protection Group (HSE-1) and the Waste Management Group (HSE-7) also conduct operational ES&H activities at TA-21. Several other groups conduct varied activities in one or two buildings at TA-21.

INC-4 occupies the majority of the old plutonium-processing buildings (TA-2,3,4,5,150) at DP West. The buildings house from 75 to 100 people. They conduct research in the following five activity areas: condensed-phase spectroscopy, organo-metallic chemistry, actinide chemistry, bioinorganics, and environmental chemistry. MST-3 operates the Tritium Systems Test Assembly (TSTA) in TA-21-209. The objective of TSTA is to develop and demonstrate technology for processing deuterium and tritium fuel for use in the magnetic fusion energy program. Johnson Controls uses TA-21-14 at DP West to house fitters, welders, painters, electricians, and tinners (sheet metal workers) to support all of Construction Area 2 (S-Site, TA-53, TA-42, TA-2, TA-21, and townsite). The sewage treatment plant and steam plant at DP East are also operated by Johnson Controls.

3.3.2 Waste Management

Waste management practices at TA-21, initiated in the 1940s to accommodate plutonium processing, were largely terminated by 1978 when plutonium-processing operations were transferred to TA-55. However, work with plutonium at a much reduced level continues at TA-21 by INC-4 generating some wastes. The five material disposal areas at TA-21 ceased operation at various times prior to 1983 (see Table 3.2-I). Additionally, in 1986, treated effluent from Building 257, the industrial waste treatment plant, was transferred via pipeline for NPDES-permitted discharge to Mortandad Canyon. Prior to that time, treated liquid waste from Building 257, and previously Building 35, had discharged to DP Canyon by an outfall pipe (see Chapter 16, Material Disposal Areas Description and Sampling Plan).

3.3.3 Decontamination and Decommissioning

Laboratory management realizes that DP West is a facility that has outlived its useful life, steadily deteriorates, and, because of changing ES&H requirements, will not be in compliance in the future. To address these issues, an action plan (Gancarz 1990) is under development. Short-term activities of this plan are to control access, phase out property storage, and designate INC division as the landlord-site manager for DP West (see Fig. 3.3-1). Long-term plans are to relocate programmatic activities from DP West and implement decontamination and demolition of DP West. In light of these activities, current and expected future operations at TA-21 are discussed.

The D&D Program is part of the ER Program; however, it is managed by the Waste Management Group (HSE-7) and not the Environmental Restoration Group (HSE-13).

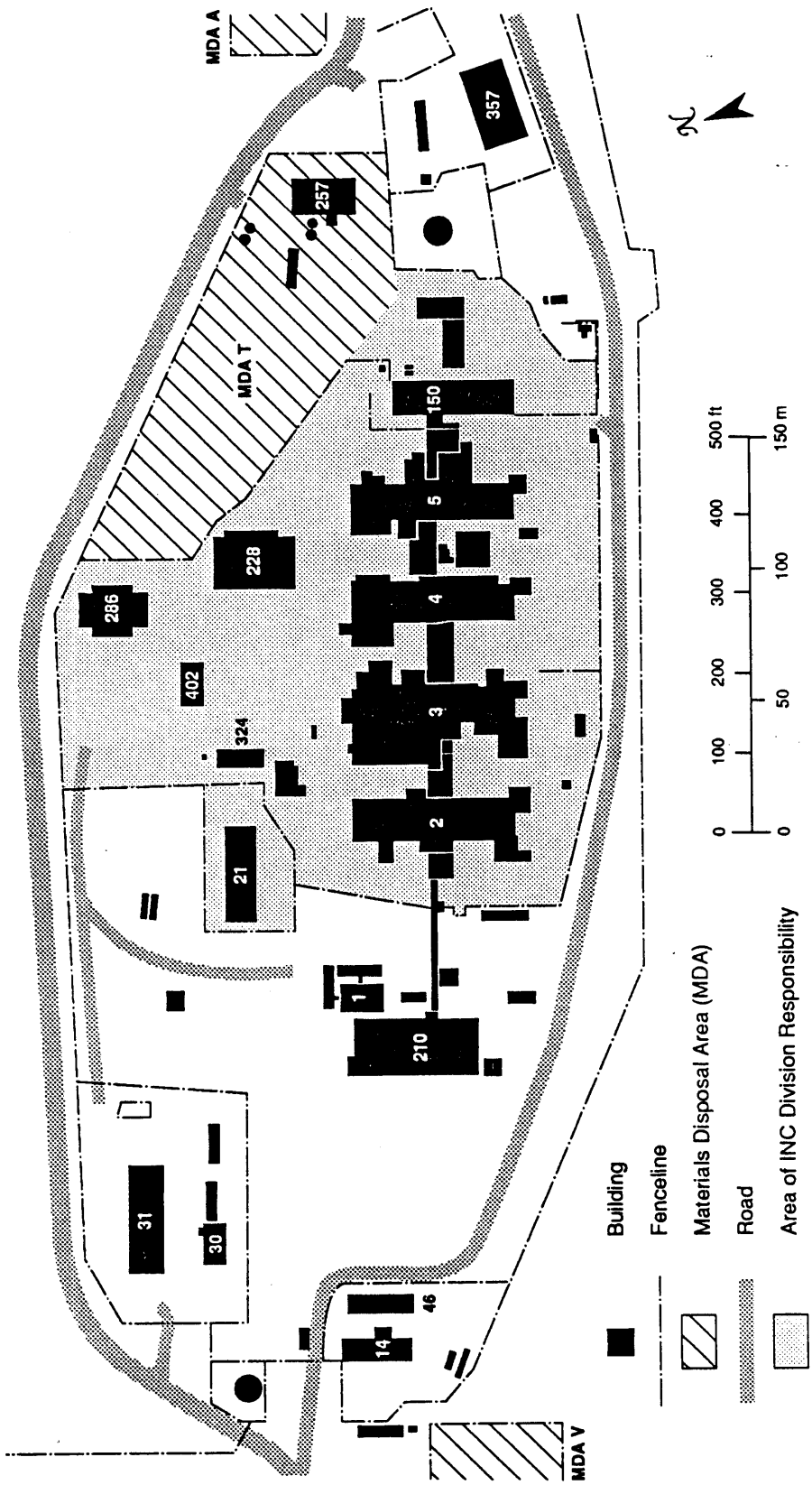


Fig. 3.3-1 Portion of DP West under INC Division as landlord site manager.

The following D&D activities are scheduled and budgeted:

- routine surveillance and maintenance of Buildings 3 and 4 south, the former enriched uranium-processing facility, which was operated by MST Division until July 1984, is budgeted for FY91. This activity involves radiological and hazardous waste measurements, physical inspections, reporting and record-keeping requirements, and correction of any deficiencies identified (Montoya 1990).

- decommissioning of Buildings 3 and 4 south is budgeted at $1.25 million each year in FY92 and FY93.

A D&D plan including building demolition is currently being developed for DP West. This plan will be incorporated into the Five Year Plan (FYP) for Environmental Restoration and Waste Management. However, the process outlined in DOE's Draft Policy for Acceptance of Facilities for Decontamination and Decommissioning (DOE 1990) suggests this will take time. The DOE Headquarters Office of Environmental Restoration (EM-40) will only consider facilities once they are made surplus and inactive. DP West is not yet surplus. Additionally, this guidance states that "there will be a 'transition period' of up to 3 years to allow for time required to appropriate funds for the cleanup and to provide for the orderly integration of the project into the EM-40 program." Cleanup activities will be scheduled on the basis of the prioritization process in the FYP.

As a result of all the above-mentioned uncertainty, it is not known when DP West will actually be decontaminated, decommissioned, and demolished. The planned D&D/ER interface, as it pertains to field sampling plans for SWMUs at DP West, is discussed in more detail in Chapter 18.

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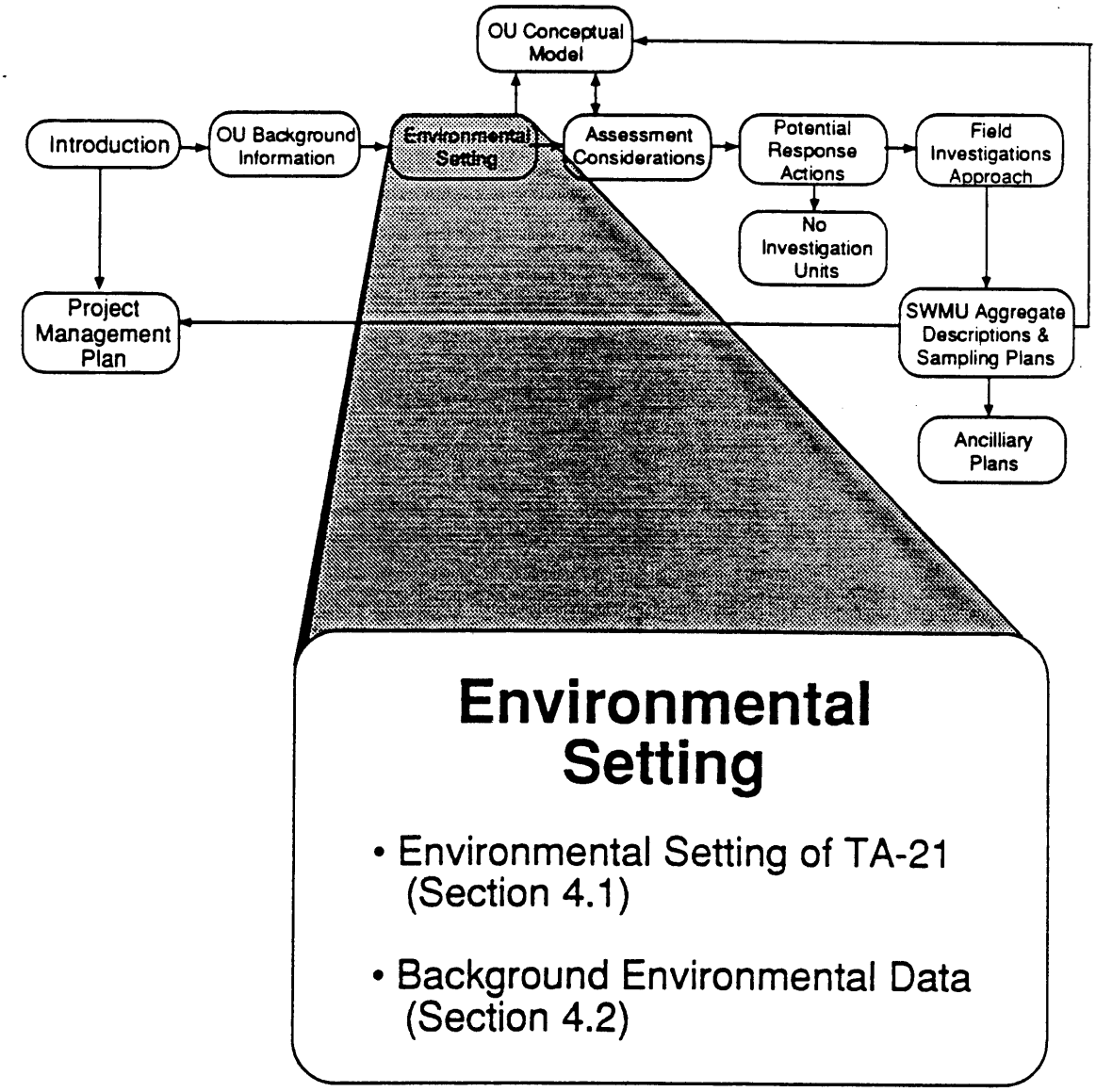
CHAPTER 4


OU Conceptual Model
Introduction
OU Background Information
Environmental Setting
Assessment Considerations
Potential Response Actions
Field Investigations Approach
No Investigation Units
Project Management Plan
SWMU Aggregate Descriptions & Sampling Plans
Ancilliary Plans
Environmental Setting
• Environmental Setting of TA-21 (Section 4.1)
• Background Environmental Data (Section 4.2)

4. ENVIRONMENTAL SETTING

Chapter 4 and Chapters 5 through 9 are intended to build an understanding of the environment at TA-21 and the significance of different contaminant migration pathways at the TA-21 OU. The RFI investigation plans presented in Chapters 12 through 19 are based on the understanding developed here.

The next three chapters present and interpret the details of existing information as follows:

- General environmental description—Sec. 4.1, Environmental Setting
- Existing data on contaminants in environmental media—Sec. 4.2, Background Environmental Data, and Sec. 5.2, Environmental Pathways.
- Description of pathways of importance for different types of SWMUs—Sec. 5.1, SWMU Conceptual Categories.
- TA-21 OU-specific discussion of the contaminant migration pathways—Sec. 5.2, Environmental Pathways.
- Evaluation of receptors affected by releases along each pathway—Chapter 6, Identification of Potential Receptors.

Throughout each of these discussions, an effort is made to explicitly identify additional information and data needs. Such needs may relate to expanding our conceptual understanding of the environmental processes at work or to providing the parameter values that will be needed to assess the magnitude and importance of those processes as potential exposure routes.

The general foundation prepared by the above-listed sections culminates in the description of a conceptual model of contaminant release, transport, and effect for the TA-21 OU as follows:

- Summary of the existing information and the current understanding presented as a conceptual model—Chapter 7, Conceptual Site Model.

The final two chapters of this six chapter sequence bring together, as summaries, a list of information and data needs and an evaluation of the nature and quality of data required to support the purposes of the RFI as follows:

- Summary of identified OU-wide and SWMU-specific data needs—Chapter 8. Data Needs.
- Summary of data quality requirements for meeting the objectives of the different aspects of the investigation—Chapter 9, Data Quality Objectives.

Data needs have been identified throughout this work plan. Data needs related to the OU as a whole are identified primarily in Chapters 4 through 6. SWMU-specific data needs are identified in the evaluations prepared for each individual SWMU in Chapters 12 through 19. The summary of data quality objectives addresses the different aspects of the RFI in view of the primary objective of selecting a remedial alternative on the basis of human health, environmental impact, and implementation and cost considerations.

The field sampling plans presented in Chapters 12 through 19 are intended to satisfy the data requirements identified in Chapters 4 through 9, as well as provide information allowing the identification of contaminants, contaminant source term, and nature and extent of environmental releases. As the results of the field sampling efforts become available, an iterative process will begin in which the current understanding documented in the next six chapters will be updated; the sufficiency of the data for supporting the RFI objectives will be assessed; new data needs will be identified; and new investigations will be designed to fulfill those needs.

This chapter presents information about the characteristics of the TA-21 environment. It describes the environmental setting of TA-21 and identifies available information that may be used to assess the presence, movement, and importance of contaminants in the TA-21 environs. This chapter has two sections. The first section, Environmental Setting of TA-21, contains descriptive information about the climate, soil, geology, and hydrology at TA-21. It also identifies additional data needed to evaluate the potential for a contaminant release to move through environmental pathways. Chapter 5 will discuss pathway significance and present data needs by pathway.

The second section, Background Environmental Data, presents regional data on surface and groundwater quality, air quality, external penetrating radiation, and soil chemical and radiological constituents. These data represent environmental conditions beyond the range of influence of Laboratory operations and provide the basis against which TA-21 data can be compared. Additional data on background levels that are needed to provide the foundation for comparisons are identified in this section.

4.1. Environmental Setting of TA-21

The environmental setting of the Laboratory as a whole is discussed in the IWP's Sec. 2, Installation Description (LANL 1990). The following descriptions of the environmental setting of TA-21 focus on the detailed situation at this OU. In this chapter, reference is made to information given in the IWP and additional detail is provided, as appropriate. In addition to giving a general description of the environmental setting, a purpose of this section is to identify information

needed to assess the potential for movement of contaminant releases through the environment at TA-21. A summary of the identified data needs is presented in Chapter 8, Data Needs.

4.1.1. Geographic Setting

The geographic setting of the Laboratory is described in the IWP at Sec. 2.1, Geographic Setting. TA-21 is located on the northern edge of the Laboratory, at an elevation of 2176 m (7140 ft). It is centrally located on the Pajarito Plateau, roughly midway between the rising of the Jemez Mountains to the west and the White Rock Canyon of the Rio Grande to the east (Fig. 4.1-1). TA-21 is sited on the relatively narrow DP Mesa, and is underlaid by approximately 800 ft of volcanic ash deposits, the Bandelier Tuff, which is the bedrock throughout the OU. Groundwater lies at a depth of approximately 1150 ft.

The TA-21 OU is defined as the area between the drainage channel in DP Canyon, on the north, to the drainage channel in Los Alamos Canyon, on the south. The eastern boundary is formed by the confluence of the two drainages, and the western boundary is defined by the property boundary for TA-21 (see Fig. 4.1-2).

4.1.2. Climate

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

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

Wind speed and direction are measured at five locations around the Laboratory, as indicated in Fig. 4.1-3 (ESG 1989). The East Gate monitoring station is 1.6 km (1.0 mi) east of TA-21. Wind speeds in 1988 were less than 2.5 m/s (5.5 mph) 38 % of the time and greater than 5 m/s (11 mph) 21 % of the time. Strong winds occur predominantly in the spring. The predominant wind direction, especially for strong winds, is south-southwest. This information implies that deposition patterns for wind-borne contaminants may be more prominent to the north-northeast of the TA-21 OU.

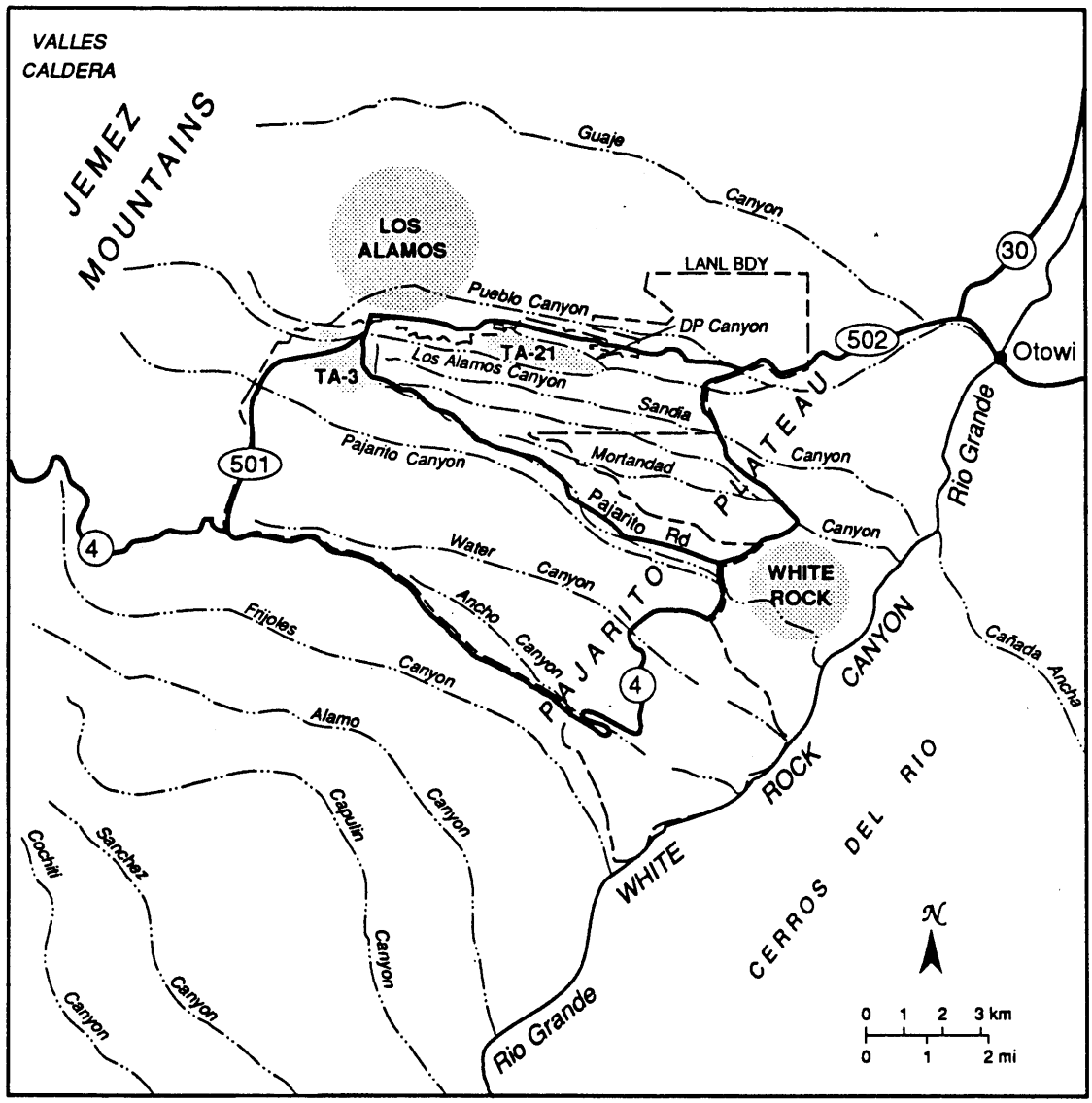


Fig. 4.1-1 Location of TA-21 on the Pajarito Plateau.

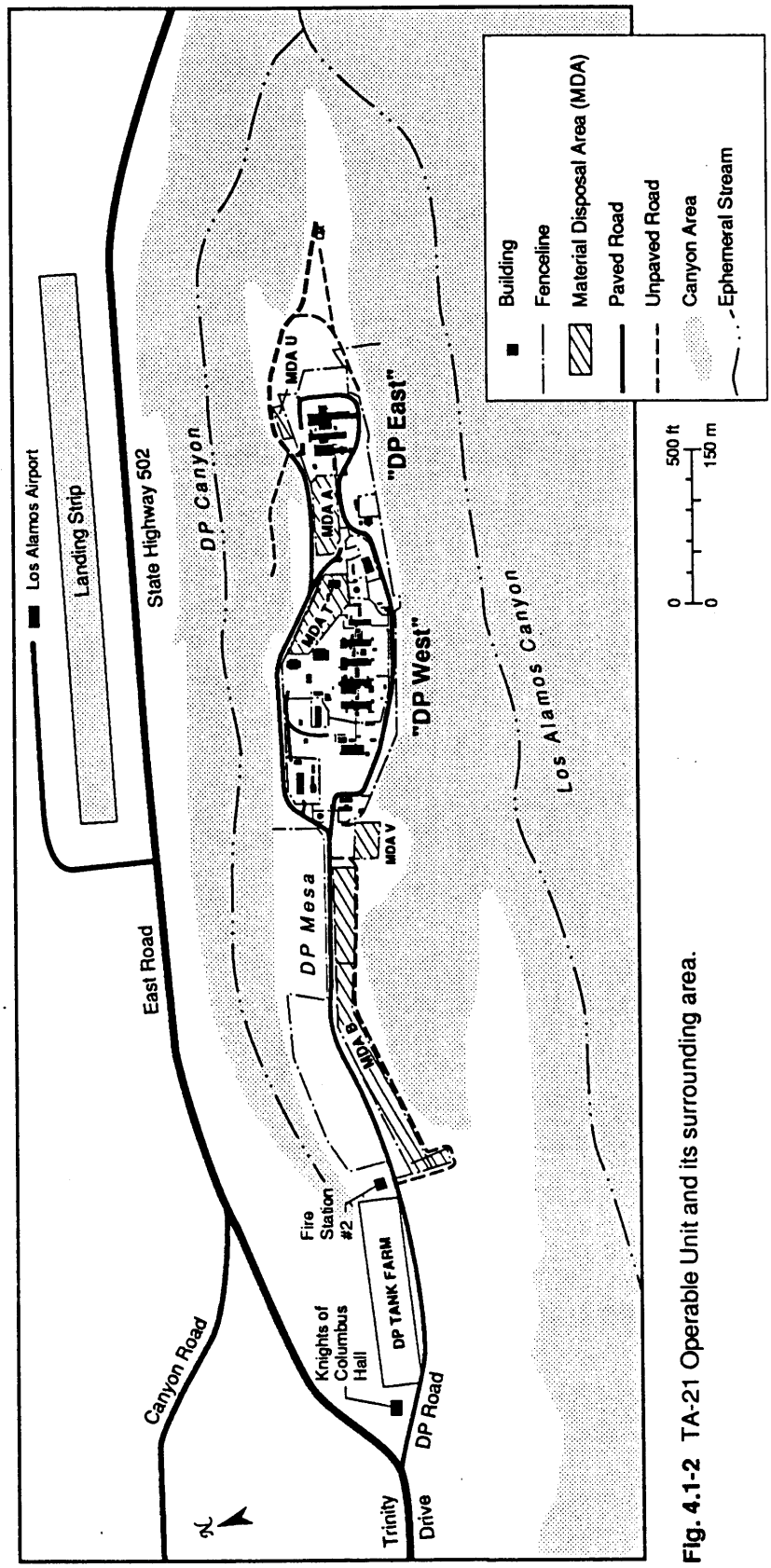


Fig. 4.1-2 TA-21 Operable Unit and its surrounding area.

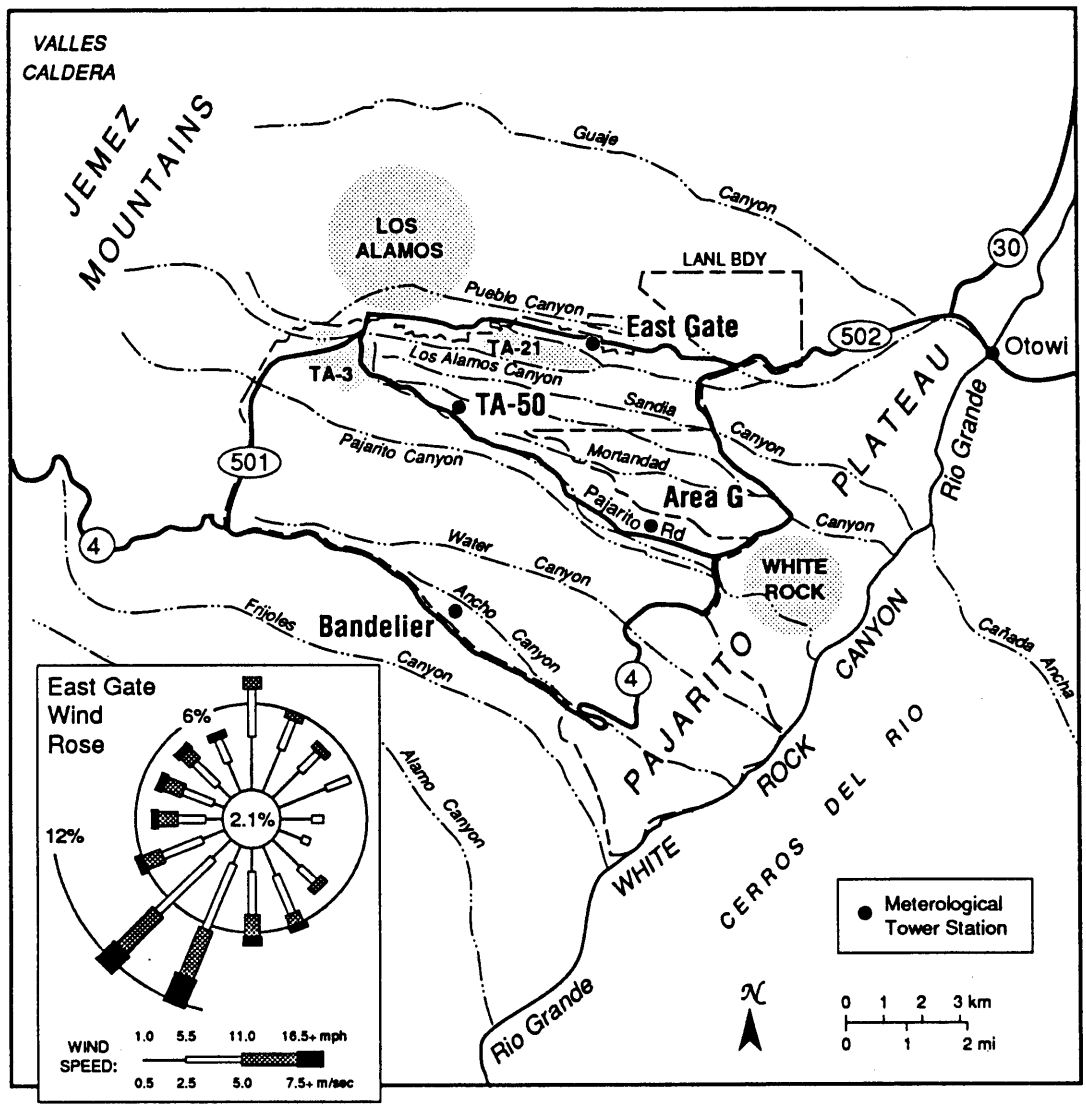


Fig. 4.1-3 Meterological tower stations at Laboratory during 1988 (ESG 1989).

Forty percent of the precipitation on the Pajarito Plateau occurs as brief, intense thunderstorms during the period of July and August. Significant run-off of surface water often occurs with these events. In the winter, snowfall averages 130 cm (51 in.) annually (ESG 1989). Figure 4.1-4 summarizes precipitation data from 1911 to 1987. The prevalence of short, intense precipitation events indicates that surface erosion and run-off transport of soils may be important mechanisms for the movement of surficial contaminants at the TA-21 OU.

Data needs. For application at TA-21, available climatic data are sufficient. Atmospheric pressure cycling is discussed further in conjunction with the atmospheric dispersion pathway in Chapter 5.

4.1.3. Soils

IWP Sec. 2.6.2.3, Soils, discusses the soils of the Pajarito Plateau. Soils in the vicinity of TA-21 are typical of those, and are generally poorly developed, derived from Bandelier Tuff bedrock, and formed under a semiarid climate. Soils in the Laboratory vicinity were mapped and described by Nyhan et al. (1978). Relevant aspects of soils include

- presence/absence, native/disturbed;
- potential for wind and water erosion: particle size distribution, classification, vegetative cover; and
- contaminant retardation/neutralization capability: ion exchange capacity, pH, K_d, clay content, permeability barriers.

Mesa Top Soils. Soils on the TA-21 mesa top are mainly shallow, well drained sandy loams of the Hackroy series. As described by Nyhan et al. (1978). "The surface layer of the Hackroy soils is a brown sandy loam, or loam, about 10-cm thick. The subsoil is a reddish brown clay, gravelly clay, or clay loam, about 20-cm thick. The depth to tuff bedrock and the effective rooting depth are 20 to 50 cm." Hackroy soils are classified as Alfisols, in part reflecting the clayey subsurface horizons.

Intermixed with the Hackroy soils on the mesa tops are small areas of deeper loams of the Nyjack series and patches of bedrock. The Nyjack soils are texturally similar to Hackroy soils and are distinguished by thicknesses of 50 to 102 cm and by the common presence of pumice fragments in the lower soil (Nyhan et al. 1978). Areas of exposed rock are predominant toward the end of the mesa, east of the TA-21 development.

IWP Sec. 2.6.3.1.2, Movement of Fluids Through Tuff, describes a distinct clay layer often formed

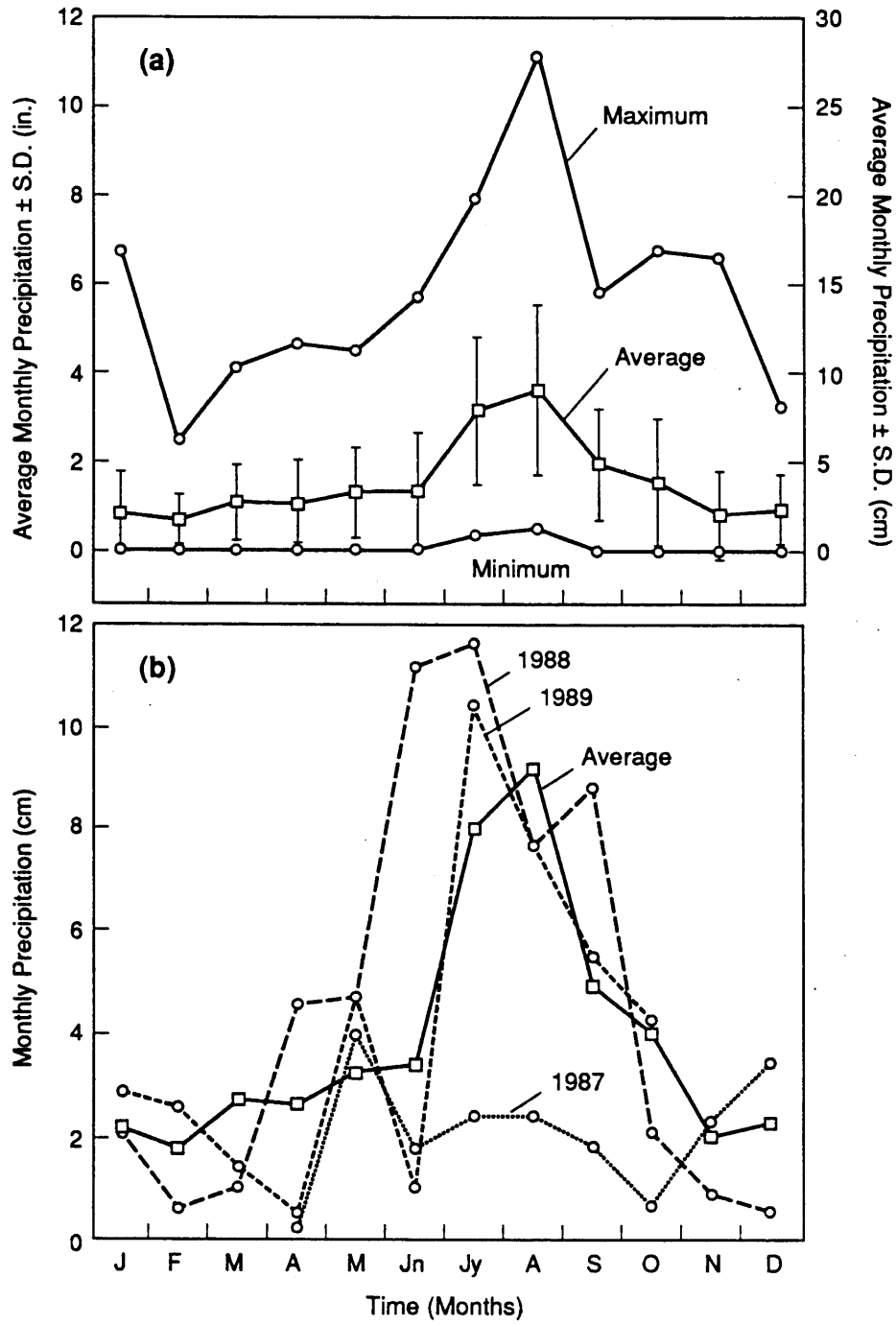


Fig. 4.1-4 (a) Distribution of average, maximum, and minimum monthly precipitation from 1911 to 1986, and (b) monthly precipitation totals from 1987 to 1989 at Los Alamos.

at the base of the soil profile. This layer has been cited as a potential barrier against infiltration of precipitation into the underlying bedrock (Abeele et al. 1981; Weir and Purtymun 1962). Areas where soils have been removed or disturbed may not exhibit this reduction of infiltration (Abrahams et al. 1961).

Data needs. Determine areas of disturbed versus undisturbed soils and the presence of a distinct clay horizon to address erodibility and contaminant-holding properties. This data need is discussed further in conjunction with the surface water run-off pathway in Chapter 5.

Canyon Walls and Canyon Bottom Soils. The slopes between the mesa tops and canyon bottoms are mostly mapped as steep rock outcrops, consisting of about 90% bedrock outcrop and patches of shallow, undeveloped soils. South-facing canyon walls are very steep and have little or no soil material or vegetation; north-facing walls are less steep and often have areas of very shallow dark-colored soils (Nyhan et al. 1978).

Part of the lower south-facing wall of Los Alamos Canyon, south of TA-21, is mapped as unnamed soils of the Typic Ustorthents-Rock Outcrop Complex, formed on colluvial material mantling the lower slope. The Typic Ustorthents are deep, well drained soils. 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. Measurements at TA-21 indicate that the depth to tuff bedrock is greater than 155 cm (Nyhan et al. 1978).

The valley bottoms north and south of TA-21 are underlaid by deep, poorly developed, well drained soils of the Totavi series formed in alluvium. The surface soil is a brown, gravelly loamy sand, or sandy loam, to 150 cm or more, with 15 to 20% gravel (Nyhan et al. 1978). Totavi soils are classified as Entisols (Birkeland 1984).

Data needs. The same data are needed as for mesa top soils.

4.1.4. Surface Water Hydrology

Neither Los Alamos Canyon nor DP Canyon in the area of the TA-21 OU has perennial stream flow. Both canyon drainages contain ephemeral streams. These streams flow only in limited segments because of effluent releases and flow along their full course only during spring snowmelt and summer thunderstorm run-off events.

Run-off and infiltration are the significant aspects of surface water hydrology at TA-21. These aspects are of importance as mechanisms by which contaminants can be mobilized and transported through the environment. Run-off may carry contaminants into surface waters, concentrate dispersed surficial contamination into drainages, and carry and deposit contaminants downstream. Surface water infiltration provides the mechanism by which contaminants may begin to move into subsurface soils and can allow contaminants to reach alluvial aquifers. Surface hydrology aspects of interest include

- areas and paths of surface water run-off, sediment transport rates, and sediment deposition areas;
- soil erosion rates, relevant to exposure of covered wastes;
- locations and sizes of areas of disturbed and undisturbed surface soils in drainages;
- infiltration versus run-off ratios for precipitation and surface releases of liquids;
- presence and effectiveness of clay soil horizons in retarding infiltration;
- presence and effectiveness of fracture-filling materials in retarding infiltration; and
- fate of infiltrating water on mesa tops and in canyons (springs, alluvial or perched aquifers, evapotranspiration).

4.1.4.1. Surface Water Run-off

Run-off in the ephemeral streams of the Pajarito Plateau occurs due to effluent releases, summer thunderstorms, and spring snowmelt. Effluent releases result in flow along limited stream segments. Run-off from summer storms reaches a maximum discharge in less than 2 hours and has a duration generally less than 24 hours. The high discharge rate carries large masses of suspended and bed sediments for long distances that may include the full stream length. Spring snowmelt occurs over a period of several weeks to several months at a low discharge rate. Although the long duration of flow results in the movement of significant masses of suspended and bed sediments, the mass transported by snowmelt run-off is small compared to that carried by summer run-off events (Purtymun et al. 1990).

4.1.4.1.1. Mesa Top Run-off

Surface run-off from DP Mesa would enter either Los Alamos Canyon (to the south) or DP Canyon (to the north). Storm run-off for DP Canyon during the period May 29 to September 26,

1967, was 343.5 m^3 (12,128.8 ft^3) with a sediment load of 453.9 metric tons (500.3 tons) (Hale 1968). The drainage area was estimated to be 152.8 ha (377.6 ac) (Hale 1968). This area would have included the portion of TA-21 draining to DP Canyon and the areas on Middle Mesa to the north and west that drain to DP Canyon.

Other data on naturally occurring surface run-off from mesa tops at Los Alamos are lacking. Experimental data from a rainfall simulator study at TA-51, approximately 5 miles south of TA-21 (Nyhan et al. 1984; Nyhan and Lane 1986) indicate that run-off is more than three times greater from an area of backfilled soil than for natural, vegetated soil.

Data needs. Mapping of disturbed and undisturbed soil areas, drainage areas and channels, and estimates of erosion and sediment transport rates are needed. These data needs are discussed further in conjunction with the surface water run-off pathway in Chapter 5.

4.1.4.1.2. Canyon Run-off

DP Canyon. DP Canyon heads on the Pajarito Plateau and is 2.4 km long above its juncture with Los Alamos Canyon. The drainage area of the canyon is approximately 1.6 km^2, of which approximately 0.5 km^2 is developed area. Channel gradient in the upper 1.6 km of the Canyon is 19 m/km. In contrast, the lower 0.8 km reach of the Canyon is deep and narrow with a channel gradient of 144 m/km. The stream flow in DP Canyon is intermittent, consisting of industrial and sanitary effluent and storm water run-off. Only during storm run-off in DP Canyon does surface flow reach Los Alamos Canyon.

Over the period of May through September 1967, storm run-off and sediment transport were measured at the mouth of DP Canyon (Purtymun 1974). There were 23 run-off events during the period of study. The mean discharge ranged from 6 to 111 L/sec; while run-off ranged from 80 to 9000 m^3. The storm run-off of 36,800 m^3 that occurred over the 5-month study transported approximately 88,000 kg of suspended sediment out of the canyon.

Los Alamos Canyon. Los Alamos Canyon drainage area extends to the drainage divide on the Sierra de los Valles and enters the Rio Grande to the east near Otowi. Surface flow in the canyon across the Pajarito Plateau is intermittent. During the summer, storm water run-off in Los Alamos Canyon occasionally reaches the Rio Grande. For the reach of Los Alamos Canyon's intermittent flow across the Pajarito Plateau above Pueblo Canyon, the peak discharge in the active channel (3.99 m^3/sec) is greater than the estimated 2-year flood (2.83 m^3/sec) (Lane 1985). The average peak discharge of out-of-bank flow exists for the period 1943 to 1980 and is

estimated to be 10.87 m^3/sec; and the maximum peak discharge for out-of-bank flow is 25.53 m^3/sec.

The transport of radionuclides in suspended sediments during run-off is discussed in Sec. 5.2.2.2.

Data needs. Run-off and sediment transport in Los Alamos and DP Canyons have been studied for a number of years. The available data are sufficient for the TA-21 OU. Whether additional data are required will be re-evaluated under the Canyons' Assessment Task (ADS 1049).

4.1.4.2. Surface Water Infiltration

The context of infiltration information is important as differences may exist for the following types of situations:

- infiltration of precipitation (or surface liquid releases) through native soils;
- infiltration in areas where the native soil profile has been destroyed, replaced or removed; and
- infiltration of liquids from releases occurring deeper in the geologic profile (e.g., liquid waste pits or leaking sumps excavated into the tuff).

Studies summarized in several IWP sections indicated that for native soil profiles infiltration of water into the tuff bedrock is not a significant mechanism for the movement of contaminants. Even with the prolonged presence of a water source, the transfer of moisture to the tuff is limited. Strong evaporative potential coupled with transpiration in vegetated areas quickly removes water from the soil and upper tuff profiles.

- IWP Sec. 2.6.3.1.2, Movement of Fluids Through Tuff, notes that much infiltrating water is quickly lost through evapotranspiration, that a natural clay layer in native soil profiles may form an infiltration barrier, and that clay filling of joints and fractures in the tuff may inhibit infiltration.
- IWP Sec. 2.6.3.3.1, Pit Infiltration Studies, reports a study in which a continuous supply of water to a pit dug in soil above the natural clay layer did not significantly increase the moisture content of the underlying tuff.
- IWP Sec. 2.6.3.4.2, Fracture Orientation Patterns, describes jointing and fracturing of the tuff and notes that many joints are filled with caliche, brown clay, or limonitic material that can block flow along fractures.
- IWP Sec. 2.6.3.4.3, Moisture Studies, indicates that little precipitation passes through undisturbed soil profiles, whereas a greater amount of infiltration penetrates to the tuff in areas where the soil has been disturbed. Moisture from single storm events has been found to penetrate as deep as 6.5 ft through disturbed fill, but is rapidly depleted by evaporation. Seasonal

moisture fluctuations were detected both in the bedrock tuff and in fill to depths of 13 ft. A downward moisture flux can be identified at that depth in fill but not in the tuff bedrock.

- IWP Sec. 2.6.3.4.6, Vadose Zone Studies, indicates that precipitation moisture does not penetrate deeper than 10 to 22 ft into tuff.

Studies of water balance where the native soil profile has been destroyed are being conducted as part of capping design pilot studies at Material Disposal Areas (MDAs) B, F, and G at the Laboratory.

Data needs. Moisture profiles in soil and tuff at TA-21 in areas of present and historical liquid releases to evaluate infiltration depths.

4.1.5. Alluvial Aquifers

IWP Sec. 2.6.4, Geohydrology of Canyon Surface Waters and Alluvial Aquifers, discusses alluvial aquifers in the canyons of the Pajarito Plateau on a canyon-by-canyon basis. Surface water infiltration creates these small, localized saturated zones in the alluvial fill of the canyon bottoms. Water infiltrates through the alluvium until the downward movement is impeded by the less permeable tuff. Depletion by evapotranspiration and movement into the underlying rock limits the size of the alluvial aquifers. These aquifers are of interest because of the following issues:

- Contaminated surface water recharging an alluvial aquifer may be stored in the canyon system and be available for uptake by biota.
- The alluvial aquifers are potential zones for infiltration into the underlying tuff and are sources of water that could move toward the much deeper main aquifer.

An alluvial aquifer occurs in Los Alamos Canyon from its upper reaches to below the confluence with DP Canyon and is monitored by several wells (see Chapter 5). The alluvial aquifer in Los Alamos Canyon is described in IWP Sec. 2.6.4.4.2. It is not known if an alluvial aquifer occurs in DP Canyon, although it is likely that at least a limited zone of saturation would occur there particularly because effluent enters the canyon from the sewage treatment plant.

Data needs. Determine if an alluvial aquifer exists in DP Canyon, because if present, it may be contaminated. If it is contaminated, it could serve as a potential pathway for biotic uptake or for downward movement of contaminants. These data needs are discussed in the context of pathways in Chapter 5.

4.1.5.1. Perched Aquifers

Perched water aquifers exist in the basalts and sediments in two canyon systems in their lower reaches below the Bandelier Tuff, as described in IWP Sec. 2.6.5, Perched Water. Neither area is close to the TA-21 OU. However, perched water has been found at depths of 117 ft in Test Well 2 and about 253 ft in Otowi 4. A clay layer 5- to 10-ft thick in the upper conglomerate layer of the Puye Conglomerate is probably responsible for this perched zone. These boreholes are near TA-21 as shown in Fig. 4.1-5. No occurrence of perched water within the Bandelier Tuff has ever been identified.

Data needs. Assess all boreholes placed during site characterization for evidence of perched water within the Bandelier Tuff. Perched water may be of concern as a potential migration pathway as detailed in Chapter 5.

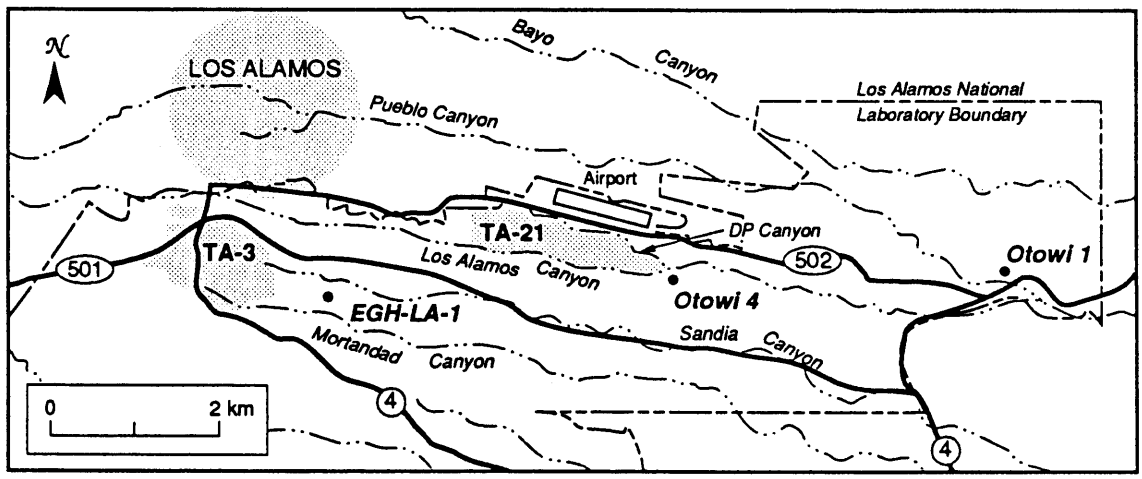


Fig. 4.1-5 Deep well locations near TA-21.

4.1.6 Springs

During reconnaissance geologic work around DP site in May 1990, a previously undescribed cold spring was discovered discharging from the north wall of DP Canyon, about 1 km from DP site (see Fig. 4.1-2). Based on established vegetation, the spring is estimated to be at least 10 years old. The discharge occurs at the contact of colluvium of tuff resting on an old erosional surface cut into the upper Bandelier Tuff. The origin of the discharging water is not known. Elevated tritium concentrations in the water indicate a potential hydraulic connection to liquid discharges

from the sewage treatment plant at TA-21, although the path of the connection is not clear because the spring is on the opposite side of the canyon from TA-21. It is remotely possible that flow crosses the canyon floor on a low-permeability surface and emerges at the spring.

Data needs. Determine whether other springs are present at the TA-21 OU. Define hydraulic corrections of springs to alluvial aquifers, perched aquifers, or effluent discharges. Why these data are needed is discussed in the context of potential migration pathways in Chapter 5.

4.1.7. Geology

The geologic setting of the Pajarito Plateau is described in Sec. 2.6.2 of the IWP. As illustrated in Figs. 4.1-6 and 4.1-7, TA-21 is situated on the Bandelier Tuff, which includes (from top to bottom) the Tshirege, Cerro Toledo, Otowi, and Guaje members. These units are volcanic ash flows and ash falls. Depending on the nature of the deposit, the rock varies from loose pumice to hard, highly welded tuff. Degrees of welding vary within the individual units depending on the conditions of deposit and cooling.

The volcanic ash deposits are underlaid by the sediments of the Santa Fe Group (Puye and Tesuque Formations) and basalt flows (basaltic rocks of Chino Mesa). The geologic sequence below the Bandelier Tuff at the TA-21 OU may be complex because of its location on the Pajarito Plateau and may vary rapidly over short distances.

Knowledge of the geology beneath the TA-21 OU is of importance because it is believed that this geologic setting provides substantial impedance to contaminant migration. There is approximately 1150 feet of volcanic and sedimentary materials between the contaminant-bearing units and groundwater. Geological aspects of interest include

- the detailed stratigraphy of the upper units of the Bandelier Tuff, specifically the erosional surfaces or other contacts between units that may form barriers to migration or create paths to divert the path of liquid or vapor movement;
- joints in the Bandelier Tuff that may provide paths for liquid and vapor movement;
- the mineralogy of the geologic strata that may be important in the retardation of contaminant movement; and
- faulting within the upper units of the Bandelier Tuff that may provide zones of fracturing along which contaminant transport may be enhanced.

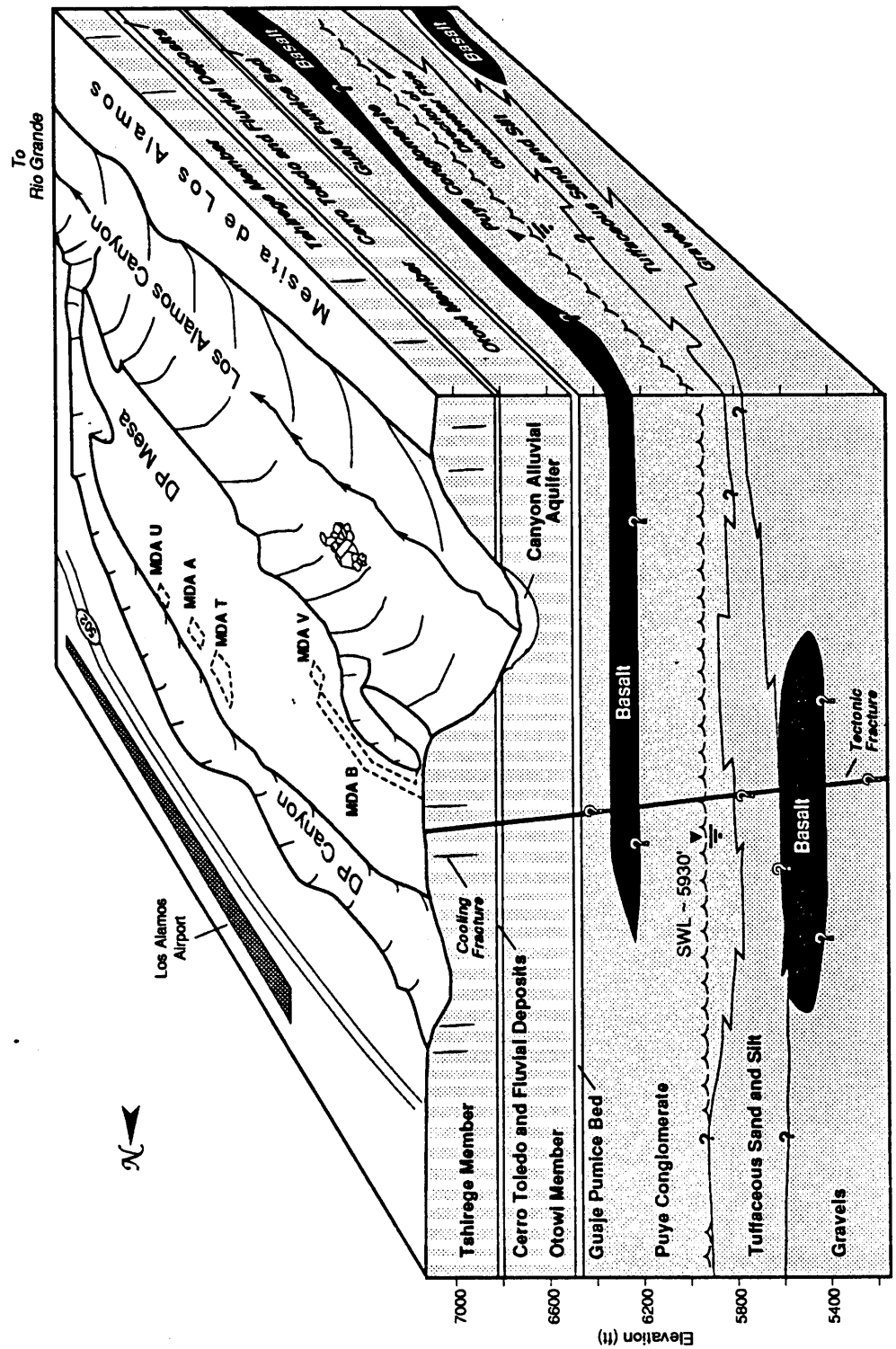


Fig. 4.1-6 Generalized geologic block diagram of TA-21.

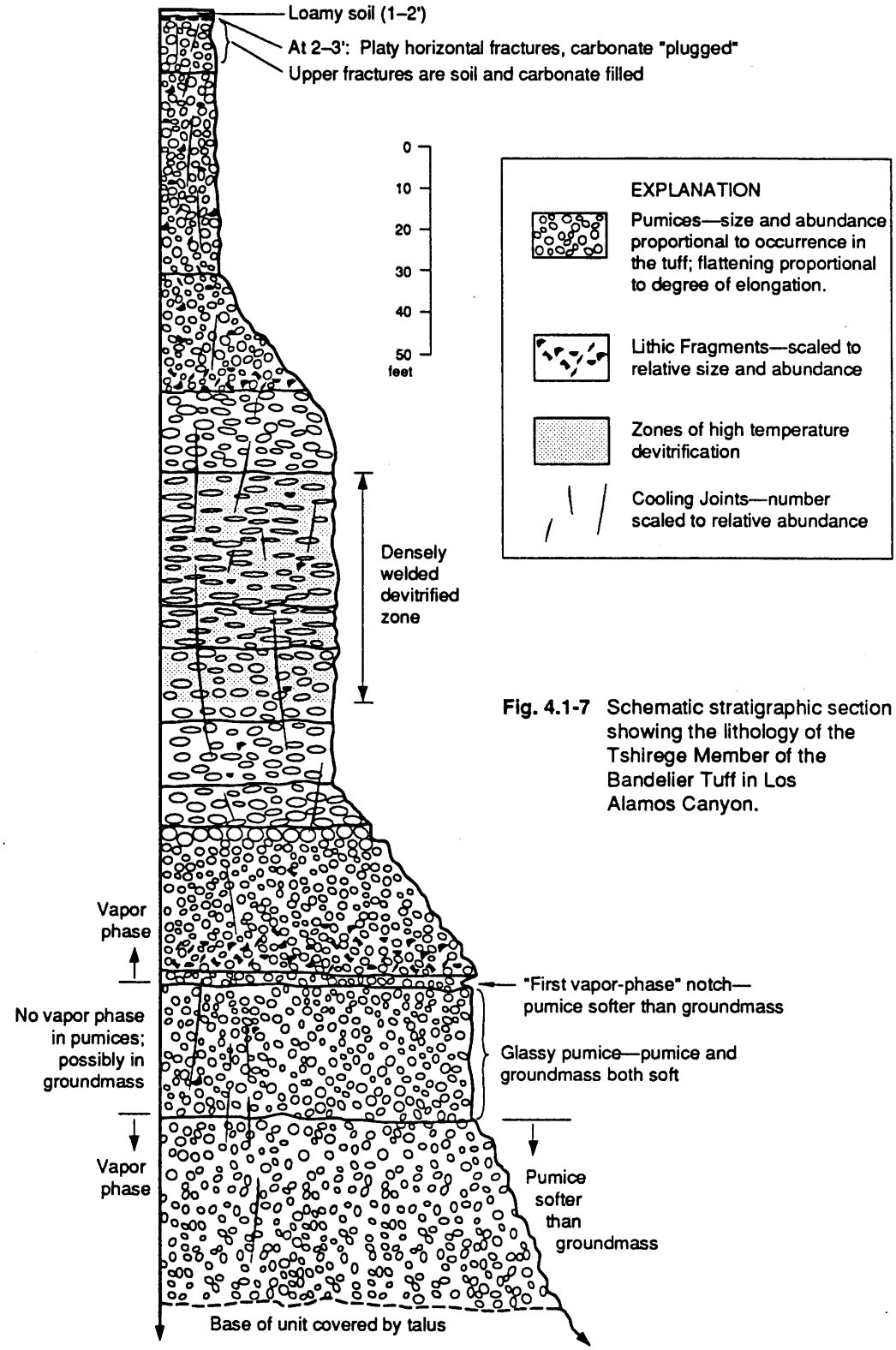


Fig. 4.1-7 Schematic stratigraphic section showing the lithology of the Tshirege Member of the Bandelier Tuff in Los Alamos Canyon.

The following discussions are specific to the geology in the immediate vicinity of TA-21 and are confined to those rock units in the vadose zone and the upper saturated zone that are considered relevant to site characterization and potential contaminant movement.

4.1.7.1. Stratigraphy

General stratigraphy for the Laboratory is discussed in IWP Sec. 2.6.2.2. The stratigraphy in the area of TA-21 is given in Table 4.1-I, including anticipated depths of stratigraphic contacts and thicknesses of rock units. No boreholes at TA-21 have penetrated to depths greater than 100 ft. The stratigraphy of the upper rock units at TA-21 can be observed directly in excellent exposures of outcrops on canyon walls and slopes surrounding the site.

The interpretation of the subsurface is based on data from three deep wells relatively close to TA-21, from regional exposures to the north and east, and from regional geologic maps. The three wells include: EGH-LA-1 located west of TA-21 on Sigma Mesa; Otowi 4 located east of TA-21 at the confluence of DP and Los Alamos Canyons: and Otowi 1 located further east at the intersection of State Roads 502 and 4 (Fig. 4.1-5). Figure 4.1-8 shows the stratigraphy and lithologies of rock units encountered in the deep wells, based on preliminary interpretations.

Significant differences in unit depths and thicknesses may be found, particularly for the lower sedimentary units, because of TA-21's location on the eastern edge of the Pajarito Plateau. Factors that may affect the geometry of subsurface units include rapid lateral and vertical facies variations in the lower sedimentary rock units, significant relief on paleotopographic surfaces on which rock units were deposited, and fault offsets in the older sedimentary units that are masked by the younger volcanic rocks that show little or no displacement.

Individual flow units in the Bandelier Tuff contain vertical and horizontal cooling joints. The vertical joints may or may not cross flow-unit boundaries. Cooling-joint spacings vary primarily with the thickness of the unit, its emplacement temperature, the substrate temperature at the time of placement, and topography (Crowe et al. 1978). The locations and relative abundances of cooling joints in the Tshirege Member are indicated schematically in Fig. 4.1-7.

Data needs. Use stratigraphic exposures to map upper units of the Bandelier Tuff. Assess boreholes drilled during site characterization activities to identify and describe stata in upper units of the Bandelier Tuff. Identify and characterize unit boundaries in the context of presenting barriers to vertical contaminant movement or preferential horizontal flow paths. Evaluate the frequency and nature of joints within the tuff, again with regard to migration paths.

TABLE 4.1-I
ESTIMATES OF STRATIGRAPHIC THICKNESS 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 units dominated by dacite clasts from Tschicoma Formation.
290-310	88-94	Otowi Member, 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.
940	287	Puye Formation: Grey 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 to north; may contain interbedded flows of Cerros del Rio basalts and Tschicoma Formation dacite; may be interbedded with Puye Formation.

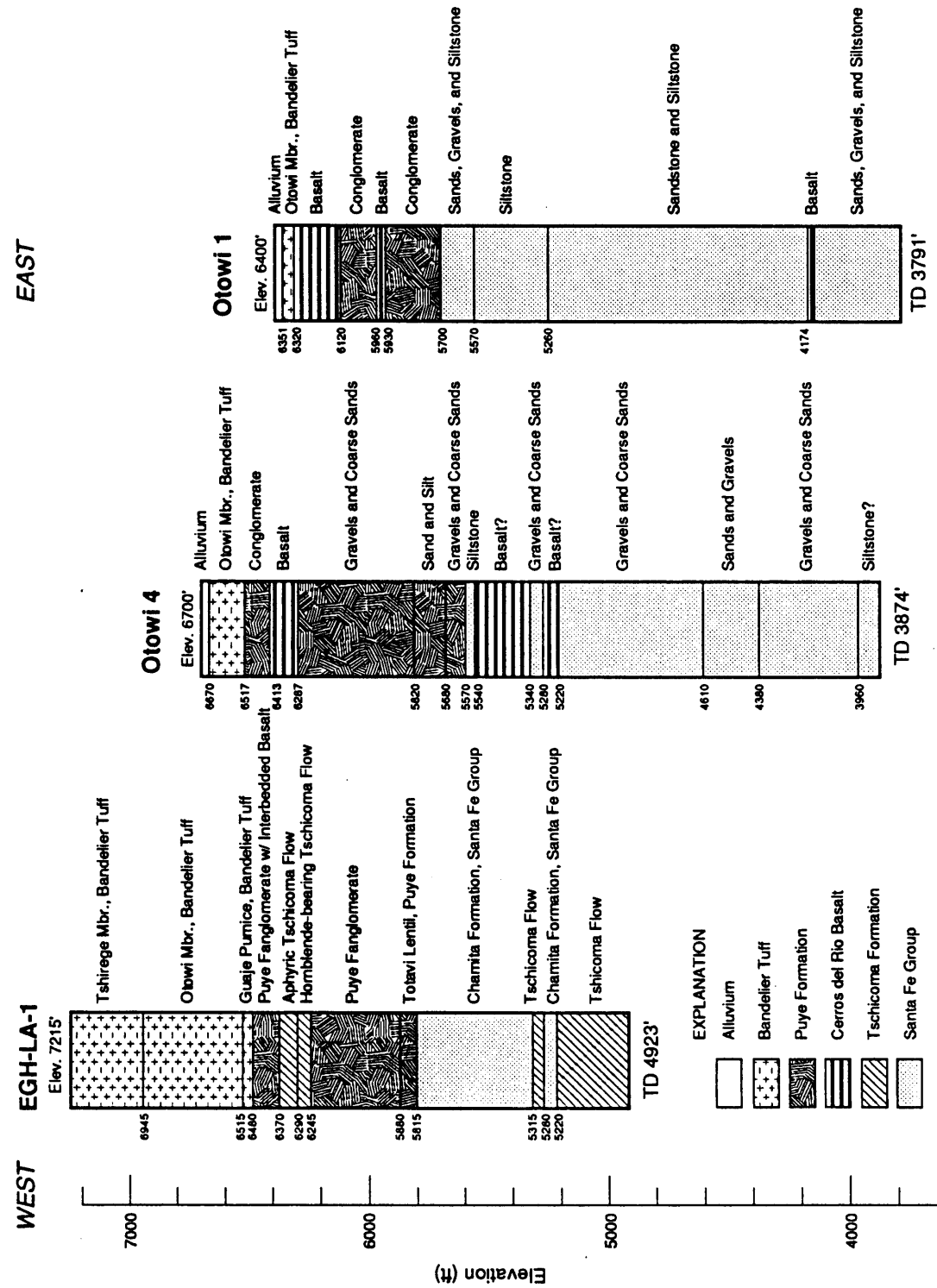


Fig. 4.1-8 Lithologic logs for deep wells near TA-21.

4.1.7.2. Faulting and Seismicity

Sec. 2.6.2.4 of the IWP discusses faulting and seismic activity for the area of the Laboratory. The Pajarito Plateau is within the Espanola Basin of the Rio Grande rift. The western edge of the Pajarito Plateau is marked by the Pajarito Fault system (Fig. 4.1-9), which also forms the western margin of the Espanola Basin. The Pajarito Fault system has had Holecene movement and historic seismicity (Gardner and House 1987).

The Guaje Mountain and Rendija Canyon Faults (Fig. 4.1-9) displace the surface of the Bandelier Tuff west of DP Mesa. Where exposed to the north, these faults are characterized by zones of gouge and breccia up to several meters wide and produce visible offset of stratigraphic horizons. To the south, the discreet faults are replaced by zones of intense fracturing superimposed on the network of cooling joints in the Bandelier Tuff. Interest in the fault systems focuses on the following:

- tectonic fractures that are likely to cross flow-unit and lithologic-unit boundaries (Gardner 1990);
- tectonic fractures that may provide more continuous and deeper penetrating flow paths for water or vapor migration than cooling joints; and
- displacements among deeper stratigraphic units that may present enhanced paths for deep contaminant movement.

Recent mapping for the Laboratory's Seismic Risk Program projects a possible fault through DP Mesa in the vicinity of MDA V (Vaniman and Wohletz 1990). Fracture mapping associated with the Seismic Risk Program has shown that fracture abundances and apertures increase over fault projections. Fracture abundances and apertures also increase towards mesa margins where large blocks tend to shift outwards as the mesa erodes.

Deeper faulting has been identified in the pre-Bandelier Tuff surface beneath the Pajarito Plateau (Dransfield and Gardner 1985). If deep migration of any contaminants is discovered, characterization activities would then be needed to determine if these faults are significant in the distribution of subsurface geologic units and/or influence transport pathways and migration mechanisms.

Data needs. Assess data from boreholes drilled during site characterization for evidence of the presence of tectonic fractures in the area of MDA V. If such fractures are found, assess their effect on contaminant movement.

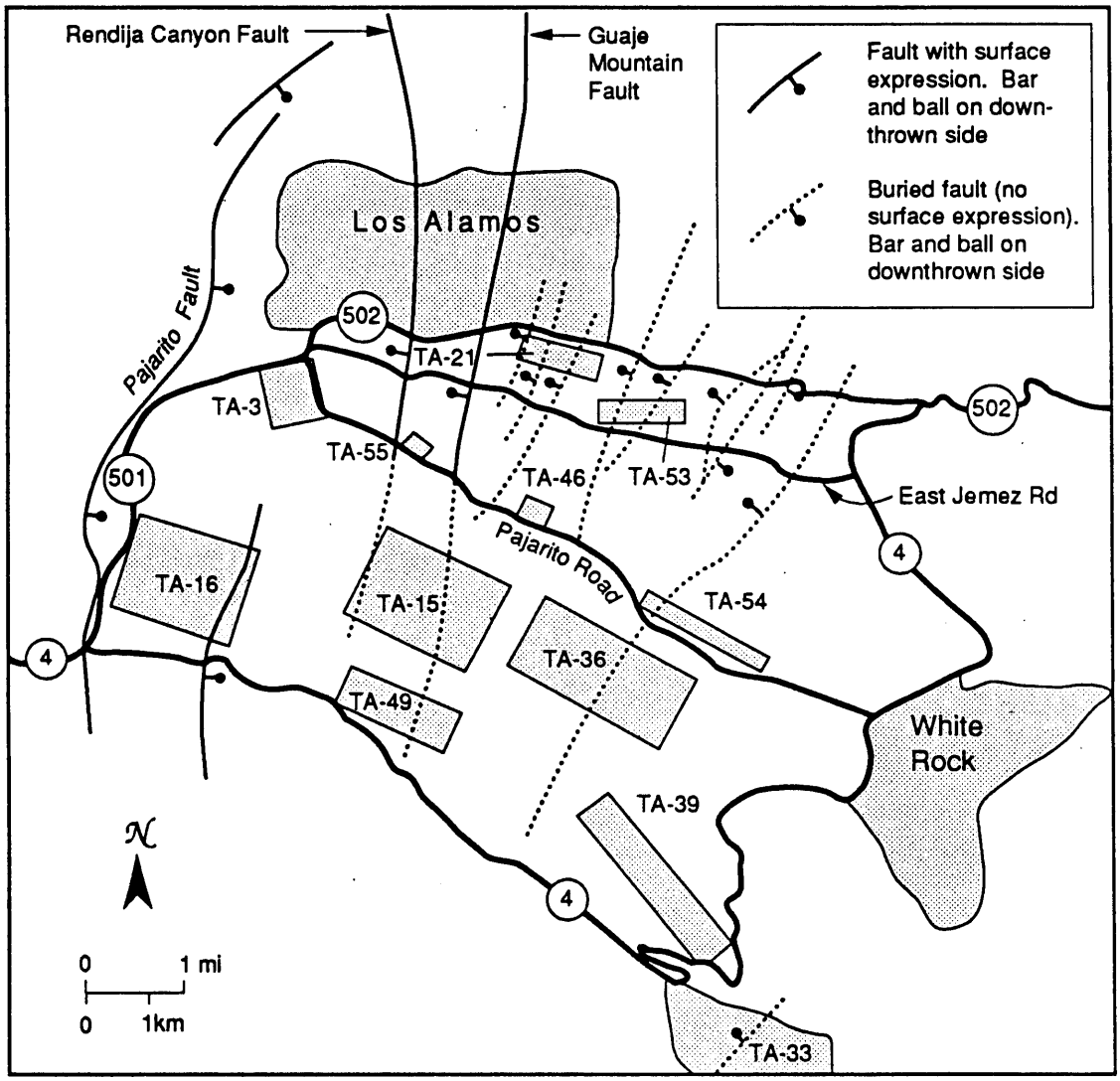


Fig. 4.1-9 Faults at selected Laboratory Technical Areas, Los Alamos, White Rock, and major roads (modified from Dransfield and Gardner 1985 and Gardner and House 1987).

4.1.8. Vadose Zone Hydrology

The hydrology of the unsaturated zone of the Pajarito Plateau is discussed in IWP Sec. 2.6.3, Geohydrology of Mesa Tops and Vadose Zone. It includes discussions of the hydrogeologic properties of the tuff and the movement of fluids through the tuff and describes related studies that have been conducted at the Laboratory The summary of the studies provides strong support for the concept that the unsaturated zone of the Bandelier tuff provides substantial impedance to the movement of liquid in the subsurface.

Detailed understanding of the vadose zone at TA-21 is important because it is believed to be the primary barrier to the movement of liquids and vapors originating from the SWMUs. Features of the unsaturated zone that are of interest include

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

For a depth of more than 1000 ft, the subsurface hydrology at TA-21 is dominated by unsaturated flow conditions. The top of the saturated zone occurs approximately 350.5 m (1,150 ft) below the surface of the mesa, and most of this distance, 243.8 m (800 ft), is in the Bandelier Tuff. Hydrologic characterization of the Bandelier Tuff has concentrated on the top 30.5 m (100 ft) throughout most of the Laboratory (Abrahams 1963; Abeele et al. 1981; Kearl et al. 1986). The same holds true for TA-21. The following subsections present some information useful in assessing movement of water and vapors in the unsaturated zone.

4.1.8.1. Properties of Tuff

Hydrogeologic properties of tuff such as porosity, permeability, moisture content, hydraulic conductivity, and moisture characteristic curves are required for hydrogeological modeling of vadose zone contaminant movement. Most available data are for crushed tuff; little data on *in situ* properties are available.

Porosity. The various units of the Bandelier Tuff tend to have relatively high porosities. Porosity ranges from 30 to 60% by volume, generally decreasing for more highly welded tuff (IWP Sec. 2.6.3.1.1, Hydrogeologic Properties of Tuff). The effective porosity ranges from 18 to 52%, indicating the interconnected or fluid-accessible porosity (Purtymun et al. 1990). No TA-21 porosity data are available.

Permeability. Permeability refers to the movement of a fluid through porous or fractured media. Permeability varies for each cooling unit of the Bandelier tuff. Values for the Tshirege member of the Bandelier tuff at TA-54, determined using *in situ* vacuum and water injection tests and laboratory analyses of cores range from 0.1 to 0.6 Darcies (Kearl et al 1986; Stoker and McLin 1990). No TA-21 specific data are available.

Moisture Content. The moisture content of native tuff is low, generally less than 5% by volume throughout the profile (IWP Sec. 2.6.3.1.1 Hydrogeologic Properties of Tuff). Previous studies at TA-21 disposal areas where liquid has been added have shown that moisture content changes little below 40 ft (Abrahams 1963; Christenson and Thomas 1962). Water content data are unavailable below 100 ft. The specific retention of the tuff ranges from 18 to 38% by volume, indicating a considerable field capacity for holding moisture (Purtymun et al. 1990).

Hydraulic Conductivity. Hydraulic conductivity is the term used to quantify the permeability of the medium. It is dependent on the porous medium and the fluid. Saturated tuff has a hydraulic conductivity in the range 0.02 cm/hr for welded tuff to 1.12 cm/hr for nonwelded tuff (IWP Sec. 2.6.3.1.1 Hydrogeologic Properties of Tuff, [Purtymun et al. 1990]). Laboratory saturated hydraulic conductivity measurements from cores at MDAs T and V range from 0.16 to 1.10 cm/hr (Abrahams 1963; Nyhan et al. 1984). *In situ* hydraulic conductivity values for TA-54 range from 1.63 to 4.44 cm/hr using air injection and vacuum tests, respectively (Kearl et al. 1986).

The hydraulic conductivity of unsaturated tuff varies with moisture content and has values two to five orders of magnitude lower than saturated tuff (Purtymun et al. 1990).

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

There have been a considerable number of moisture characteristic determinations on crushed Bandelier tuff (Abeele 1984; Abeele et al 1986). A question remains concerning the applicability of crushed tuff data to intact tuff. Abrahams (1963), comparing core and cuttings values from

MDA T at TA-21 concluded that cuttings could not be used to determine physical properties other than the water content at one-third bar. Similar results were found by Kearl et al. (1986). Little *in situ* moisture characteristic data are available, particularly for low water contents generally found in tuff.

Hysteresis. The moisture characteristic curve is hysteretic, meaning that it has a different shape when soil is wetting than when it is drying. If a system exhibits significant hysteresis, the time history of wetting and drying will be required in order to predict pressure head from water content values. Abrahams (1963) found that MDA T samples exhibited hysteresis. For example, the difference in water content at the 333-cm pressure head for this sample was a value of 0.22 on the wetting curve versus 0.14 on the drying curve.

Data Needs. Laboratory and *in situ* measurements of hydrogeological properties of tuff at the TA-21 OU are needed.

4.1.8.2. Injection Well Study.

The hydrologic characteristics of the Bandelier Tuff are presented in a recent report documenting an injection well study conducted in 1964 (Purtymun et al. 1990). The purpose of the study was twofold: first, to investigate the rates and conditions at which the unsaturated tuff would accept water from an injection well, and second, to monitor the movement of fluids from the injection zone into the adjacent tuff. The original intent of the injection well program was to evaluate the tuff as a sorptive medium into which liquid radioactive waste could be injected and be held indefinitely. The injection well disposal technique was never implemented, but the concept of the tuff as a sorptive medium remains valid.

Purtymun et al. (1990) determined that a moderately welded tuff with an effective porosity of about 38% by volume has four different forms of moisture movement as follows:

- No movement of moisture occurs at moisture contents below 6% by volume.
- Fluid movement is governed by diffusion in the moisture range from 6 to about 12% by volume.
- Movement is primarily controlled by capillary forces in the range from about 13 to about 24% by volume. In the higher end of this range gravity begins to supplement capillary forces.
- For 24 to 38% moisture by volume, gravity dominates as the moisture moving force.

During the injection well tests, it was found that considerable injection pressure was required to continuously inject water. It was found that tuff near the well became saturated, but further from the well the three, slower, unsaturated-flow mechanisms dominated and resisted the rapid movement of fluid that was possible in the saturated zone. Further it was found that when injection ceased, the zone of saturation was gradually depleted as unsaturated flow mechanisms removed the fluid and, with time, the system stabilized at low-moisture contents where further moisture movement was minimal (Purtymun et al. 1990).

Two aspects of this description are important. First, the unsaturated tuff effectively resists the rapid influx of water. This may supplement the clay layer in the lower soil profile as an explanation of the low observed precipitation infiltration rates. Second, fluids accepted by the tuff may not be rapidly transmitted downward through the tuff but may rather be retarded and dispersed in the tuff near the point of infiltration.

Data needs. None.

4.1.8.3 Zones of High Moisture Content

The presence of joints, fractures, and erosional surfaces at unit contacts within the tuff raises issues of potential fracture flow, interception and diversion of vertical flow by less permeable horizontal surfaces, enhanced flow across unit boundaries in tectonic fracture systems, or channel flow controlled by fractures or contacts.

In contrast to the results of the injection study discussed above, which suggests water does not move downward in the tuff, moisture measurements in boreholes in a number of investigations have identified discrete zones of higher moisture content beneath liquid waste disposal pits. Two examples can be seen in Figs. 4.1-10 and 4.1-11.

Figure 4.1-10 shows data collected from 1959 through 1961 at TA-21 MDA V beneath pit 3. The high-water contents at 33 ft in Hole 1 and at 20 to 25 ft in Hole 2 were believed to be a function of low-permeability layers that "perch" water (Abrahams 1963). (Note: these moisture contents are below saturation, and the above statement does not imply a "perched aquifer" similar to that discussed above in Sec. 4.1.7.)

Figure 4.1-11 shows data collected in 1978 at TA-21 MDA T, directly through and beneath absorption beds 1 and 2. The moisture contents were measured gravimetrically, and the zones of high-moisture content were correlated with a clay unit and with permeability zones or contacts that may divert water (Nyhan et al. 1984).

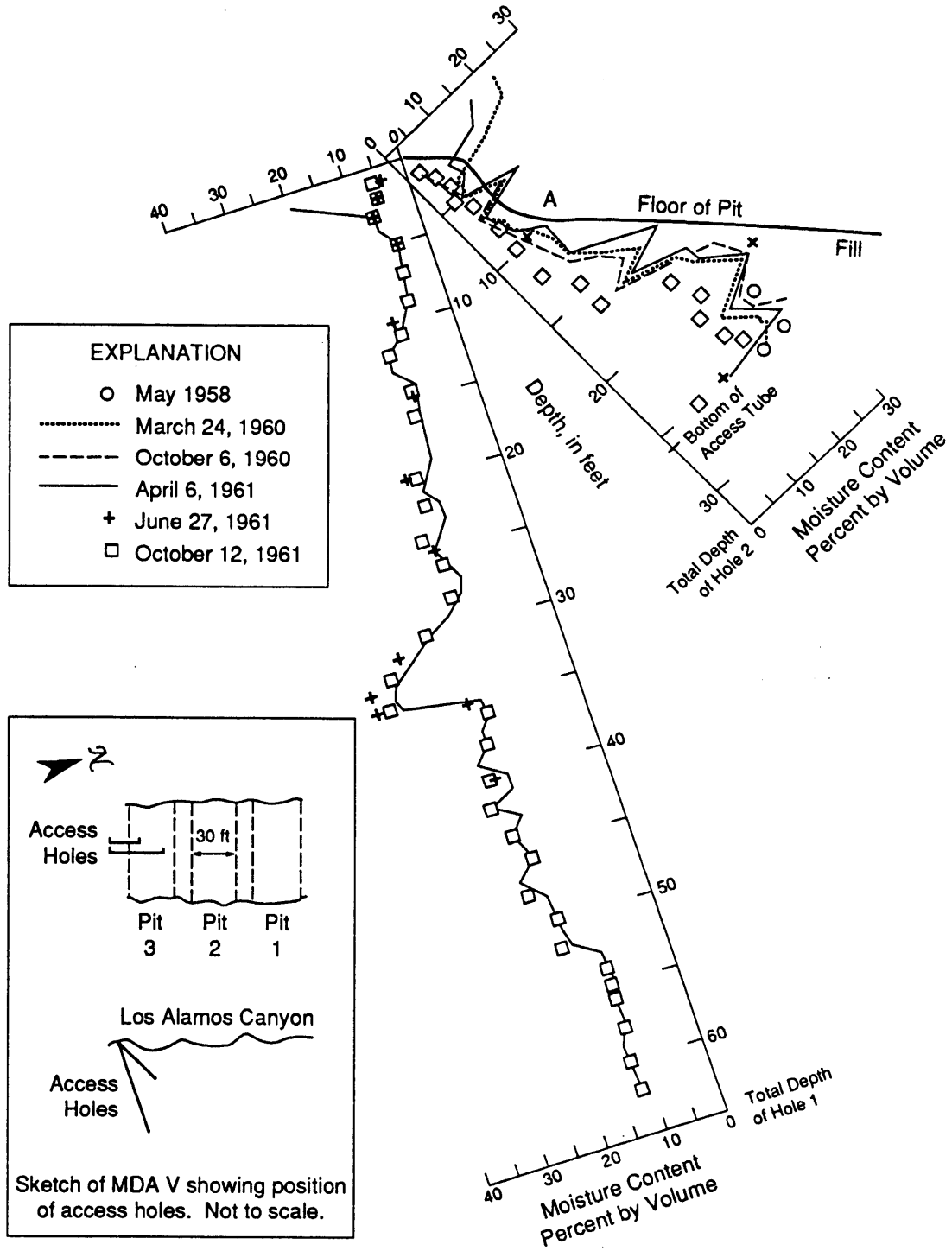


Fig. 4.1-10 Moisture content of tuff beneath the disposal pit at MDA V, Pit 3 (Abrahams 1963).

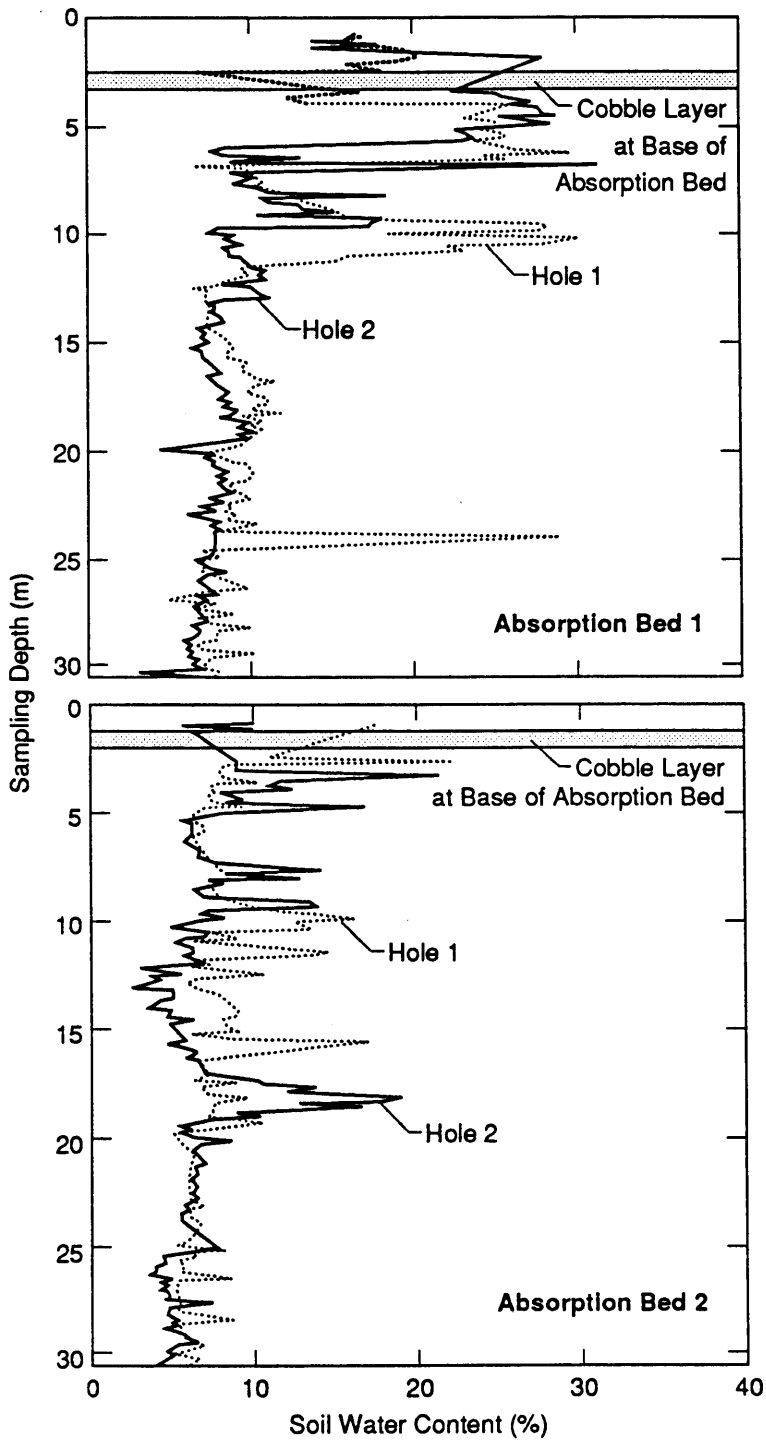


Fig. 4.1-11 Gravimetric soil water content as a function of sampling depth for MDA T absorption beds 1 and 2 in 1978 (Nyhan 1984).

Data Needs. Assess moisture content correlations with geologic features and material properties in boreholes drilled during site characterization.

4.1.9. Saturated Zone Hydrology

IWP Sec. 2.6.6, Hydrology of the Main Aquifer, describes the main aquifer beneath the Pajarito Plateau. As indicated in Fig. 4.1-5, the surface of the aquifer lies in the sediments well below the base of the Bandelier Tuff. Figure 4.1-12 shows the regional aquifer surface contours (Purtymun and Johansen 1974). The depth to the aquifer beneath TA-21 is not precisely known but is estimated to be approximately 1150 ft. While general flow of the aquifer is from recharge areas in the Jemez Mountains on the west toward the Rio Grande on the east, the exact groundwater flow direction beneath TA-21 is not known.

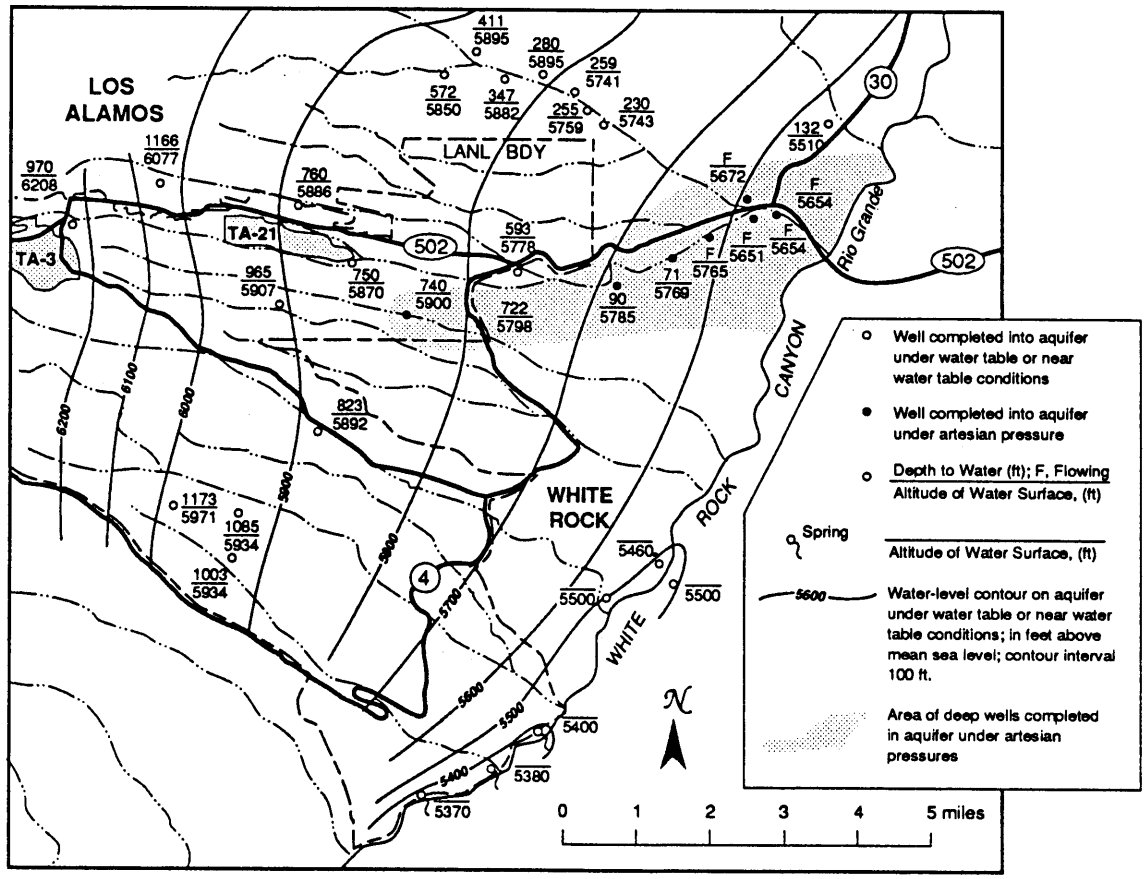


Fig. 4.1-12 Generalized contours on top of main aquifer (Purtymun and Johansen 1974).

Water quality in the main aquifer, based on samples from all wells and springs is discussed in Sec. 4.2, below. No evidence of any Laboratory-related contamination has ever been detected in the main aquifer. Sampling of the main aquifer in immediate proximity to TA-21 has not been done, and in the absence of evidence of contaminant migration through the more than 1000 ft of overlying vadose zone, there is no compelling reason to do so.

Data needs. None, unless deep contaminant migration is identified during site characterization.

4.2 Background Environmental Data

This section presents a summary of environmental data representing the natural, or background, conditions for surface and groundwater, air, soil, and radioactivity in the region surrounding the TA-21 OU. These data are presented for comparison to analysis results on samples from individual SWMUs and from the general vicinity of TA-21. These data are tied to potential migration pathways in Chapter 5 and to potential receptors in Chapter 6.

This summary is also used to identify gaps and weaknesses in the existing set of background data. Some of the identified data needs will be addressed in the RFI work plan. Others will be used as input for planning a Pajarito Plateau background study, planned in support of the ER Program Laboratory-wide.

4.2.1. Sources of Information

Three categories of information sources have been used to develop this summary of background environmental data as follows:

- the Laboratory's environmental monitoring network (described below), which includes perimeter stations and regional stations that are uninfluenced by Laboratory operations;
- special studies conducted at the Laboratory and in the region, which address environmental data in areas unaffected by Laboratory operations; and
- general environmental literature addressing concentrations of chemicals, elements, and radionuclides in natural systems.

The Laboratory's environmental surveillance program includes 406 stations sampled for various media, as summarized in Table 4.2-I (ESG 1989). Three categories of monitoring stations are defined as follows:

TABLE 4.2-I
NUMBER OF SAMPLING LOCATIONS[a]

Type of Monitoring	Regional	Perimeter	On Site
External radiation	4	12	139
Air	3	11	12
Surface and ground waters[b]	6	32	37
Soil and sediments	16	16	34
Foodstuffs	10	8	11

[a]ESG (1989).
[b]An additional 22 stations for the water supply and 33 special surface and groundwater stations related to the Fenton Hill Geothermal Program were also sampled and analyzed as part of the monitoring program.

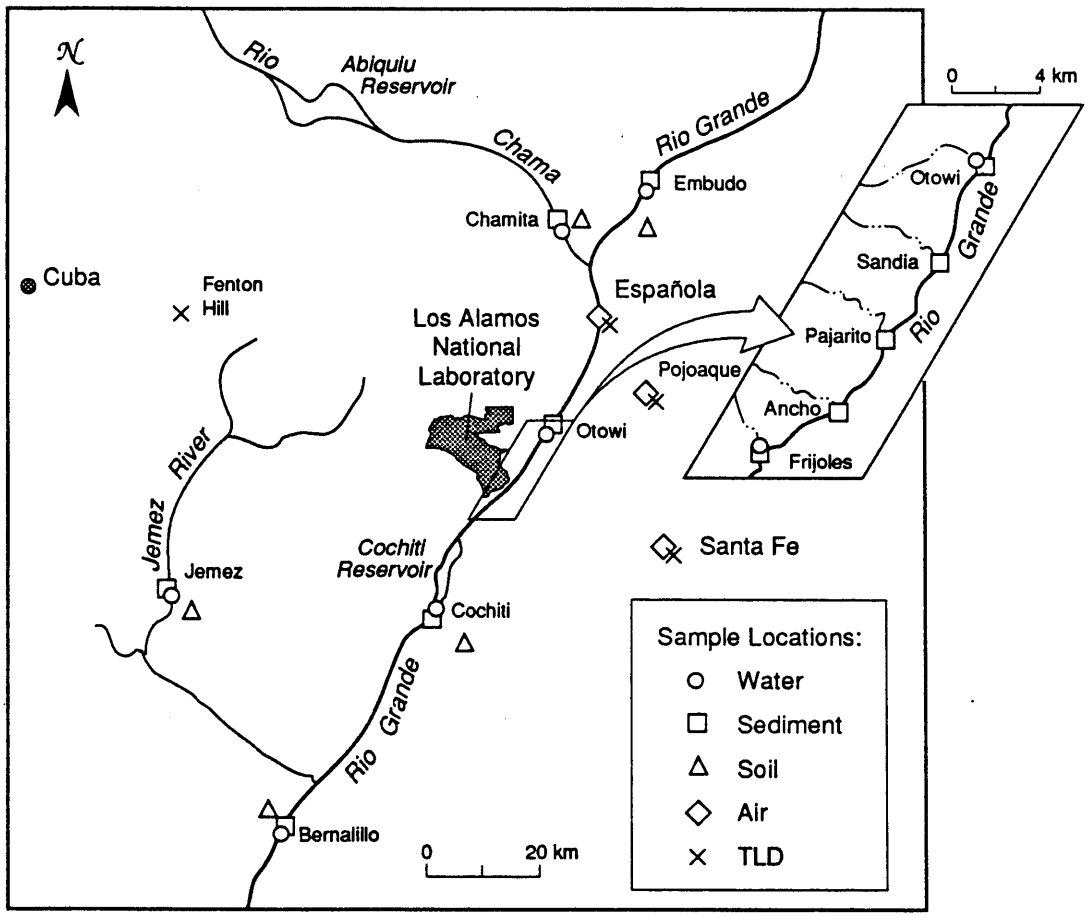


Fig. 4.2-1 Location of regional water, soil, TLD, sediment, and air sampling stations. (Purtymun et al. 1987; ESG 1989)

1. **Regional** stations determine conditions beyond the range of potential influence from Laboratory operations. The regional stations are located within the five counties surrounding Los Alamos County, at distances up to 80 km (50 mi) from the Laboratory (Fig. 4.2-1).

2. **Perimeter** stations are located closer to the Laboratory boundaries. These stations are not expected to be routinely affected by Laboratory operations, although unexpected releases could affect these stations. They are used to confirm that any releases beyond the Laboratory boundary are evaluated and remain minimal (Fig. 4.2-2).

3. **On site** stations are in proximity to Laboratory facilities and monitor the effect of releases close to the source. Data from these stations have not been used in this section. Data from on site stations close to TA-21 are used in the pathways discussions of Chapter 5.

Data collected from regional stations and selected perimeter stations have been included in the summaries in the following sections. Most of the existing environmental data were acquired using standard practices and methods of the day. These data are used in this document solely to guide assessment of available data. These data represent the best available information to describe unimpacted natural conditions for the vicinity of the Laboratory and the TA-21 OU.

The remainder of this section includes tables summarizing data on background concentrations of chemicals, elements, and radionuclides in several environmental media. In addition, background levels for ambient gamma radiation levels are given.

4.2.2. Surface Water

Data from the Laboratory's environmental surveillance program's regional and perimeter stations from 1988 sampling are summarized here as an indicator of background water quality (ESG 1989). For the purposes of this document, the perimeter stations are assumed to include the stations in White Rock Canyon. Also, surface water stations have been assumed to include the springs that are sampled in White Rock Canyon, in addition to streams and reservoirs.

Surface water is collected for analysis at six regional stations within 75 km (47 mi) of the Laboratory. These locations are at US Geological Survey Gaging Stations on the Rio Chama, Rio Grande, and Jemez River (Fig. 4.2-1). Data for 33 perimeter and White Rock Canyon stations are summarized; seven stations represent open surface waters (two reservoirs, four streams, and a sanitary effluent), and 26 are springs (Fig. 4.2-2).

Radionuclides. Tables 4.2-II and 4.2-III summarize the radiochemical quality of surface water from the regional, perimeter and White Rock Canyon stations, and springs in White Rock Can-

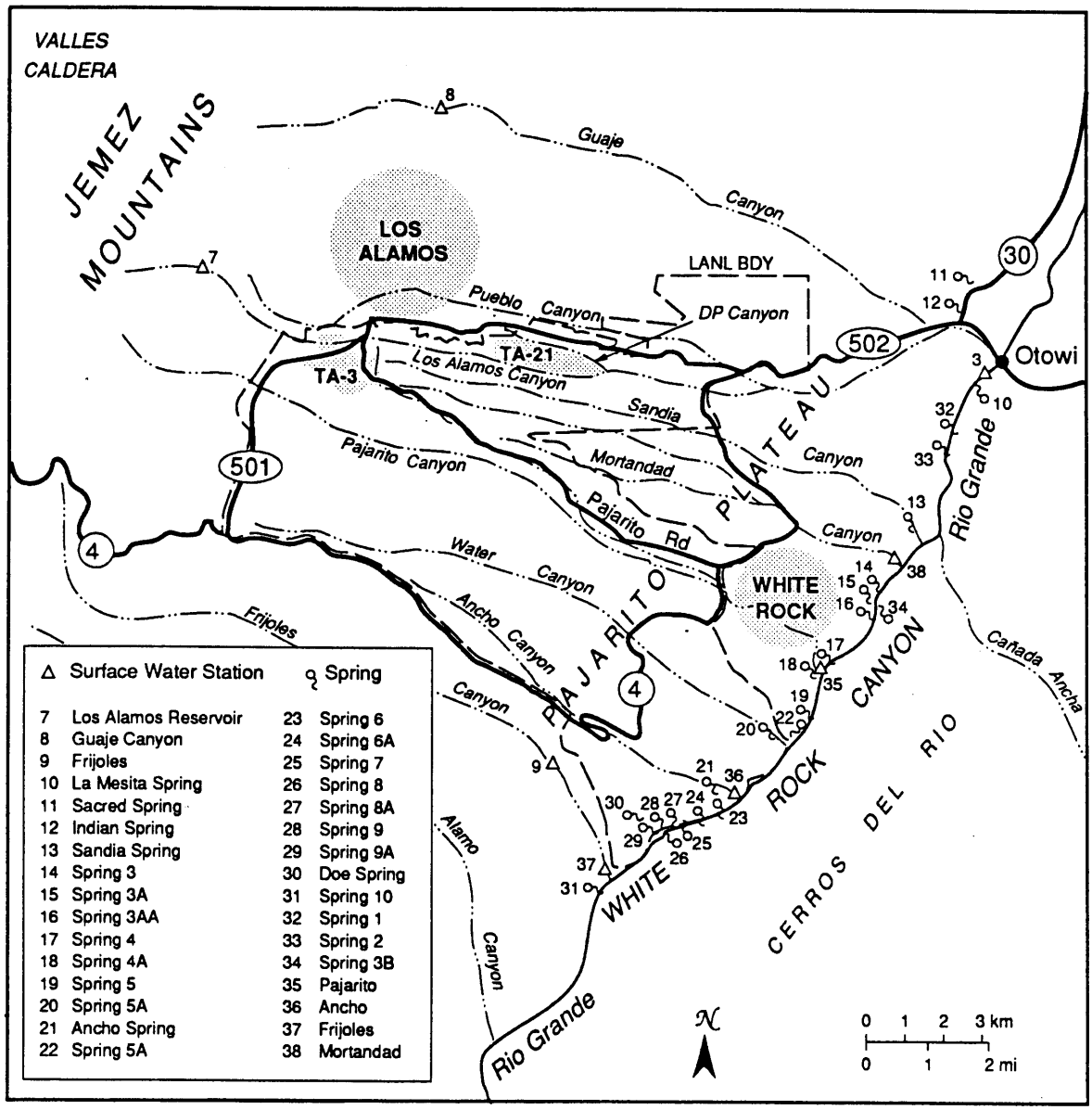


Fig. 4.2-2 Surface water and spring sampling locations on and near the Laboratory site (ESG 1989).

TABLE 4.2-II
RADIOCHEMICAL QUALITY OF SURFACE WATER FROM REGIONAL, PERIMETER, AND WHITE ROCK CANYON STATIONS[a]

Station	Tritium (pCi/mL)	^{137}Cs (pCi/L)	Total Uranium (µg/L)	^{238}Pu (pCi/L)	$^{239/240}Pu$ (pCi/L)
Regional Stations[b]					
Rio Chama					
Chamita	-0.4 (0.3)	86 (68)	2 (1)	0.004 (0.010)	0.000 (0.010)
Rio Grande					
Embudo	0.5 (0.3)	93 (67)	2 (1)	0.017 (0.012)	0.013 (0.010)
Otowi	-0.5 (0.3)	145 (69)	2 (1)	0.011 (0.011)	-0.004 (0.009)
Cochiti	-0.5 (0.3)	-65 (66)	3 (1)	-0.008 (0.012)	0.004 (0.007)
Bernalillo	-0.5 (0.3)	185 (67)	4 (1)	0.011 (0.013)	-0.004 (0.010)
Jemez River					
Jemez	-0.3 (0.3)	1 (59)	1 (1)	-0.009 (0.007)	0.005 (0.012)
Perimeter Stations[b]					
Los Alamos Reservoir	-1.2 (0.3)	77 (60)	1 (1)	0.000 (0.010)	-0.009 (0.010)
Guaje Reservoir	-0.8 (0.3)	6 (60)	1 (1)	0.000 (0.010)	0.007 (0.009)
Frijoles Canyon	-0.7 (0.3)	86 (60)	1 (1)	0.013 (0.016)	-0.008 (0.006)
Streams[c]					
Pajarito	-0.1 (0.3)	101 (62)	1 (1)	-0.004 (0.004)	0.004 (0.010)
Ancho	0.1 (0.3)	47 (69)	1 (1)	0.004 (0.012)	0.012 (0.014)
Frijoles	0.7 (0.3)	-43 (53)	1 (1)	0.000 (0.010)	0.000 (0.010)
Sanitary Effluent[c]					
Mortandad	0.3 (0.3)	47 (67)	1 (1)	0.005 (0.011)	0.024 (0.011)
Limits of detection	0.7	40	1	0.009	0.03

[a]ESG (1989).
[b]Samples were collected in March 1988; counting uncertainty is in parentheses.
[c]Samples were collected in October 1988; counting uncertainty is in parentheses.

TABLE 4.2-III
RADIOCHEMICAL QUALITY OF SPRING WATERS FROM WHITE ROCK CANYON[a,b]

Station	Tritium (pCi/mL)	^{137}Cs (pCi/L)	Total Uranium (µg/L)	^{238}Pu (pCi/L)	$^{239/240}Pu$ (pCi/L)
Group I					
Sandia Spring	0.2 (0.3)	21 (68)	1 (1)	0.016 (0.018)	0.016 (0.012)
Spring 3	0.2 (0.3)	-111 (66)	1 (1)	0.000 (0.010)	0.000 (0.010)
Spring 3A	0.0 (0.3)	-105 (70)	1 (1)	0.013 (0.016)	0.018 (0.012)
Spring 3AA	-0.1 (0.3)	-82 (67)	1 (1)	0.005 (0.005)	0.000 (0.010)
Spring 4	0.0 (0.3)	0 (60)	2 (1)	0.000 (0.010)	0.000 (0.010)
Spring 4A	0.4 (0.3)	-59 (61)	1 (1)	0.000 (0.010)	0.005 (0.005)
Spring 5	0.1 (0.3)	-5 (62)	1 (1)	0.013 (0.010)	0.000 (0.010)
Spring 5AA	0.8 (0.3)	0 (62)	1 (1)	0.000 (0.010)	0.000 (0.010)
Ancho Spring	0.1 (0.3)	20 (60)	1 (1)	0.026 (0.014)	0.009 (0.011)
Group II					
Spring 5A	0.0 (0.3)	3 (61)	1 (1)	0.000 (0.010)	0.009 (0.007)
Spring 5B	0.2 (0.3)	101 (79)	1 (1)	0.004 (0.008)	0.032 (0.015)
Spring 6	0.2 (0.3)	-82 (55)	1 (1)	0.000 (0.010)	0.005 (0.005)
Spring 6A	0.3 (0.3)	50 (67)	1 (1)	0.004 (0.004)	0.000 (0.010)
Spring 7	0.4 (0.3)	-35 (59)	1 (1)	0.008 (0.006)	-0.004 (0.007)
Spring 8A	0.2 (0.3)	71 (67)	1 (1)	0.010 (0.007)	0.000 (0.010)
Spring 9	-0.4 (0.3)	-15 (60)	1 (1)	0.000 (0.010)	0.000 (0.010)
Spring 9A	0.0 (0.3)	100 (70)	1 (1)	0.015 (0.013)	0.000 (0.010)
Doe Spring	0.2 (0.3)	—	1 (1)	-0.004 (0.004)	0.004 (0.008)
Group III					
Spring 1	0.1 (0.3)	65 (69)	1 (1)	0.004 (0.008)	0.005 (0.013)
Spring 2	0.4 (0.3)	-16 (52)	3 (1)	0.019 (0.019)	0.005 (0.008)
Group IV					
Spring 3B	0.2 (0.3)	21 (67)	13 (1)	0.012 (0.013)	-0.004 (0.011)

[a]Samples were collected in October 1988.
[b]ESG (1989).

yon. All values were low; none indicate any impact from Laboratory operations, including those below the Laboratory in White Rock Canyon and along the Rio Grande.

Data needs. None. The available data are suitable for background comparisons.

Chemical and Trace Elements. Surface water samples from regional stations for chemical analyses were collected in March 1988. Tables 4.2-IV and 4.2-V summarize the chemical quality of surface water from the regional, perimeter, and White Rock Canyon stations and from springs in White Rock Canyon.

Tables 4.2-VI and 4.2-VII summarize trace element concentrations in surface water from White Rock Canyon stations and from springs in White Rock Canyon. A number of trace elements were not detected in any of the waters tested. These are summarized in Table 4.2-VIII.

Data needs. None. The available data are sufficient for comparisons.

4.2.3. Ground Water

No regional groundwater sampling stations are included in the environmental surveillance program. Perimeter groundwater samples are collected from three springs (La Mesita Springs, Indian Springs, and Sacred Springs) and the main aquifer beneath the Pajarito Plateau to provide background water quality data (ESG 1989).

La Mesita Spring is east of the Rio Grande, whereas Indian and Sacred Springs are west of the river in lower Los Alamos Canyon. These springs discharge from faults in the siltstones and sandstones of the Tesuque Formation and from small seep areas. Total discharge at each spring is probably less than 1 L/s (0.3 gal/s).

The main aquifer beneath the Laboratory is sampled in both the supply and distribution systems. The water quality depends on well depth, lithology of the aquifer adjacent to the well, and yield from beds within the aquifer.

Radionuclides. Radiochemical quality of groundwater from the perimeter stations is given in Table 4.2-IX. Maximum concentrations for radiological constituents in the main aquifer are given in Table 4.2-X. All radionuclides are below EPA's maximum concentration levels (MCL) (values are provided in the table).

Data needs. None. The available data are sufficient for comparisons.

TABLE 4.2-IV
CHEMICAL QUALITY OF SURFACE WATER FROM REGIONAL, PERIMETER, AND WHITE ROCK CANYON STATIONS (mg/L)[a]

Station	SiO_2	Ca	Mg	K	Na	CO_3	HCO_3	P	SO_4	Cl	F	N	TDS	Total Hardness	ph	Conductivity (mS/m)
Regional Stations[b]																
Rio Chama																
Chamita	13	45	10	2.0	24	1	89	<0.2	92	6	0.3	<0.2	268	160	8.3	39
Rio Grande																
Embudo	24	27	5.7	2.8	20	0	77	<0.2	37	6	0.5	0.3	189	95	8.2	26
Otowi	24	27	5.7	2.8	20	0	78	<0.2	36	6	0.5	0.2	183	96	8.1	27
Cochiti	19	37	7.8	2.9	22	1	97	<0.2	51	8	0.5	0.2	228	127	8.3	34
Bernalillo	19	37	7.8	3.1	24	0	100	<0.2	54	9	0.5	0.3	220	133	8.2	35
Jemez River																
Jemez	14	17	1.7	4.0	9	0	48	<0.2	4	9	0.3	0.2	98	52	7.9	15
Perimeter Stations[b]																
Los Alamos Reservoir	30	6	1.9	1.6	5	0	23	<0.2	5	3	0.1	0.3	68	21	7.4	7.2
Guaje Canyon	50	8	2.5	2.5	6	0	30	<0.2	6	2	0.2	<0.2	99	25	7.6	8.5
Frijoles Canyon	29	6	1.9	1.6	5	0	20	<0.2	5	3	0.1	0.8	75	22	7.1	7.2
Streams[c]																
Pajarito	67	20	4.6	3.5	13	2.1	85	<0.2	7	5	0.5	0.6	173	66	8.4	19
Ancho	69	13	3.5	1.3	10	6.5	67	<0.2	2	2	0.4	<0.2	133	45	8.7	14
Frijoles	57	10	3.5	2.4	10	0	55	<0.2	3	3	<0.2	<0.2	110	38	8.2	12
Sanitary Effluent[c]																
Mortandad	83	26	7.9	1.3	76	0	125	9.5	32	4	14	7.8	389	93	7.8	59

[a]ESG (1989).
[b]Samples were collected in March 1988.
[c]Samples were collected in October 1988.

TABLE 4 2-V
CHEMICAL QUALITY OF SPRING WATERS FROM WHITE ROCK CANYON[a,b]

Station	SiO_2	Ca	Mg	K	Na	CO_2	HCO_3	P	SO_4	Cl	F	N	TDS	Total Hardness	pH	Conductivity (mS/m)
Group I																
Sandia Spring	44	33	3.2	2.6	15	0	116	<0.2	6	4	0.7	<0.2	177	100	8.2	27
Spring 3	49	20	1.6	2.7	15	0	82	<0.2	5	3	0.5	0.8	132	57	8.2	18
Spring 3A	50	20	1.8	3.6	14	0	80	<0.2	5	4	0.5	0.6	137	63	8.1	18
Spring 3AA	40	24	0.5	4.4	17	0	101	<0.2	6	5	0.6	<0.2	151	60	8.0	23
Spring 4	51	24	4.6	2.4	13	0	90	<0.2	11	7	0.6	1.4	159	80	8.2	22
Spring 4A	57	20	5.0	1.9	11	0	80	<0.2	8	6	0.6	1.3	165	71	8.2	19
Spring 5	64	19	5.0	2.2	12	0.7	82	<0.2	6	5	0.6	0.4	162	65	8.3	18
Spring 5AA	62	31	6.5	2.5	14	0	130	<0.2	7	7	0.6	<0.2	198	105	8.2	28
Ancho Spring	70	13	3.2	2.1	10	0	61	<0.2	3	3	0.5	0.3	140	42	8.2	13
Group II																
Spring 5A	52	24	2.9	2.6	21	2.0	106	<0.2	11	5	0.5	0.4	169	78	8.4	25
Spring 5B	42	23	5.7	2.1	14	0	75	<0.2	14	8	0.5	5.7	180	79	8.2	25
Spring 6	66	12	3.8	1.8	10	0	63	<0.2	3	3	0.4	0.5	140	43	8.2	13
Spring 6A	72	9	2.7	1.9	9	0	53	<0.2	2	2	0.3	0.4	127	35	8.2	12
Spring 7	64	20	4.5	2.3	17	1.7	96	<0.2	11	4	0.4	1.1	193	68	8.3	23
Spring 8A	61	11	3.2	2.0	11	0	62	<0.2	3	2	0.5	<0.2	149	42	8.2	13
Spring 9	71	10	3.2	1.4	10	0	62	<0.2	3	2	0.5	<0.2	132	41	8.2	13
Spring 9A	66	10	3.2	1.4	10	0	59	<0.2	2	2	0.6	<0.2	134	41	8.0	13
Doe Spring	73	12	3.7	1.4	12	0	66	<0.2	2	3	0.6	<0.2	139	46	8.1	14
Group III																
Spring 1	32	16	1.1	1.6	28	3.7	102	<0.2	6	3	0.7	0.9	123	49	8.4	22
Spring 2	39	24	1.3	1.6	60	2.1	183	<0.2	7	4	1.2	<0.2	230	75	8.4	37
Group IV																
Spring 3B	40	32	4.2	3.0	139	6.6	359	<0.2	25	4	1.1	<0.2	469	96	8.4	72

[a]Samples were collected in October 1988.
[b]ESG (1989).

TABLE 4.2-VI TRACE ELEMENTS IN SURFACE WATERS FROM WHITE ROCK CANYON (µg/L)[a,b]

Station	As	B	Ba	Br	Co	Cr	Cu	Fe	I	Li	Mn	Mo	Rb	Sc	Sr	U	V
Streams[a]																	
Pajarito	<10	<10	<1	62	<1	<10	<1	<100	10	85	10	<1	<1	30	230	<1	<1
Ancho	<10	<10	<1	<10	<1	<10	<1	<100	<10	66	11	<1	<1	32	86	<1	<1
Frijoles	<10	<10	<1	<10	<1	<10	12	<100	<10	40	28	<1	8	<1	92	<1	<1
Sanitary Effluent[a]																	
Mortandand	<10	<10	<1	140	<1	<10	56	<100	<10	112	66	<1	26	88	218	<1	34

[a]Samples were collected in October 1988.
[b]ESG (1988).

TABLE 4.2-VII TRACE ELEMENTS IN SPRING WATERS FROM WHITE ROCK CANYON (µg/L)[a,b]

Station	As	B	Ba	Br	Co	Cr	Cu	Fe	I	Li	Mn	Mo	Rb	Sc	Sr	U	V
Group I																	
Sandia Springs	<10	<10	180	90	<1	<10	<1	<100	—	100	820	<1	<1	55	800	<1	<1
Spring 3	<10	<10	<1	90	<1	<10	<1	<100	<10	75	<1	<1	<1	60	480	<1	34
Spring 3A	<10	60	<1	90	<1	<10	<1	<100	<10	90	<1	<1	<1	120	500	<1	60
Spring 3AA	<10	50	<1	<10	<1	<10	<1	1200	<10	80	260	<1	<1	70	400	<1	50
Spring 4	<10	<10	150	180	10	<10	<1	2300	<10	90	1100	<1	<1	30	380	2	60
Spring 4A	<10	<10	<1	130	<1	<10	<1	<100	<10	80	<1	<1	<1	130	210	<1	20
Spring 5	<10	<10	<1	80	<1	<10	<1	<100	<10	80	40	<1	<1	140	220	<1	40
Spring 5AA	<10	50	130	130	<1	<10	<1	300	10	<10	530	<1	<1	130	400	<1	<1
Ancho Spring	<10	<10	<1	25	<1	<10	<1	<100	<10	70	170	<1	<1	140	130	<1	22
Group II																	
Spring 5A	<10	<10	<1	<10	<1	20	<1	<100	10	90	140	<1	<1	60	440	1	<1
Spring 5B	<10	<10	<1	130	<1	<10	<1	<100	<10	70	70	<1	<1	30	290	<1	20
Spring 6	<10	<10	<1	50	<1	<10	<1	<100	<10	70	<1	<1	<1	100	120	<1	<1
Spring 6A	<10	<10	<1	30	<1	<10	<1	<100	<10	60	15	<1	<1	100	100	<1	<1
Spring 7	<10	<10	<1	<10	<1	<10	<1	<100	10	70	15	<1	10	80	240	1	50
Spring 8A	<10	10	<1	10	<1	<10	<1	<100	<10	70	10	<1	<1	80	110	<1	<1
Spring 9	<10	<10	<1	20	<1	<10	<1	<100	<10	17	14	<1	<1	50	80	<1	<1
Spring 9A	<10	<10	<1	40	<1	<10	<1	<100	<10	20	12	<1	<1	40	80	<1	<1
Doe Spring	<10	<10	<1	<10	<1	<10	<1	<100	<10	72	110	<1	<1	11	114	<1	<1
Group III																	
Spring 1	<10	<10	<1	40	<1	<10	10	<100	14	100	24	<1	<1	<1	400	1	24
Spring 2	60	100	15	70	10	10	<1	<100	16	150	950	<1	<1	<1	600	2	150
Group IV																	
Spring 3B	24	170	<1	30	<1	<10	20	<100	32	300	240	8	<1	<1	930	13	74

[a]Samples were collected in October 1988.
[b]ESG (1989).

TABLE 4.2-VIII
TRACE ELEMENTS NOT DETECTED AT ANY STATION[a,b]

Ag	<1	Os	<1
Au	<1	Pb	<1
Be	<10	Pd	<1
Bi	<1	Pr	<1
Cd	<1	Pt	<1
Ce	<1	Re	<1
Cs	<1	Rh	<1
Dy	<1	Ru	<1
Er	<1	Sb	<1
Eu	<1	Se	<10
Ga	<1	Sm	<1
Gd	<1	Sn	<1
Ge	<1	Ta	<1
Hf	<1	Tb	<1
Hg	<1	Te	<1
Ho	<1	Th	<1
In	<1	Ti	<100
Ir	<1	Tl	<1
La	<1	Tm	<1
Lu	<1	W	<1
Na	<10,000	Y	<1
Nb	<1	Yb	<1
Nd	<1	Zn	<1
Ni	<1	Zr	<1

[a]Samples were collected in October 1988.
[b]ESG (1989).

TABLE 4.2-IX
RADIOCHEMICAL QUALITY OF GROUNDWATER FROM PERIMETER STATIONS[a,b]

Station	Tritium (pCi/mL)	^{137}Cs (pCi/L)	Total Uranium (µg/L)	^{238}Pu (pCi/L)	$^{239/240}Pu$ (pCi/L)
La Mesita Spring	-0.8 (0.3)	19 (59)	1 (1)	0.019 (0.013)	0.016 (0.010)
Sacred Spring	-10 (0.3)	71 (67)	2 (1)	0.004 (0.009)	0.019 (0.010)
Indian Spring	-0.7 (0.3)	145 (63)	4 (1)	0.004 (0.011)	-0.009 (0.008)
Limits of detection	0.7	40	1	0.009	0.03

[a]Samples were collected in March 1988; counting uncertainty is in parentheses.
[b]ESG (1988) (modified from Table G-17).

TABLE 4.2-X
MAXIMUM CONCENTRATIONS OF RADIOACTIVITY IN WATER SUPPLY WELLS AND DISTRIBUTION SYSTEM[a]

	Number of Stations	Tritium (pCi/mL)	^{137}Cs (pCi/L)	Total Uranium (µg/L)	^{238}Pu (pCi/L)	$^{239/240}Pu$ (pCi/L)
Supply wells (Los Alamos)	10	-0.6 (<1)[d]	56 (28)	2 (<1)	0.009 (<1)	0.024 (<1)
Distribution (Los Alamos)	6	-0.8 (<1)	135 (68)	1 (<1)	0.032 <1	0.016 (<1)
Analytical limits of detection		0.7	40	1.0	0.009	0.03
Maximum concentration level (MCL)[b]		20	200	1800[c]	15	15

[a]Copied from Table 16, ESG 1988.
[b]EPA (1976).
[c]ICRP (1977).
[d]Percentage of EPA's MCL is in parentheses; this usage is for comparison only.

Chemical Quality. Chemical quality data for groundwater from the perimeter stations are given in Table 4.2-XI. Maximum concentrations for chemical constituents in the main aquifer are given in Table 4.2-XII. All constituents are below EPA's drinking water standards (values are provided in the table).

Data needs. None. The available data are sufficient for comparisons.

4.2.4. Soil and Sediment

This section describes regional background concentrations of organic compounds, radionuclides, and stable elements in soil and in river and stream sediments.

Organic Chemicals. No data are available for organic chemicals that may occur naturally in the soil or sediments on the Pajarito Plateau. For this document it is assumed that any natural compounds are below the detection limit of the analytical techniques specified for the analysis of the samples (see Chapter 11 and Appendix A).

Data needs. For the purposes of the work described in this plan, it is not considered necessary at this time to define the presence of background organic compounds in soils or sediments. Many of the investigations are biased to worst-case locations to identify contaminants if they are present. If contaminants not believed to be present are identified at above-background levels, background levels may need to be re-evaluated to determine if levels present are naturally occurring or contaminated.

Radionuclides. Table 4.2-XIII and 4.2-XIV summarize the mean and "upper limit" background radionuclide concentrations in soil and sediments to be used for data comparisons in this document. In this discussion, the term "background" will be used to mean both the naturally occurring radionuclides (its normal usage), and the man-made radionuclides that have been deposited worldwide as fallout from nuclear weapons testing (which are now an integral part of the world's environments). The term "upper limit" of background was defined for Laboratory use as the mean plus two standard deviations (Purtymun et al. 1987).

The values from Purtymun et al. (1987) are for soil and sediment samples collected over a 13-year period at the regional environmental monitoring stations (Fig. 4.2-1). The values from Myrick et al. (1981) are for soil samples collected at 13 locations in the north western corner of New Mexico (Fig. 4.2-3).

TABLE 4.2-XI
RADIOCHEMICAL QUALITY OF GROUNDWATERS FROM PERIMETER STATIONS (mg/L)[a,b]

Station	SiO_2	Ca	Mg	K	Na	CO_3	HCO_3	P	SO_4	Cl	F	N	TDS	Total Hardness	pH	Conductivity (mS/m)
La Mesita Spring	48	7	2.4	2.5	6	0	29	<0.2	6	2	0 2	<0.2	105	28	7.5	8.4
Sacred Spring	29	20	0.3	2.6	20	0	83	<0.2	7	3	0 6	<0.2	155	56	7.5	19
Indian Spring	42	12	2.1	2.2	20	0	85	<0.2	5	12	0.5	0.7	172	73	8.1	24
Maximum	48	20	2.4	2.6	20	0	85	<0.2	7	12	0.6	0.7	172	73	8.1	24

[a]Samples were collected in March 1988.
[b]Modified from ESG (1988), Table G-19.

TABLE 4.2-XII
MAXIMUM CHEMICAL CONCENTRATION IN WATER FROM
SUPPLY WELLS AND DISTRIBUTION SYSTEM[a]

	Standard[b]	Supply Wells	Percentage of Standard	Distribution System	Percentage of Standard
Number of Stations		10		7	
Chemical Constituents (mg/L)					
Primary					
Ag	0.05	<0.001	<2	0.002	4
As	0.05	0.034	68	0.011	22
Ba	1.0	0.086	9	0.105	11
Cd	0.01	<0.001	<10	<0.001	<10
Cr	0.05	0.006	12	0.006	12
F	4.0	0.8	20	0.6	15
Hg	0.002	<0.0002	<10	<0.0002	<10
NO_3 (N)	10	0.6	6	0.5	5
Pb	0.05	0.007	14	0.002	4
Se	0.01	0.001	10	0.001	10
Secondary					
Cl	250	7	3	30	12
Cu	1.0	0.104	10	0.033	3
Fe	0.3	0.042	14	0.350	117
Mn	0.05	0.002	4	0.001	2
SO_4	250	6	2	9	4
Zn	5.0	0.081	2	0.230	5
TDS	500	230	46	279	56

[a]Copied from Table 17, ESG (1988).
[b]USEPA primary and secondary drinking water standards are used for comparison only.

TABLE 4.2-XIII
SUMMARY OF BACKGROUND LEVELS OF RADIONUCLIDES IN SOIL

Source	Radionuclides	Units	Mean $\bar{x}$	Standard Deviation (s)	Upper Limit Background ($\bar{x}$ + 2s)	Number of Analyses	Detection Limit
	Naturally Occurring						
a	^{226}Ra	pCi/g	1.5	0.5	2.5	13	0.3
a	^{232}Th	pCi/g	1.0	0.4	1.8	13	0.3
a	^{238}U	pCi/g	1.1	0.5	1.7	13	0.01
b	Total Uranium	µg/g	2.4	0.5	3.4	34	1.0
b	Tritium	pCi/L	2.6	2.3	7.2	43	0.3
	Fallout						
b	^{90}Sr	pCi/g	0.34	0.27	0.88	29	0.05
b	^{137}Cs	pCi/g	0.43	0.33	1.09	64	0.1
b	^{238}Pu	pCi/g	0.001	0.002	0.005	76	0.002
b	$^{239/240}Pu$	pCi/g	0.007	0.009	0.025	76	0.002

[a]Myrick et al. (1981).
[b]Purtymun et al. (1987).

TABLE 4.2-XIV
SUMMARY OF BACKGROUND LEVELS OF RADIONUCLIDES IN SEDIMENT[a]

Radionuclides	Units	Mean $\bar{x}$	Standard Deviation (s)	Upper Limit Background ($\bar{x}$ + 2s)	Number of Analyses	Detection Limit
Naturally Occurring						
Total Uranium	µg/g	2.6	0.9	4.4	59	1.0
Fallout						
^{90}Sr	pCi/g	0.23	0.32	0.87	36	0.05
^{137}Cs	pCi/g	0.18	0.13	0.44	103	0.1
^{238}Pu	pCi/g	0.	0.003	0.006	113	0.002
$^{239/240}Pu$	pCi/g	0.005	0.009	0.023	113	0.002

[a]Myrick et al. (1981).

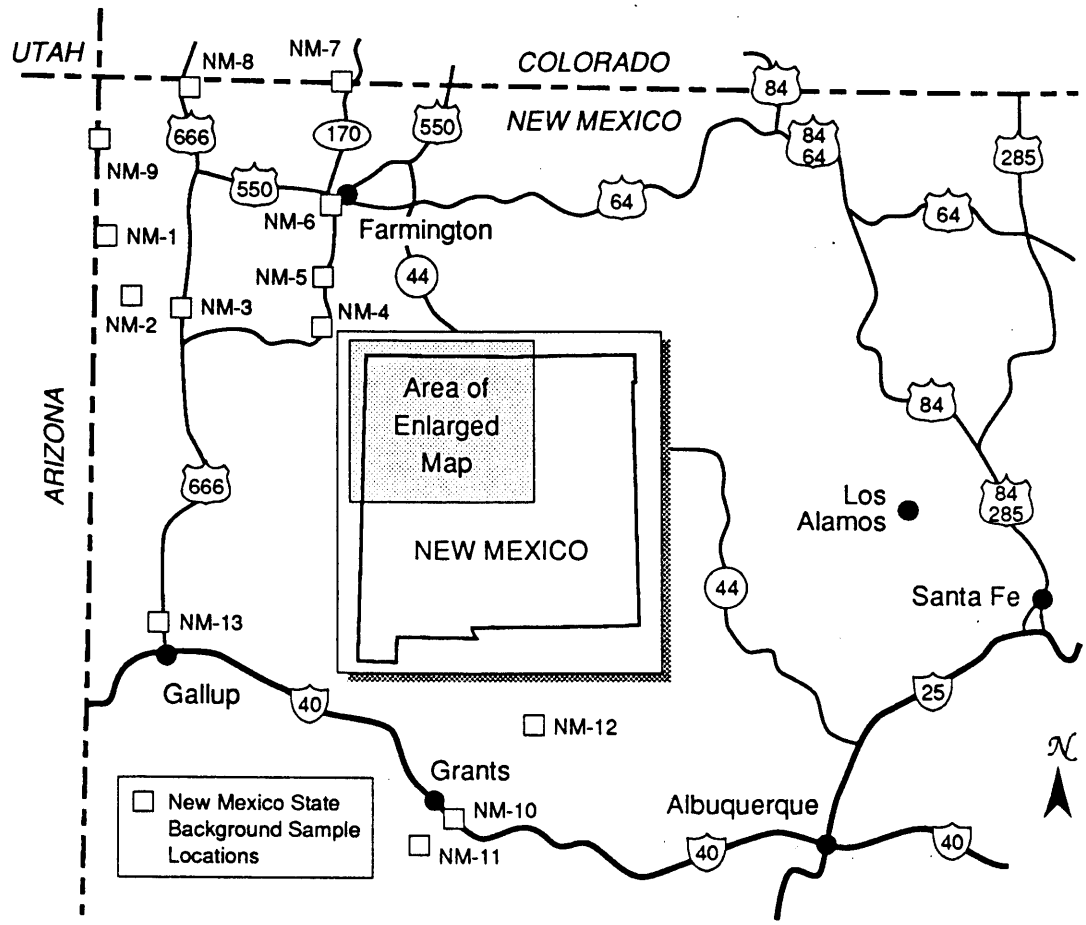


Fig. 4.2-3 Location of background samples in New Mexico (Myrick et al. 1981).

In evaluating the soils data summarized in Table 4.2.XIII, the following observations were made:

Sample increment. All sample analyses reported by Purtymun et al. (1987) were 5-cm (2-in.) increments taken from the earth surface. Soil samples to be collected for this RFI work plan will be either 15-cm (6-in.) or 2.5-cm (1-in.) increments. For uniform soils within a soil profile these differences would not be important. For surface soil samples, however, and particularly for the fallout deposited radionuclides, sample thickness may be important because the concentrations of the radionuclides may change rapidly with depth in the first few inches of the soil profile. In assessing data comparability, these background data may overstate the concentration of fallout radionuclides in background soil when compared to results for a 15-cm sample and understate the concentration when compared to a 2.5-cm sample.

Sample depth. The background levels reported by Purtymun et al. (1987) were based on samples from the soil surface. Many of the investigations for this RFI work plan will target deeper soils and the tuff bedrock. Because the surficial soils are those most impacted by the deposition of fallout radionuclides, the background data may overstate the concentration of fallout radionuclides when

compared to subsurface soils and rock. Surface soil background levels may not be representative of those at greater depths.

Sample locations. Soils are generally derived from the underlying rock and often share a common mineralogy and background levels of the naturally occurring radionuclides. The background samples collected by Purtymun et al. (1987) were not taken on the Pajarito Plateau but rather from the Rio Grande or Chama River valleys to the north and south or the Jemez Mountains to the west. Similarly, the samples collected by Myrick et al. (1981) were from the northwestern corner of New Mexico, quite distant from the Laboratory. The mineralogy of these areas is different from that of the Pajarito Plateau. The background samples may not be representative of materials found on the Pajarito Plateau.

The following issues were identified during the assessment of radionuclide data from past investigations at the MDAs (see data tables in Sec. 16.2 or 16.3, for example). Three common trends were noted as follows:

1. Concentrations of ^{137}Cs (a fallout radionuclide), in deeper soils and tuff from areas where contamination would be unlikely, tended to be generally below the mean background value for ^{137}Cs and seldom approached the upper limit of background. For detecting trace subsurface migration, use of the surface soil background value may be misleading.

2. Concentrations of ^{238}Pu and $^{239/240}Pu$ (fallout radionuclides), in deeper soils and tuff from areas where contamination would be unlikely, were far below the levels given in Table 4.2-XIII. These appeared to be at the detection limit of the method and may represent soils that are relatively unimpacted by worldwide fallout. For detecting trace subsurface migration, use of the surface soil background values may be misleading.

3. Concentrations of total uranium (naturally occurring radionuclides) in deeper soils and tuff from areas where contamination would be unlikely were consistently above the upper limit of background. Given the pattern described for ^{137}Cs, ^{238}Pu, and $^{239/240}Pu$ it is unlikely this consistent "elevated" uranium concentration site-wide at TA-21 represents a contamination problem. Rather it is likely that the background level of uranium in tuff and tuff-derived soils is naturally greater than in the soils used to develop the background data. In the data assessments given for each SWMU in Chapters 12–19, the upper limit background value in Table 4.2-XIII was used, resulting in the conclusion that there may be widespread uranium contamination. This assessment may be in error.

In evaluating the sediment data of Table 4.2-XIV, the following observations were made:

Sample locations. These samples were collected in the Rio Grande, Chama River, and Jemez River channels. The mineralogy of these sediments may not be representative of those on the Pajarito Plateau.

Drainage type. The drainages sampled were perennial streams. The drainages in immediate proximity to TA-21 (i.e., the DP Canyon and Los Alamos Canyon drainages) are ephemeral, running primarily during heavy snow melt and after

thunderstorms. This may affect the nature of the sediments, reducing the comparability of the background data to sediments on the Pajarito Plateau.

Similarity to soils. The data for sediments are very similar to those for soils (with the exception of ^{137}Cs). This may indicate that a distinction between soil and sediment samples is unnecessary. This may be particularly true for ephemeral drainages where the sediments are eroded soil materials that are not continually washed by flowing water.

Data needs. A need for better soil and sediment background radionuclide data is evident, particularly for deeper soils and tuff. Investigations are included in this plan to provide such data. Until such data are available, comparisons will be based on the information given in Tables 4.2-XIII and XIV.

Stable Elements. Table 4.2-XV gives the mean and range of concentrations of stable elements in soils that will be used for comparisons in this document. A portion of the data was obtained from samples collected on Sigma Mesa (Fig. 4.2-4) at the Laboratory where the soils were assumed to be representative of background conditions (Ferenbaugh et al. 1990). In addition, values for soils from the western United States (Shacklette and Boerngen 1984) are provided to supplement the suite of values for stable elements.

Data needs. For the purposes of the work described in this plan, it is not considered necessary at this time to define precisely the background levels of all stable elements in soils or sediments. Many of the investigations are biased to worst-case locations to identify contaminants if they are present. If contaminants not believed to be present are identified at above-background levels, background levels may be re-evaluated to determine if levels present are naturally occurring or contaminant caused.

4.2.5. Air

This section describes available data for radionuclides in air in the region surrounding the Laboratory. Three regional air monitoring stations are located 28 to 44 km (18 to 28 mi) from the Laboratory at Espanola, Pojoaque, and Santa Fe (Fig. 4.2-1). Eleven perimeter air monitoring stations are located within 4 km (2.5 mi) of the Laboratory boundary (Fig. 4.2-5) (ESG 1989).

Radionuclides. For use as a measure of background radionuclide levels in air, a summary of the perimeter and regional air sample analysis results for the period 1984 through 1988 is given in Table 4.2-XVI (ESG 1985–1989). Also included in the table are comparable values for a station in Santa Fe from an EPA study (ESG 1989).

TABLE 4.2-XV
STABLE ELEMENT CONCENTRATIONS IN SOIL

Element Dev.	Sigma Mesa[a](ug/g) No. of Samples	Mean $\bar{x}$	Std. Dev. s	Upper Limit of Background $\bar{x} \pm s$	Western United States[b](ug/g) Arithmetic Mean (Range)	Geo Mean ± Geo. Std.
Aluminum	40	58000	3500	65,000	58,000 (5000->100,000)	58,000 ± 2.00
Antimony	---	---	---	---	0.62 (<1-2.6)	0.47 ± 2.15
Arsenic	40	3.9	1.6	7.1	7.0 (<0.1-97)	5.5 ± 1.98
Boron	38	16	7.2	30.4	29 (<20-300)	23 ± 1.99
Barium	40	410	220	850	670 (70-5000)	580 ± 1.72
Beryllium	37	1.9	0.5	2.9	0.97 (<1 -15)	0.68 ± 2.30
Bromine	38	1.9	1.2	4.3	0.86 (<0.5-11)	0.52 ± 2.74
Cadmium	36	0.17	0.10	0.37	---	---
Calcium	----	---	---	---	33,000 (600-320,000)	18,000 ± 3.05
Chlorine	40	---	---	<100	---	---
Chromium	40	27	24	75	56 (3-2000)	41 ± 2.19
Cobalt	---	---	---	---	9.0 (3-50)	7.1 ± 1.97
Copper	40	10	4.5	19	27 (2-300)	21 ± 2.07
Fluorine	40	240	74	388	440 (10-1900)	280 ± 2.52
Iron	40	17000	4800	26,600	26,000 (1000-100,000)	21,000 ± 1.95
Lead	40	24	15	54	20 (10-700)	17 ± 1.80
Lithium	40	24	4.6	33.2	25 (5-130)	22 ± 1.58
Magnesium	40	2300	1200	4,700	10,000 (300->100,000)	7,400 ± 2.21
Manganese	40	510	130	770	480 (30-5000)	380 ± 1.98
Mercury	39	0.018	0.006	0.03	0.065 (<0.01-4.6)	0.046 ± 2.33
Molybdenum	---	---	---	---	1.1 (<3-7)	0.85 ± 2.17
Nickel	40	8.9	4.8	18.5	19 (<5-700)	15 ± 2.10
Phosphorous	---	---	---	---	460 (40-4500)	320 ± 2.33
Potassium	---	---	---	---	18,000 (0.19-6.3)	---
Rubidium	40	120	15	150	74 (20-210)	69 ± 1.50
Selenium	---	---	---	---	0.34 (<0.1-4.3)	0.23 ± 2.43
Silver	---	---	---	---	---	---
Sodium	---	---	---	---	12,000 (500-100,000)	9,700 ± 1.95
Strontium	---	---	---	---	270 (10-3000)	200 ± 2.16
Thallium	---	---	---	---	---	---
Thorium	---	---	---	---	9.8 (2.4-31)	9.1 ± 1.49
Titanium	40	2600	1500	5,600	2,600 (500-20,000)	2,200 ± 1.78
Uranium	---	---	---	---	2.7 (0.68-79)	2.5 ± 1.45
Vanadium	---	---	---	---	88 (7-500)	70 ± 1.95
Zinc	40	54	12	78	65 (10-2100)	55 ± 1.79

[a]Ferenbaugh et al. (1990).
[b]Shacklette and Boerngen (1984).

TABLE 4.2-XVI
RADIONUCLIDE CONCENTRATIONS IN AIR AND AMBIENT GAMMA RADIATION LEVELS

Radionuclide	Units	EPA[a] 1986-1988	Laboratory 1984–1986 Regional	Laboratory 1984–1986 Perimeter
Gamma Radiation	mrem/yr	---	100 ± 20	114 ± 15
^{3}H	10^{-6}pCi/L	---	4.7 ± 3.3	10.5 ± 8.4
$^{239/240}Pu$	10^{-12}pCi/L	0.6 ± 0.3	0.8 ± 0.7	1.1 ± 1.2
^{241}Am	10^{-12}pCi/L	---	2.5 ± 0.7	3.2 ± 1.5
Total Uranium	pg/m^3	73 ± 35	76 ± 47	34 ± 20

[a]EPA data, January 1986—March 1988, from Santa Fe, NM, as reported in ESG (1988).

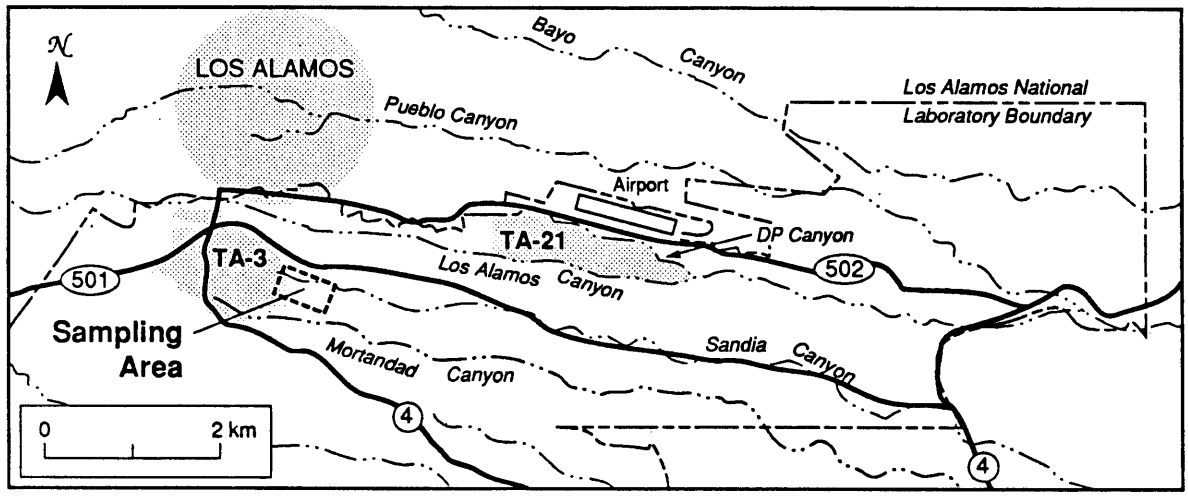


Fig. 4.2-4 Location of stable element soil sampling area (Ferenbaugh et al. 1990).

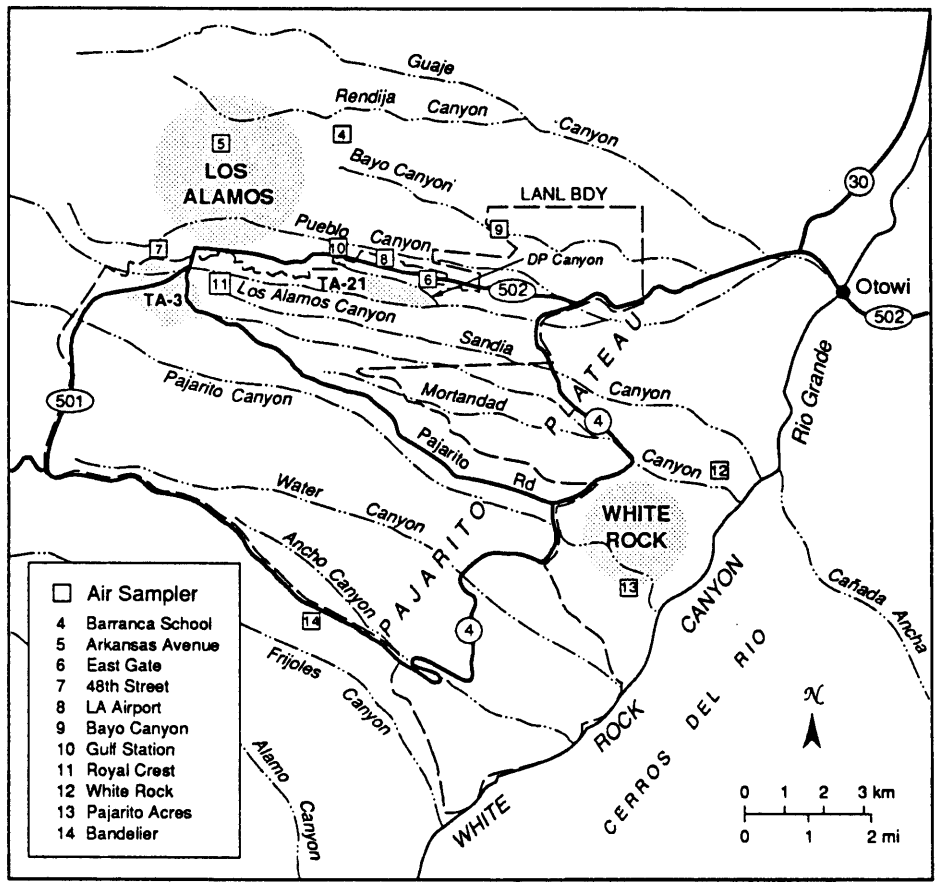


Fig. 4.2-5 Perimeter air sampler locations (ESG 1989).

Data needs. Based on knowledge of airborne contaminant levels near TA-21, as discussed in Chapter 5, the existing data are sufficient for background comparisons.

Other airborne contaminants. Because the Los Alamos area is remote from large metropolitan areas and major sources of air pollution, air monitoring for nonradioactive contaminants has not been conducted.

Data needs. No monitoring of air to determine background concentrations of other elements or chemicals is needed at this time.

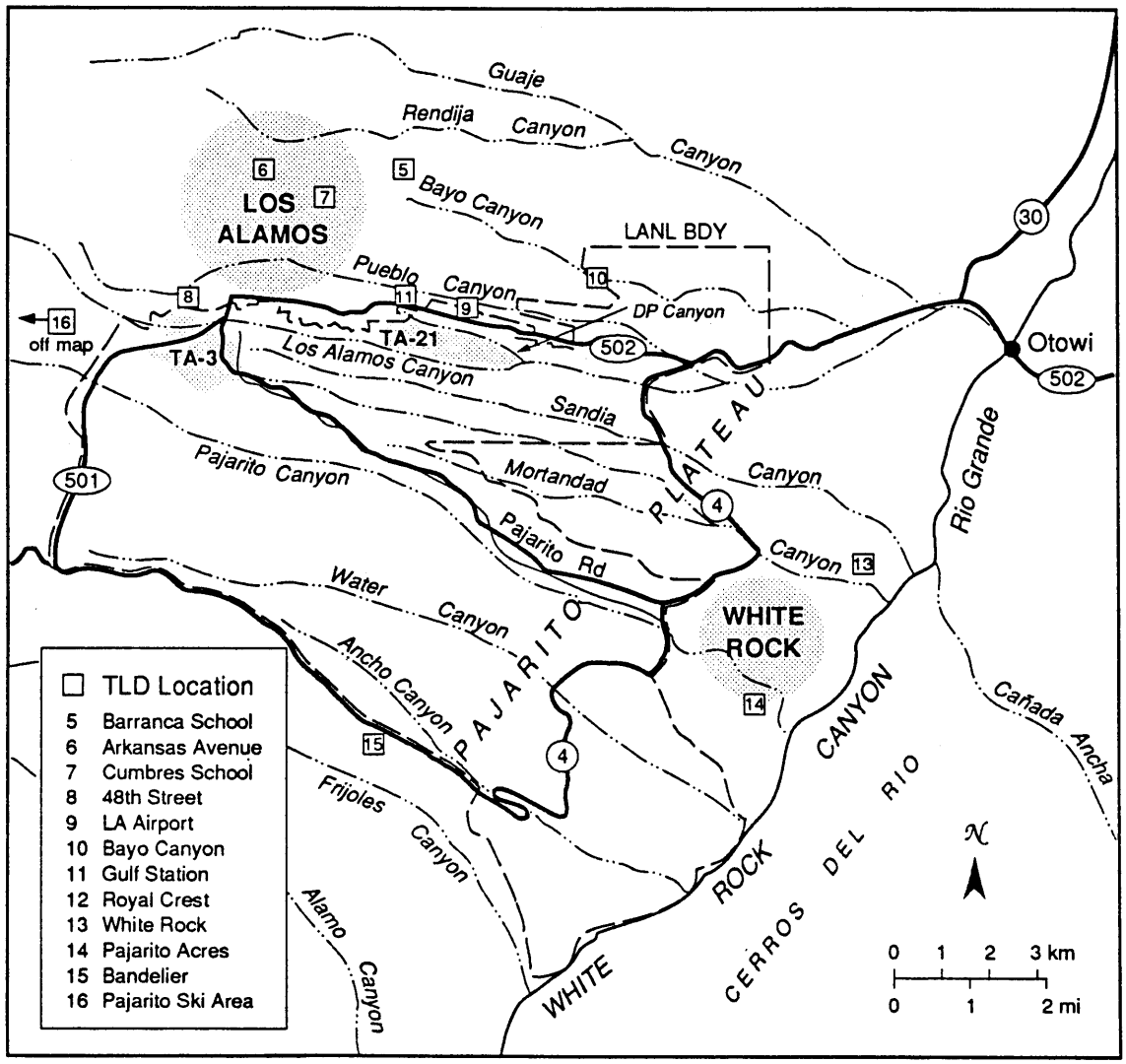


Fig. 4.2-6 Perimeter thermoluminescent dosimeter (TLD) locations (ESG 1989).

4.2.6. Ambient-Penetrating Radiation

Background gamma radiation levels are measured at four regional and twelve perimeter locations using thermoluminescent dosimeters (TLDs) (Fig. 4.2-6). A summary is included in Table 4.2-XVI.

Data needs. The available background data are sufficient for comparisons.

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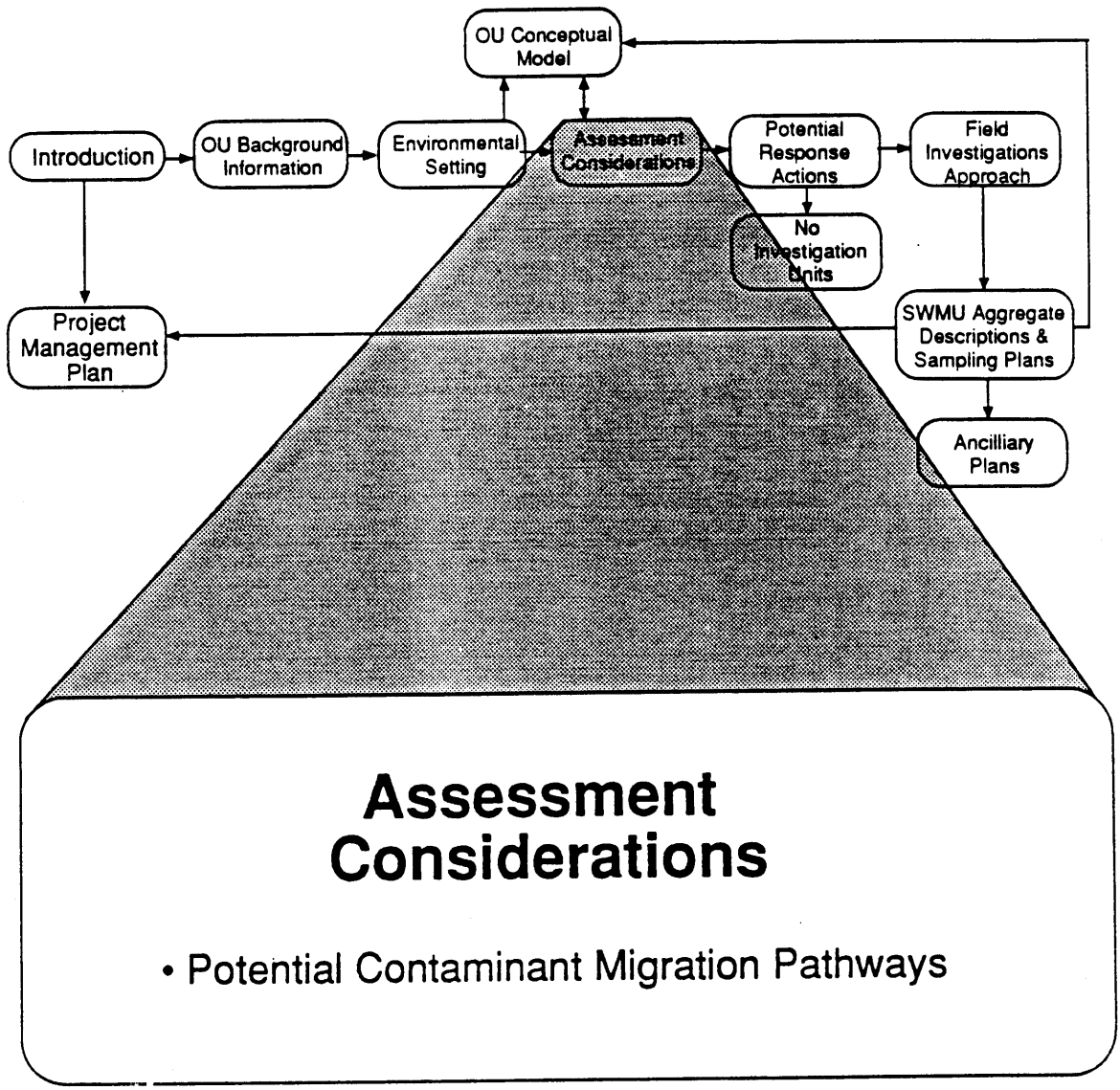
CHAPTER 5


OU Conceptual Model
Introduction
OU Background Information
Environmental Setting
Assessment Considerations
Potential Response Actions
Field Investigations Approach
No Investigation Units
Project Management Plan
SWMU Aggregate Descriptions & Sampling Plans
Ancilliary Plans
Assessment Considerations
• Potential Contaminant Migration Pathways

5. POTENTIAL MIGRATION PATHWAYS

This chapter identifies the major potential environmental pathways for contaminant release from SWMUs at TA-21. It categorizes the TA-21 SWMUs, and presents available monitoring data pertinent to each pathway. This chapter has two sections. The first section, SWMU Conceptual Categories, defines four conceptual categories of SWMUs, defines the categories applying to each SWMU, and discusses the probable environmental contaminant release and transport mechanisms for each category.

The second section, Pathways Description, describes the environmental endpoints of the potentially important release and transport mechanisms identified in the first section. It summarizes available data regarding the presence of contaminants in the endpoint media for each environmental pathway at TA-21.

Throughout this chapter, an effort is made to identify additional data that are needed to assess the conditions and importance of the various environmental pathways. Identified data needs are summarized in Chapter 8, Data Needs.

5.1. SWMU Conceptual Categories

The large number (approximately 112) and diversity of the SWMUs at TA-21 have been indicated in Chapter 2. In an attempt to streamline the assessment of potential environmental pathways, this section gives a categorization of the SWMUs into four conceptual categories as listed below:

- deep liquid releases,
- near-surface liquid releases,
- subsurface solid waste disposals, and
- surface contamination areas.

These categories allow an emphasis on the current sources of contaminants in the environment, rather than on the multitude of original release types. This limits the discussion of environmental pathway networks to four situations.

Few TA-21 SWMUs can be characterized by only one of the conceptual categories. Table 5.1-I identifies all categories that apply to each SWMU. In Sec. 2.2.3, the SWMUs are grouped into five investigation groups, according to similarities of expected field investigations. The investigation groups are used as the major divisions in Table 5.1-I. While the investigation groups are not

TABLE 5.1-I
CROSS REFERENCE OF SWMUS TO CONCEPTUAL CATEGORIES BY INVESTIGATION GROUPS

Investigation Groups	SWMUs	Conceptual Categories
Surface Soil Contamination from Airborne Contamination Area Emissions (Chapter 13)	21-007 Salamanders	Surface
	21-008 Incinerator	Surface Contamination Area
	21-009 Filter Houses/Exhaust Stacks	Surface Contamination Area
	21-020 Decommissioned Filter Houses	Surface Contamination Area
	21-021 Stack Emissions	Surface Contamination Area
Surface Units (Chapter 14)	21-002(b) Inactive Container Storage Areas	Surface Contamination Area
	21-003 PCB Container Storage Area	Surface Contamination Area
	21-004 Aboveground Tanks and Drain Lines	Surface Contamination Area Near-surface Liquid Releases
	21-013(a)–(f) Surface Disposal Areas	Surface Contamination Area Near-surface Liquid Releases
	21-026 Sewage Treatment Plant	Surface Contamination Area Near-surface Liquid Releases Deep Liquid Releases
	21-028 (d),(e) Active Container Storage Areas	Surface Contamination Area
	21-029 DP Tank Farm	Surface Contamination Area Near-surface Liquid Releases
Outfalls (Chapter 15)	21-004(d) Aboveground Tanks and Drainlines	Surface Contamination Area
	21-006(b) Seepage Pit (Outfall)	Surface Contamination Area
	21-011(k) New Industrial Liquid Waste Treatment Plant	Surface Contamination Area
	21-022(h) Acid Waste Lines and Sumps (Outfall)	Surface Contamination Area
	21-023(c) Decommissioned Septic Systems	Surface Contamination Area Near-surface Liquid Releases
	21-024(a)–(m) Inactive Septic Systems/Outfalls	Surface Contamination Area Near-surface Liquid Releases
	21-026(d) Wastewater Treatment Plant	Surface Contamination Area
	21-027(a)–(d) Surface Discharge	Surface Contamination Area
Material Disposal Areas (Chapter 16)	21-014 MDA A	Surface Contamination Area Subsurface Solid Waste Disposals
	21-015 MDA B	Surface Contamination Area Subsurface Solid Waste Disposals

TABLE 5.1-I (continued)
CROSS REFERENCE OF SWMUS TO CONCEPTUAL CATEGORIES BY INVESTIGATION GROUPS

Investigation Groups	SWMUs	Conceptual Categories
	21-016 MDA T	Deep Liquid Releases
		Subsurface Solid Waste Disposals
		Surface Contamination Area
	21-017 MDA U	Deep Liquid Releases
		Surface Contamination Area
	21-018 MDA V	Deep Liquid Releases
		Surface Contamination Area
	21-010 Industrial Liquid Waste Treatment Facility	Surface Contamination Area
		Near-surface Liquid Releases
	21-011 New Industrial Waste Treatment Plant	Surface Contamination Area
		Near-surface Liquid Releases
Subsurface Units (Chapter 17)	21-005 Acid Pit	Near-surface Liquid Releases
	21-006(b) Underground Seepage Pits	Near-surface Liquid Releases
		Deep Liquid Releases
	21-009 Waste Treatment Laboratory	Near-surface Liquid Releases
	21-012 Dry Wells	Deep Liquid Releases
	21-022(a),(l) Acid Waste Lines and Sumps	Deep Liquid Releases
SWMUs for Coordination with Building D&D (Chapter 18)	21-002(a) Inactive Container Storage Areas	Surface Contamination Area
	21-006(a),(c)–(l) Underground Seepage Pits	Near-surface Liquid Releases
		Deep Liquid Releases
	21-022(b)–(e), (g)–(j) Acid Waste Lines and Sumps	Near-surface Liquid Releases
		Deep Liquid Releases
	21-028(c) Active Container Storage Areas	Surface Contamination Area

directly based on the four conceptual categories, the SWMUs within an investigation group tend to fall into similar categories.

The descriptions below serve as simple models for each conceptual category of SWMU, identifying the nature of the waste, some typical SWMUs, and the major contaminant release and transport mechanisms of concern.

5.1.1. Deep Liquid Releases

Waste—Large volume, relatively deep releases of contaminated liquids to the subsurface. The present contaminant sources are absorption bed/seepage pit fill and subsurface soil and tuff.

Example SWMUs—The three liquid waste Material Disposal Areas (MDAs T, U, and V), several sumps and seepage pits, and a dry well.

Description—Units in this category have had substantial releases of contaminants or liquids to the subsurface, either for the purpose of material disposal or as a result of long term leakage.

Potentially Important Release/Transport Mechanisms

- Unsaturated flow of liquids in the vadose zone
- Vapor-phase transport in the vadose zone

Other Release/Transport Mechanisms

- Erosive exposure of subsurface-contaminated soils
- Mobilization of the liquid-borne contaminants by precipitation infiltration

5.1.2. Near-surface Liquid Releases

Waste—Shallow liquid releases of small volumes or low contaminant concentrations. Present contaminant source is surface and near-surface soil.

Example SWMUs—Septic systems, certain drain lines and outfalls, and larger liquid spills on the surface.

Description—The releases from SWMUs in this category are relatively shallow, less likely to have high concentrations of contaminants, and more likely to be associated with surficial soil materials than with deep penetration of liquids into the subsurface.

Potentially Important Release/Transport Mechanisms

- Erosion and wind dispersal of contaminated surface soils

- Storm water run-off erosion of contaminated surface soils
- Erosive exposure of contaminated subsurface soils, followed by wind and water erosion, as above

Other Release/Transport Mechanisms

- Liquid migration in the vadose zone
- Vapor migration in the vadose zone
- Precipitation infiltration and liquid migration in the vadose zone

5.1.3. Subsurface Solid Waste Disposals

Waste—Solid waste placed in subsurface disposals. Present source term is the waste disposed.

Example SWMUs—he two solid waste Material Disposal Areas (MDAs A and B) and the solid waste shafts at MDA T.

Description—This category is characterized by predominantly dry, solid wastes placed in waste trenches for disposal.

Potentially Important Release/Transport Mechanisms

- Vapor-phase movement within the waste and neighboring soils
- Precipitation infiltration and mobilization of otherwise-contained contaminants
- Unsaturated liquid movement in the vadose zone

Other Release/Transport Mechanisms

- Erosive exposure of wastes, followed by wind and water erosion.

5.1.4. Surface Contamination Areas

Waste—Contaminated surface soils. The present contaminant sources are deposited on, mixed with, or sorbed on surface soils.

Example SWMUs—Container storage areas, incinerators and stack releases, surface disposals, drainage channels, and some drain line outfall areas.

Description—This category includes SWMUs comprised primarily of contaminated surface soils resulting from airborne releases, solid waste spills, and surface liquid waste leaks or spills of limited volume. Most of the MDAs categorized above as deep liquid releases or solid waste disposal areas also have a component of surface contamination. Surface soils in the vicinity of the MDAs tend to be contaminated from past operations, spills, overflows, windblown dust releases and similar processes.

Potentially Important Release/Transport Mechanisms

- Surface erosion by precipitation run-off
- Dispersal of contaminated soils by wind

Other Release/Transport Mechanisms

- Transport into deeper soils with the infiltration of precipitation

5.1.5. Summary of Potentially Important Release/Transport Mechanisms

For the four conceptual categories of SWMUs, six primary contaminant release and environmental transport mechanisms have been identified. These are summarized in Table 5.1-II, where the media representing the environmental endpoints of the release/transport pathway are identified. The remaining sections of this chapter discuss available information on the transport of contaminants through the identified pathways and evaluate existing data on contaminant concentrations in the endpoint media.

5.2. Environmental Pathways

Five pathways of concern have been identified from the TA-21 OU environmental setting data presented in Chapter 4 and the discussion of major release/transport mechanisms and environmental endpoints summarized in Sec.5.1 (see Table 5.1-II). These pathways are

- atmospheric dispersion,
- surface water run-off,
- precipitation infiltration,
- migration in the vadose zone, and
- erosive exposure.

These pathways are summarized in Fig.5.2-1, and discussed in more detail in the following sections. Where available, TA-21 specific data are presented for a given pathway to give an idea of what is known of its importance at the TA-21 OU. However, because relatively little is known about potential contaminants present at TA-21 SWMUs (see Chapters 12–18), it is difficult to rank pathway importance for the TA-21 OU. Additional data needs are identified for each pathway.

Based on the information about the Laboratory's environmental setting presented in the IWP, and on the specific setting of the TA-21 OU presented in Chapter 4, it has been concluded that no

TABLE 5.1-II
SUMMARY OF MAJOR RELEASES/TRANSPORT MECHANISMS
AND ENVIRONMENTAL END-POINTS OF INTEREST

Release/Transport Mechanisms	Environmental End-Point of Interest
A. Wind entrainment and dispersal of surface soil	1. Contaminants deposited on surface soils. 2. Contaminants in air.
B. Surface water run-off carrying soil/sediment in suspension, contaminants in solution	1. Contaminants deposited in drainage sediments. 2. Contaminants released to surface waters. 3. Contaminated surface water infiltrating canyon bottom alluvium to alluvial aquifer.
C. Liquid movement in the vadose zone	1. Expanded contamination of subsurface soil and rock. 2. Immobilization in the subsurface. 3. Collection at, and movement along, unit contacts, fractures, and joints. 4. Releases at springs or seeps.
D. Vapor movement in the vadose zone	1. Expanded contamination of subsurface soil and rock. 2. Immobilization in the subsurface. 3. Preferential transport along joints and fractures leading to releases at surface or canyon walls.
E. Erosive exposure of subsurface wastes or contaminated soil	1. Feeds wind dispersal (A) and surface water run-off (B).
F. Infiltration of precipitation	1. Feeds liquid movement in vadose zone (C) and vapor movement in vadose zone (D).

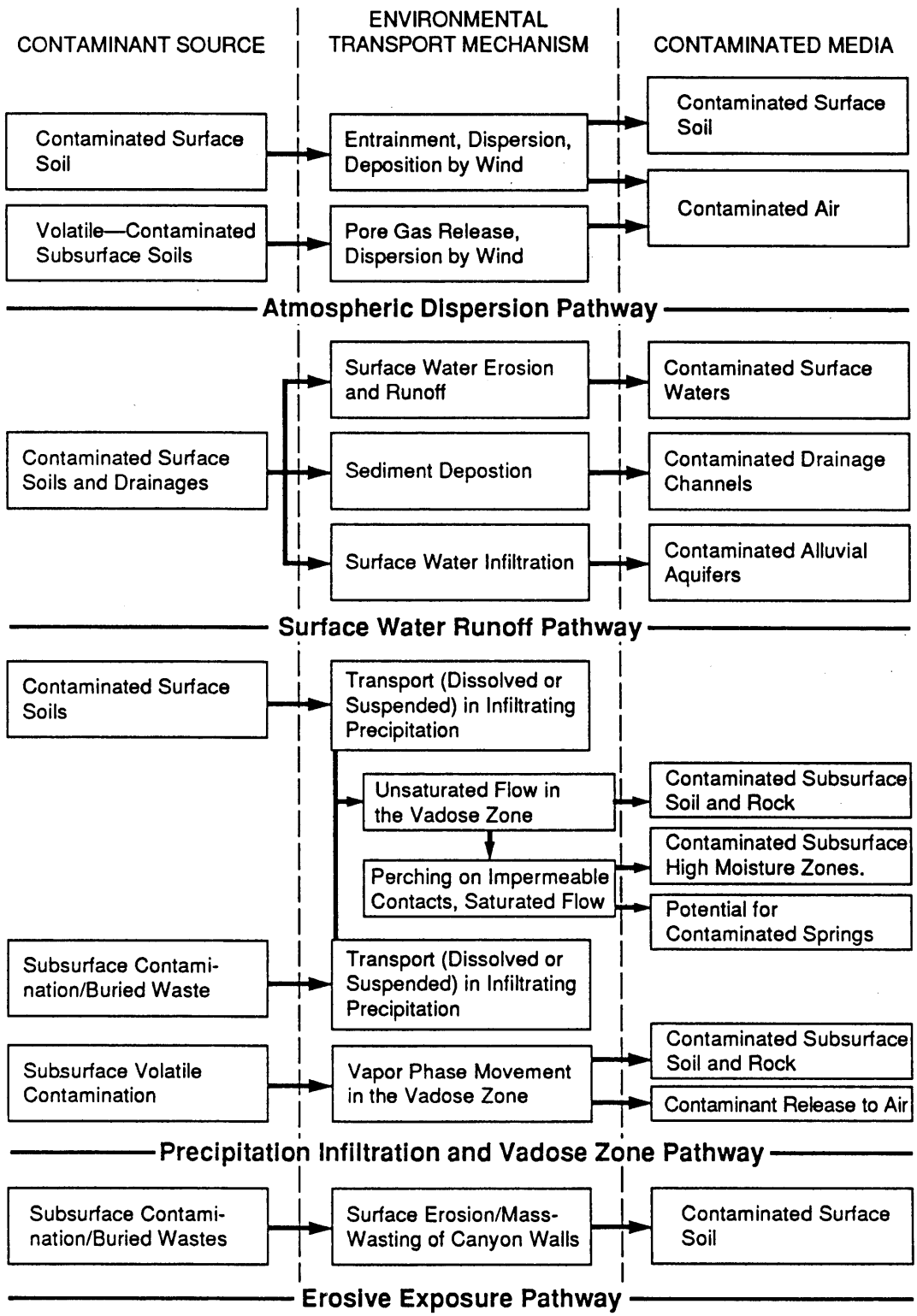


Fig. 5.2-1 Diagram of major contaminant transport pathways.

pathway exists for the migration of contaminants to groundwater beneath the Bandelier Tuff. Therefore, it is not considered further. In the unlikely event that site characterization data indicate it should be considered further, it will be addressed.

5.2.1. Atmospheric Dispersion Pathway

Release mechanisms for the air pathway include wind entrainment of contaminated soil (resuspension) and releases of volatile compounds and tritium from within the soil profile. A simple diagram identifying the major release mechanisms and resulting contaminated media is given in Fig.5.2-2. Wind speed, direction and stability class, plus vegetative cover, soil physical properties, soil moisture content and soil heat flux are important variables affecting resuspension and soil gas releases (Travis 1975; Abeele and Nyhan 1987).

Resuspension/deposition. Past airborne releases from facility stacks and other sources at TA-21 have resulted in elevated concentrations of radionuclides in soils on DP Mesa and surrounding areas. These elevated levels have been defined as SWMUs (see Chapter 13) and constitute one potential source of contaminants that may now be suspended and redeposited. In addition, numerous discrete SWMUs have had releases of contaminants to the surface soils that also constitute a part of the source term for resuspension, atmospheric dispersion, and deposition.

Few data are currently available documenting the distribution of contaminant levels in soils across TA-21. SWMU-specific data are discussed in Chapters 13–18, but these data were collected to document contaminant levels in immediate proximity to discrete SWMUs. They represent only a part of the contaminant distribution picture.

Data needs. Documentation of the current contaminant levels throughout the OU is needed. This will form the basis for defining the source term available for resuspension.

Release of Volatile Compounds and Tritium. Releases of tritiated water vapor and tritium gas from facilities at TA-21 and in waste streams disposed at the MDAs occurred for many years. Some releases still continue from the Tritium Systems Test Assembly (TSTA) (see Sec.3.1.2) and the TA-21 sewage treatment plant. Low levels of tritium are pervasive in the environment at TA-21. It is probable that common laboratory solvents and other volatile organic compounds were released to the MDAs and other SWMUs at TA-21.

As a result of subsurface releases to absorption beds or seepage pits, some distribution of volatile organic compounds and tritiated water is likely within the subsurface profile. Few data are

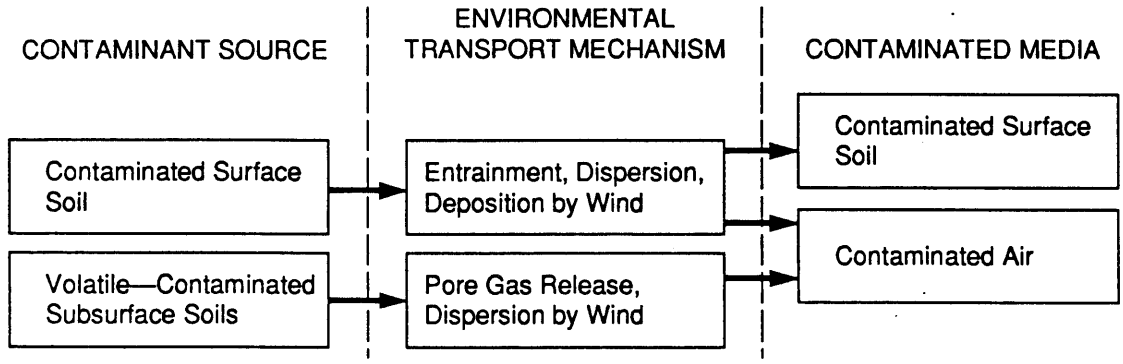


Fig. 5.2-2 Diagram of the atmospheric dispersion pathway.

available to document the subsurface distribution of contaminants that could be released in the gas phase from the soil.

Data needs. Characterize the subsurface source term for contaminants that could be released to the atmosphere in the gas phase. Quantify the presence of those contaminants in the air in and around the OU.

Airborne contaminants. Some measurements are available on contaminant concentrations in air in the vicinity of TA-21. The data focus on radionuclides and are summarized below.

Figure 5.2-3 identifies six air sampling locations in the vicinity of TA-21. Table 5.2-I summarizes the air monitoring data from these six stations and three regional stations (see Fig.4.2-1) for the five-year period from 1984 through 1988. Samples were collected and analyzed monthly for tritium and quarterly for total uranium and $^{239/240}Pu$.

For tritium, the perimeter and onsite stations in the vicinity of TA-21 appear elevated above regional levels, with the exception of the Bayo STP monitoring station. This is consistent with known elevated levels of tritium in soil at TA-21 from past operations and its potential for continuing release. TA-21 is not the only source of tritium in the area, however, and the observed values may not be directly attributable to releases from SWMUs or soil contamination at TA-21. One source of operational releases of tritium at the Laboratory is the TSTA, noted above. In addition, tritium is present in the permitted liquid effluent from TA-21's sewage treatment plant.

For $^{239/240}Pu$, the results from the onsite monitoring station at TA-21 are comparable to those from the regional stations. The perimeter stations in the vicinity of TA-21 have slightly higher values, but the significance of this observation is not known. The total uranium measurements for

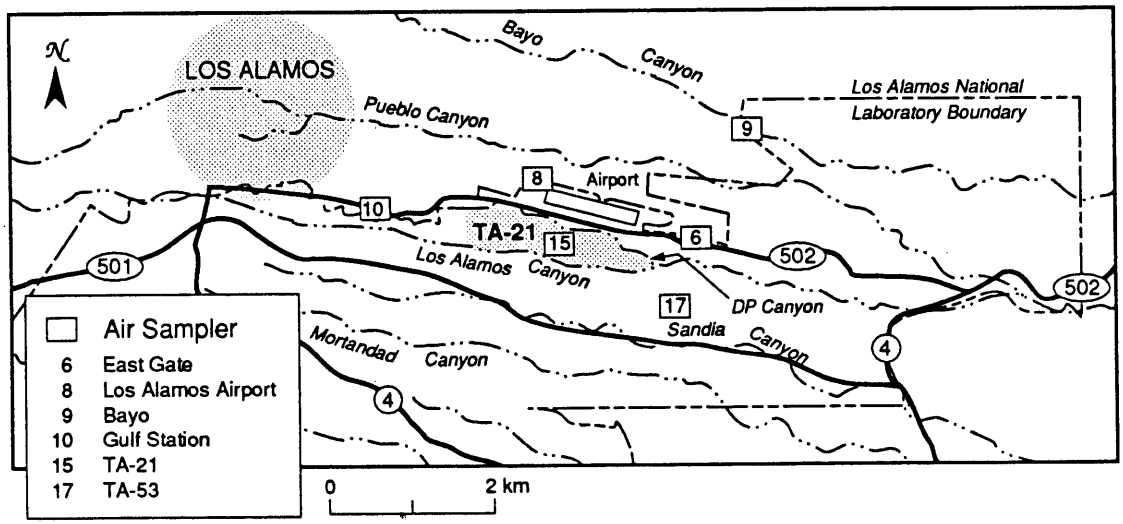


Fig. 5.2-3 Air sampling locations potentially susceptible to TA-21 emissions.

all stations were within the range expected for background in air.

The annual average concentrations of these radioactive materials are less than 0.1 % of their respective DOE-derived concentration guides (DCG) for uncontrolled areas. The DCGs are included in Table 5.2-I.

Data needs. For purposes of predicting transport of contaminants by air, more detailed information on the contaminant sources at the several SWMUs is needed. The need for, and design of, any SWMU-specific air monitoring program should be based on those data when they have been obtained and evaluated. As discussed in Sec.4.1.2, Climate, available meteorological data are sufficient. For resuspension/deposition and volatilization estimates, measurements of the physical properties of the soil will be needed.

5.2.2. Surface Water Run-off Pathway

The climate of the Pajarito Plateau (Sec.4.1.2, Climate) is characterized by snowfall in the winter with intermittent melt events and high-intensity, short-duration rainfall events in the summer. These factors often result in significant surface water run-off and soil erosion. A simple diagram of the major release mechanisms and resulting contaminated media is given in Fig.5.2-4. The release mechanism for the run-off pathway is erosion of contaminated surface soils. The environmental dispersal of contaminants by the run-off pathway has three major components as follows:

TABLE 5.2-I
AIRBORNE RADIOACTIVITY IN THE VICINITY OF TA-21[a]

Air Monitoring Station	Tritium pCi/m^3	$^{239/240}Pu$ aCi/m^3 ($10^{-18}\mu Ci/mL$)	Total U pg/m^3
Regional			
Espanola	4.7 ± 2.8	1.0 ± 0.8	75.8 ± 47.4
Pojoaque	6.4 ± 3.7	0.3 ± 0.5	96.7 ± 43.7
Santa Fe	3.2 ± 2.6	1.0 ± 0.6	54.8 ± 41.0
™x ± s	4.8 ± 3.3	0.8 ± 0.7	75.8 ± 47.3
Nearby Perimeter Stations			
6 East Gate	12.4 ± 7.5	1.3 ± 0.5	37.7 ± 6.6
8 LA Airport	11.4 ± 4.6	2.1 ± 1.8	60.0 ± 28.2
9 Bayo STP	4.4 ± 1.5	1.1 ± 0.8	43.9 ± 37.3
10 Exxon Station	11.0 ± 2.0	2.6 ± 1.1	45.6 ± 4.4
™x ± s	9.7 ± 5.6	1.8 ± 1.3	46.9 ± 25.7
™x ± s w/o Bayo	11.2 ± 5.5	2.0 ± 1.3	52.6 ± 26.0
Onsite Stations near TA-21			
15 TA-21	26.5 ± 16.5	1.0 ± 0.4	45.8 ± 11.5
17 TA-53	13.9 ± 5.4	0.9 ± 0.7	35.6 ± 11.0
DOE Derived Air Concentration (DAC) Guides.			
DAC:	$1x10^5$	$1x10^4$	$1x10^5$

[a]ESG (1985–1989).

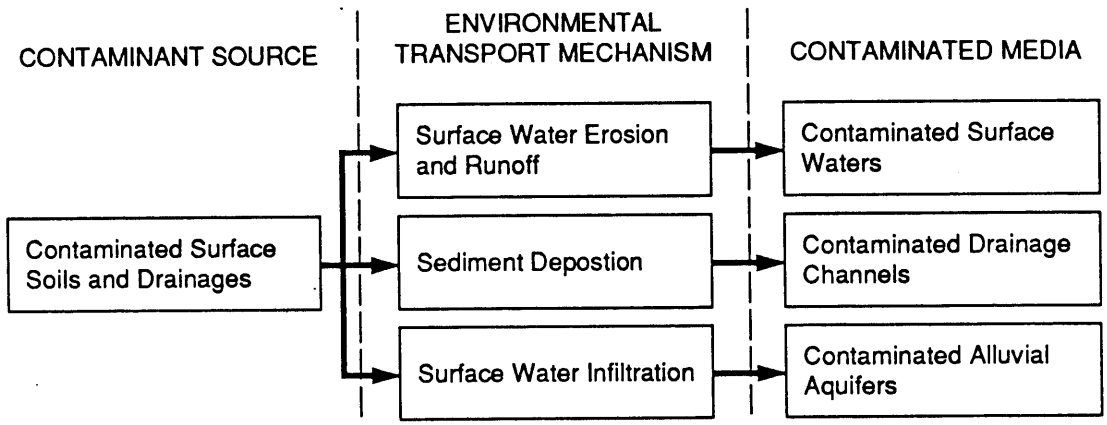


Fig. 5.2-4 Diagram of the surface water runoff pathway.

- deposition of contaminated sediments in drainage channels,
- contamination of surface water from the dissolved and suspended solids, and
- contamination of the shallow saturated zones in the alluvium of the canyon bottoms (alluvial aquifers).

At TA-21, the water and sediments discharged from the mesa top go to DP Canyon on the north and Los Alamos Canyon on the south, as described in Sec.4.1.4.1. At the eastern edge of the OU, DP Canyon merges with Los Alamos Canyon and Los Alamos Canyon joins the Rio Grande at Otowi, (see Fig.4.2-6, for example).

The organization of the ER Program at the Laboratory includes an OU specifically for investigation and remediation of all canyon systems, the Canyons' OU. Thus, while the TA-21 OU is bounded by the drainage channels of DP and Los Alamos Canyons, responsibility for characterization and assessment of those canyons belongs to the Canyons' OU. The focus of the TA-21 RFI work plan is on the present potential for releases from the TA-21 OU; in this case as contributions to the Canyons' OU. The discussions below review available data on contaminants in sediments, surface water, and alluvial aquifers for the TA-21 OU.

Data needs. For the purposes of the TA-21 RFI work plan, investigations are needed to determine erosion rates, contaminant levels and distribution in drainage channels within the OU, and the available source term for erosion by surface water run-off. Properties of the soils and drainages that affect erosion potential need to be characterized.

5.2.2.1. Surface Water

Surface water flow normally occurs in the canyons only in the upper reaches near the Jemez Mountains or for short distances downstream from Laboratory effluent sources such as the sewage treatment plant at TA-21, which discharges to DP Canyon. Many run-off events generate surface flow along portions of a canyon's length, but not the full length. This is particularly true of summer run-off events, which may reach the Rio Grande less frequently than once per year (Purtymun et al. 1990). The long duration of the spring run-off event can saturate the drainage channel and provide conditions supporting flow along the entire length of a canyon. In a study of spring run-off in Los Alamos Canyon covering seven years, flow reached the Rio Grande in five of the years (Purtymun et al. 1990).

Table 5.2-II gives data for plutonium in solution (and in sediments) during snowmelt run-off at a station (GS-2) in Los Alamos Canyon approximately 2 miles below the confluence with DP Canyon (Fig.5.2-5). The plutonium in solution is in the same range as background levels reported in deep groundwater wells (Sec.4.2.3, Groundwater).

TABLE 5.2-II
PLUTONIUM IN RUN-OFF WATER, SUSPENDED SEDIMENTS, AND BED SEDIMENTS IN LOS ALAMOS CANYON BELOW DP CANYON (STATION GS-2)

Year	Total Plutonium		
	Solution (pCi/L)	Suspended Sediments (pCi/g)	Bed Sediments (pCi/g)
1975[a]	0.03	1.16	0.18
1979[a]	0.01	4.56	0.40
1980[a]	0.01	5.37	0.17
1982[a]	0.05	11.1	0.31
1983[a]	0.01	4.97	0.24
1985[a]	0.03	5.47	0.82
1986[a]	0.01	1.84	0.29
1987[b]	0.021	2.05	—
1988[c]	0.004	3.32	—

aPurtymun et al. 1990.
bESG 1988 - ^{238}Pu and $^{239/240}Pu$ concentrations were summed to give total plutonium.
cESG 1989 - ^{238}Pu and $^{239/240}Pu$ concentrations were summed to give total plutonium.

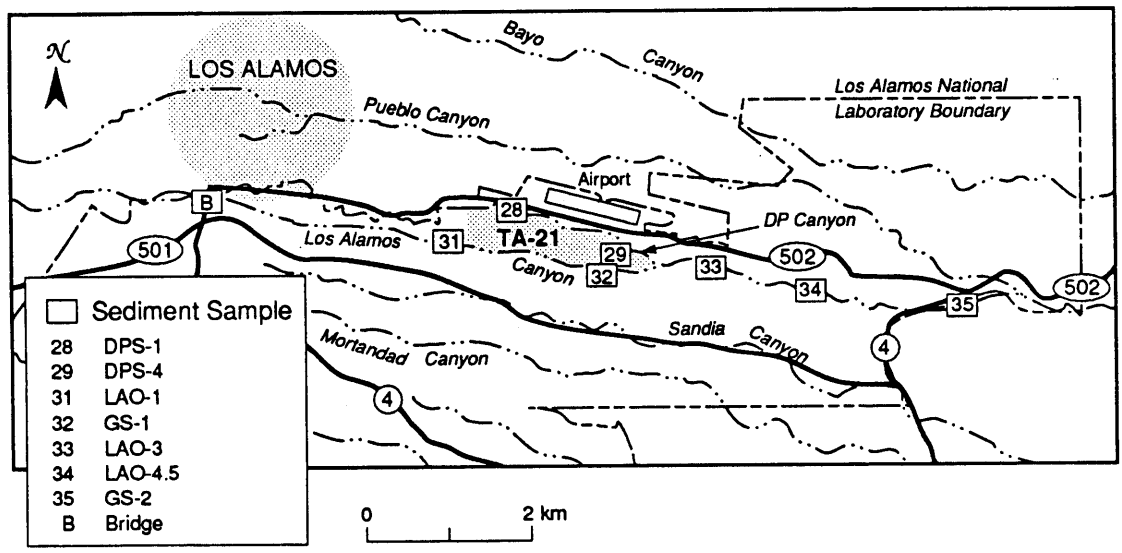


Fig. 5.2-5 Sediment sampling locations in DP and Los Alamos Canyons.

Two surface water sampling stations in Los Alamos and DP Canyons were among those sampled (including groundwater locations) for a broad suite of chemical analyses in 1986 (Purtymun et al. 1988). The locations are identified in Table 5.2-III and shown on Fig.5.2-6. With the qualifications in Table 5.2-III, no contaminants were present above detection limits.

Data needs. Measurements of fraction of precipitation, which runs off the TA-21 mesa top, drainage collection basins, water velocities, channel configurations, and the dissolved and suspended contaminant loading of surface water run-off at TA-21 are needed.

5.2.2.2. Sediments.

Sediment transport by surface water run-off includes soil carried in suspension and heavier particles moved by the force of the water along the bed of the drainage, depending on the properties of the soil and the velocity of the water. The quantity of various contaminants that may be transported depends on physical and chemical properties of both the soil and the contaminant. Contaminants originally released in solution may become chemically bound to and transported with soil particles. Contaminants released as airborne particulates may behave differently in the soil matrix, and water-soluble contaminants will be distributed and behave in yet another fashion.

Enhanced contaminant retention often occurs in the silt-clay fraction of the soil because of mineralogy and higher specific surface. The silt-clay fractions are readily transported in suspension once detached from the soil; thus surface water run-off can be an efficient contaminant

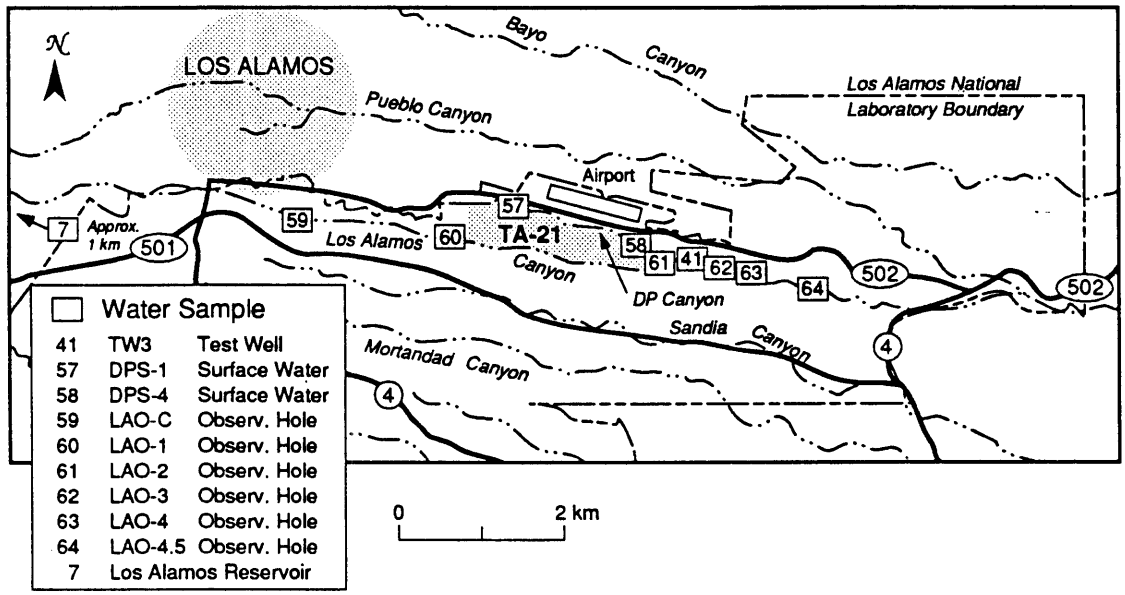


Fig. 5.2-6 Surface and groundwater sampling locations in DP and Los Alamos Canyons.

transport mode. For insoluble contaminants, such as plutonium, movement with sediment is the primary mode of surface water transport in arid and semiarid ecosystems (Hakonson and Nyhan 1980; Hakonson et al. 1979; Hakonson et al. 1981).

Table 5.2-II gives data on the plutonium concentrations in suspended sediments and bed sediments (and in solution) during run-off events for nine years in the period 1975 through 1988. The sampling location, GS-2, is shown in Fig.5.2-5. Table 5.2-IV gives results of analyses for several radionuclides in sediments collected when the channel was not flowing. These data cover the five-year period from 1984 through 1988. The samples were collected at eight locations, two in DP Canyon and six in Los Alamos Canyon, as shown in Fig.5.2-5. The data are also presented in Figures 5.2-7 and 5.2-8, where the concentrations are plotted as a function of the location in Los Alamos and DP Canyons. These data indicate an increase in radionuclide content of sediments in Los Alamos Canyon from TA-21 downstream. DP Canyon sediments generally have higher concentrations than Los Alamos Canyon, except for tritium and uranium. Both tritium and uranium are within the range of background in both canyons. Strontium-90 concentrations exceed the range of background in DP Canyon (twice and six times the background value) but not in Los Alamos Canyon. The other radionuclides (^{137}Cs, ^{238}Pu, $^{239/240}Pu$, and ^{241}Am) are above background levels in both canyons, except at the furthest upstream point (see Figs. 5.2-7 and 5.2-8).

TABLE 5.2-III
ORGANIC COMPOUNDS IN SURFACE WATER AND ALLUVIAL AQUIFERS IN DP AND LOS ALAMOS CANYONS[a]

Stations	Type of sample (depth)	Volatile organics (35 Compounds)	Semivolatile organics (65 Compounds)	BNA Fraction	Pesticides (20 Compounds)	Herbicides (3 Compounds)	Polychlorinated Biphenyls (7 Compounds)	Cyanide
Los Alamos Reservoir	Surface Water	U	U	U	U	U	U	U
DDS-4	Surface Water	U	B	U	U	U	U	U
LAO-C	Alluvial Aquifer (9 ft)	U	U	C	U	U	U	U
LAO-1	Alluvial Aquifer (32 ft)	A	U	U	U	U	U	U
LAO-3	Alluvial Aquifer (32 ft)	U	U	U	U	U	U	U
LAO-4.5	Alluvial Aquifer (48 ft)							
TW-3	Groundwater (750/815 ft)	U	D	U	U	U	U	U

U: no compounds detected
A: chloroform 7 µg/L (detection limit 5 µg/L)
B: Bis(2-ethylexyl) phthalate 400 µg/L (detection limit 10 µg/L); this is a common analytical laboratory contaminant.
C: Unknown, scan number 1535, 40 µg/L [detection limit (estimated) 25µg/L]
Unknown, scan number 1700, 30 µg/L [detection limit (estimated) 25µg/L]
Unknown, scan number 1774, 40 µg/L [detection limit (estimated) 25µg/L]
D: Di-n-butyl phthalate 16 µg/L (detection limit 10 µg/L)

[a]Purtymun et al. (1988)

TABLE 5.2-IV
RADIONUCLIDE CONCENTRATIONS IN SEDIMENTS OF DP AND LOS ALAMOS CANYONS, 1984–1988[a]

Map Number	Location	Tritium[b,d] (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							
28	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
29	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 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
31	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 S.R. 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

[a]ESG (1985–1989).
[b]Data from one year (1984) only.
[c]Data from four years (1984–1986, 1988).
[d]Measurement ± counting uncertainty.
[e]Mean of measurements ± standard deviation ($\bar{x} \pm s$).
[f]Data for four years (1984–1987).
[g]Data for three years (1984–1986).

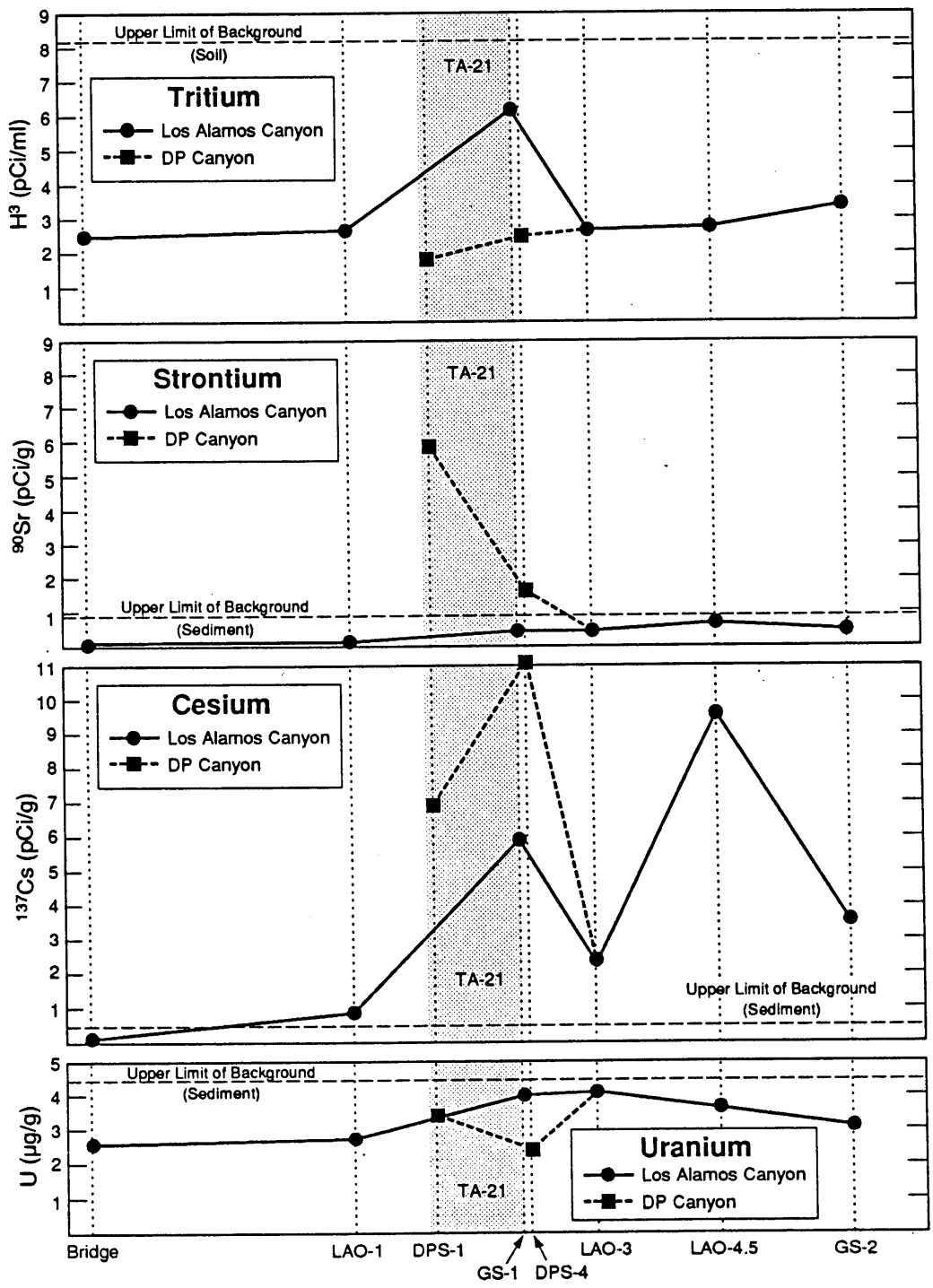


Fig. 5.2-7 Graphs showing concentrations of tritium, strontium, cesium and uranium in samples along Los Alamos and DP Canyons.

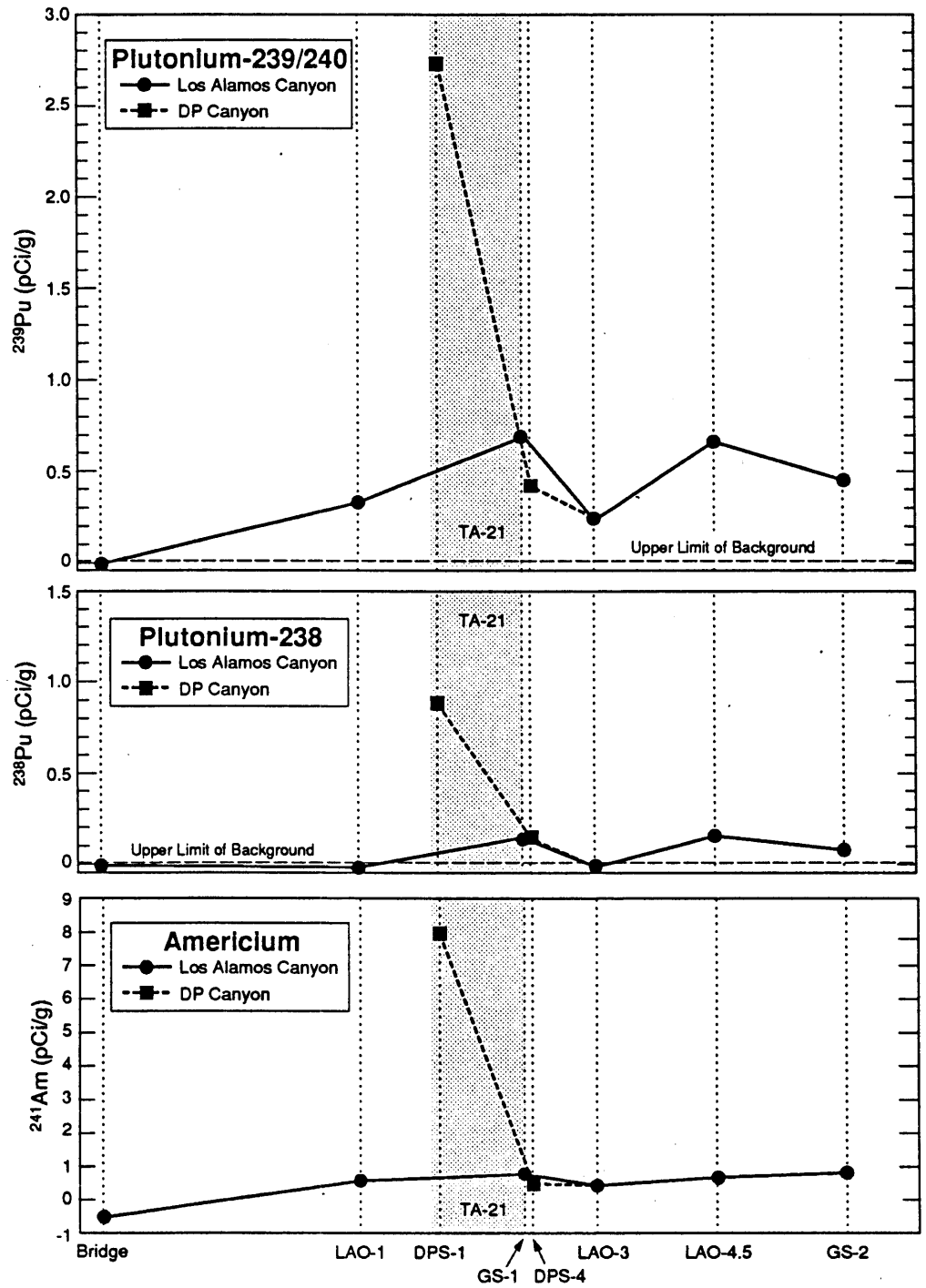


Fig. 5.2-8 Graphs showing concentrations of plutonium-238, -239/240, and americium in samples along Los Alamos and DP Canyons.

A large buildup of radionuclides has not occurred in sediments at the effluent outfall in DP Canyon because the sediments are moved downgradient with summer storm and spring snowmelt run-off.

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 1981). A model (Lane 1985) placed 33% of the inventory in the active channel and 67% in the inactive channel and on its banks.

Stoker (1981) reported the plutonium inventory in the active channel in DP Canyon and Upper Los Alamos Canyon was 5.0 μCi in May 1968; 1.5 μCi in August 1968; 5.7 μCi in February 1970; and 3.7 μCi in October 1972. The inventory in May 1968 shows the build up of plutonium during the fall-winter-spring months and the August 1968 inventory represents the residual after the summer rainfall season.

The estimated inventory of ^{137}Cs on sediments in DP and Upper Los Alamos Canyon was about 154 mCi in 1972. About 84% was within 1.8 km of the outfall in DP Canyon (Stoker 1981). For DP Canyon, transport of radionuclides in summer storm run-off was studied by Purtymun (1974). Precipitation during the period of May through September 1967 resulted in 23 run-off events that carried about 88,000 kg of suspended sediments out of the canyon in about 36,800 m^3 of water. The suspended sediments carried out about 70μCi of gross alpha emitters and 11,300 μCi of gross beta emitters. The source of gross beta emitters is principally ^{90}Sr.

On the basis of available measurements, Stoker (1981) estimated that the typical amount of plutonium transported by run-off from Los Alamos Canyon into the Rio Grande is on the order of 1 mCi. If the 1 mCi of plutonium is distributed in the average annual suspended sediment load of 2.2×10^8 kg in the Rio Grande at Otowi, then the average plutonium concentration would be 0.0005 pCi/g.

Data needs. Estimates of soil erosion by surface water transport, the contaminant loading, and the available contaminant source term in the surface soils of TA-21 will aid in assessing the importance of this pathway.

5.2.2.3 Alluvial Aquifers

The surface water run-off pathway leads to the alluvial aquifers as a reservoir for one contaminated media, the shallow groundwater. In this context, the following discussions summarize pertinent information and indicate the impact prior surface water releases from TA-21 have had

on the alluvial aquifers.

Los Alamos Canyon. The alluvial aquifer in Los Alamos Canyon extends from its upper reaches to below the confluence with DP Canyon. It is recharged by infiltration from the drainage channel during spring and late-summer run-off. Water levels decline in the winter and early summer when run-off is at a minimum (ESG 1989). Depletion occurs by evapotranspiration and infiltration into the underlying tuff. Contaminants in surface water may enter the alluvial aquifer and will move with or be removed from the water according to the chemical nature of the contaminant and the alluvium.

Six groundwater sampling locations in Los Alamos Canyon are shown in Fig.5.2-6. Five of these (the LAO- series) sample the alluvial aquifer in the canyon, the sixth (Test Well 3) samples groundwater in the Puye Formation at a depth of 750 to 815 ft below the canyon floor.

Table 5.2-III, presented earlier, gives the results of analyses for organic compounds for samples from the wells in Los Alamos Canyon. Generally, organic compounds were absent. In two alluvial aquifer wells (LAO-C and LAO-1) and a groundwater test well (TW-3), concentrations of one organic in each well were found above, but very close to, detection limits. These results are not believed to be significant; however, no subsequent sampling and analysis have been done to confirm the presence of these compounds.

Table 5.2-V summarizes data on radionuclides in water from the six wells during the five-year period 1984–1988. Conclusions are given below, based on background levels in well and spring water given in Sec.4.2.2, Surface Water, and Sec.4.2.3, Groundwater. All radionuclides are within the range of background level for the samples from the main aquifer (TW-3, see Fig.5.2-6)). In the alluvial aquifer, the levels of ^{137}Cs and ^{238}Pu are within the range of background at all sampling locations. Uranium is also in the range of background level, except at well LAO-2, which may be slightly elevated. This well is the first one sampled below the confluence with DP Canyon. From well LAO-2 downstream through the remaining wells sampled in Los Alamos Canyon, $^{239/240}Pu$ is slightly elevated above the range of background in water. Tritium is within the background level range at the furthest upstream well (LAO-C) but has elevated levels in all wells downstream from there. The elevated levels are present at well LAO-1, which is upstream of TA-21 and of the confluence with DP Canyon. This may indicate a tritium source other than TA-21.

Table 5.2-VI summarizes data from the same time period for chemical constituents. EPA Maximum Contaminant Levels (primary and secondary standards) for inorganic chemicals and radio-

TABLE 5.2-V
RADIONUCLIDE CONCENTRATIONS IN THE ALLUVIAL AQUIFER AND THE MAIN AQUIFER BENEATH LOS ALAMOS CANYON

	Tritium pCi/mL	^{137}Cs pCi/L	^{238}Pu pCi/L	$^{239/240}Pu$ pCi/L	Total U µg/L
Alluvial Aquifer					
LAO-C	0.4 ± 0.8	34.3 ± 36.1	0.006 ± 0.010	0.002 ± 0.009	1.0 ± 0.8
LAO-1	6.8 ± 8.0	0.0 ± 44.1	-0.000 ± 0.008	0.009 ± 0.012	1.1 ± 0.5
LAO-2	7.3 ± 11.4	33.6 ± 44.8	0.010 ± 0.009	0.069 ± 0.076	5.1 ± 9.5
LAO-3	8.2 ± 12.1	-24.7 ± 42.8	0.009 ± 0.014	0.037 ± 0.052	2.2 ± 1.4
LAO-4	3.9 ± 4.5	30.9 ± 65.5	0.022 ± 0.033	0.051 ± 0.054	1.4 ± 1.2
LAO-4.5	4.3 ± 5.4	5.2 ± 65.3	0.006 ± 0.013	0.049 ± 0.053	1.6 ± 1.1
Main Aquifer					
TW-3	0.3 ± 1.2	10.0 ± 25.4	0.006 ± 0.013	0.010 ± 0.018	1.1 ± 1.1
EPA MCL (primary std)	20.	200.	15.	15.	

TABLE 5.2-VI
CHEMICAL QUALITY OF WATER FROM THE ALLUVIAL AND MAIN AQUIFERS FROM BENEATH LOS ALAMOS CANYON (1984—1988)[a]

	SiO_2 (mg/L)	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	CO_3 (mg/L)	HCO_3 (mg/L)	P (mg/L)	SO_4 (mg/L)	Cl (mg/L)	F (mg/L)	N (mg/L)[b]	TDS (mg/L)	Total Hardness (mg/L)	pH	Conductivity (mS/m)
Main Aquifer																
TW-3	43 ± 35	15 ± 5	4.7 ± 1.5	2.3 ± 0.5	11 ± 4	0	75 ± 32	0.3 ± 0.2	4 ± 1	4 ± 1	0.2 ± 0.2	0.4 ± 0.4	129 ± 49	55 ± 19	7.8 ± 0.2	55 ± 90[c]
Alluvial Aquifer																
LAO-C	34 ± 9	17 ± 11	3.9 ± 2.1	3.0 ± 0.7	33 ± 24	0	53 ± 32	0.2 ± 0.2	8 ± 6	51 ± 36	0.4 ± 0.3	0.22 ± 0.05	179 ± 80	58 ± 40	7.5 ± 0.3	27 ± 17
LAO-1	34 ± 7	17 ± 6	3.8 ± 1.8	6.6 ± 4.7	54 ± 20	0	76 ± 39	0.3± 0.1	15 ± 6	63 ± 40	1.1 ± 1.0	1.0 ± 0.9	239 ± 79	59 ± 19	7.6 ± 0.2	40 ± 16
LAO-2	30 ± 11	17 ± 6	3.6 ± 0.9	8.7 ± 4.9	59 ± 39	0	83 ± 39	0.3 ± 0.1	17 ± 7	57 ± 32	2.0 ± 2.0	1.2 ± 1.0	303 ± 109	57 ± 20	7.4 ± 0.3	43 ± 20
LAO-3	38 ± 4	22 ± 7	4.7 ± 1.3	12.3 ± 5.9	67 ± 33	0	86 ± 30	0.3 ± 0.1	21 ± 8	79 ± 46	1.6 ± 1.0	1.6 ± 1.0	296 ± 113	73 ± 26	7.3 ± 0.2	50 ± 21
LAO-4	36 ± 5	13 ± 3	3.6 ± 0.7	6.4 ± 3.7	42 ± 11	0	78 ± 35	0.3 ± 0.2	12 ± 3	40 ± 20	0.9 ± 0.7	0.6 ± 0.4	194 ± 27	46 ± 5	7.3 ± 0.1	31 ± 6
LAO-4.5	46 ± 14	14 ± 2	3.9 ± 1.0	5.9 ± 3.5	42 ± 11	0	77 ± 35	0.3 ± 0.2	12 ± 3	38 ± 17	0.9 ± 0.7	0.6 ± 0.6	205 ± 27	50 ± 8	7.3 ± 0.3	31 ± 6
EPA MCL									250 secondary	250 secondary	2 primary	10 primary	500 secondary		6.5—9.5 secondary	

[a]ESG (1985–1986).
[b]Data for four years (1985–1988). Prior to 1985, data reported were NO_3.
[c]A value of 215 mS/m appears anomalous; without that value $\bar{x} \pm s$ is 1.5 ± 5.

nuclides are given in the tables for reference (EPA 1976, 1979; ICRP 1977). There are no regulatory standards for the following cations and anions: sulfate, calcium, magnesium, potassium, sodium, carbonate, bicarbonate, phosphorus, sulfate, total hardness, or conductivity. When compared with the background data presented in Sec.4.2.3, it appears all parameters are at background levels in the main aquifer at TW-3. In the alluvial aquifer, all parameters except potassium, sodium, sulfate, and chlorine are within the normal range for local waters. The first three of these parameters are at background levels at the furthest upstream location in Los Alamos Canyon (LAO-C) and are slightly elevated at all downstream wells. For chlorine, all alluvial aquifer wells sampled in Los Alamos Canyon are elevated. In all cases, the elevated levels of these four chemicals are apparent upstream of TA-21 and at the confluence with DP Canyon.

Data needs. No additional data for the alluvial aquifer in Los Alamos Canyon are needed at present. Other investigations may be undertaken by the Canyons' OU.

DP Canyon. No wells have been placed in DP Canyon, and there is no direct evidence regarding the presence of an alluvial aquifer. DP Canyon has in the past received contaminated liquid effluents from several sources, accounting for the elevated levels of radionuclides observed in DP Canyon sediments. Past effluent volumes were much larger than current releases from the NPDES-permitted outfall of the TA-21 sewage treatment plant. The sewage treatment plant discharge, sampled in August 1990, contained tritium at 9 pCi/mL (see Table 5.2-VII).

TABLE 5.2-VII
TRITIUM AND LIMITED CHEMICAL DATA FOR DP SPRING AND TA-21 SEWAGE TREATMENT PLANT EFFLUENT

	Temp.		Tritium	B	Cl	NO_3
DP Spring	C	pH	pCi/mL	mg/kg	mg/kg	mg/kg
5/30/90	8.4	7.5	2.8	<0.05	39.5	5.78
8/10/90	9.8	7.4	1.1	0.53	24.7	3.41
9/6/90	16.0	7.9	1.3	0.10	21.1	2.45
TA-21 Sewage Treatment Plant Outfall						
8/10/90	18.5	7.4	9.0	<0.05	38.1	153.

During reconnaissance geologic work in May 1990, a spring was discovered discharging from the north wall of DP Canyon about 1 km downstream (east) of TA-21. It has been named DP Spring. Well-established vegetation at the spring indicates an age of not less than 10 years. The discharge point occurs at the contact of colluvium of Bandelier Tuff resting on an old erosional surface cut into a lower unit of the upper Bandelier Tuff.

The spring rises on the opposite wall of the canyon from the sewage plant discharge but at a lower elevation in the canyon. A possibility exists for a hydrologic connection between the spring and the discharge. The discharge may infiltrate the alluvium of DP Canyon, perch in the old erosional surface, cross the canyon, and emerge on the opposite wall. This would imply the presence of at least a limited zone of saturation in the alluvium and could demonstrate one subsurface migration pathway, which has been considered speculative in the past. On the other hand, the spring may rise from unknown water sources on the mesa above it to the north.

This spring was sampled three times during the period May to September 1990. Although flow rate has been variable (2 to 20 L/min) during this time period, this spring has not gone "dry" to date. Analyses results for samples from this spring collected from May to September 1990 are shown in Table 5.2-VI. Tritium values averaged 1.7 pCi/mL for the three samples taken.

Data needs. Investigations to identify the origin of the water emerging at DP Spring are needed. The presence of an alluvial aquifer in DP Canyon needs to be determined.

5.2.3. Infiltration and Vadose Zone Transport

Within the OU at TA-21, migration of contaminants in the subsurface will be in the vadose zone of the Bandelier Tuff. This is in contrast to the alluvium of the canyon bottoms discussed above (part of the **Canyons** OU), where zones of saturation are known and saturated flow processes are possible. As diagrammed in Fig.5.2-9, three mechanisms are of importance in the vadose zone as follows:

- infiltration of precipitation, which can provide the water to serve as a contaminant-carrying transport media;
- movement of the contaminant-bearing water in the vadose zone via unsaturated flow processes; and
- movement of tritiated water vapor and vapors of volatile compounds through the vadose zone in the gas phase.

Section 4.1.7, Vadose Zone Hydrology, summarized available information regarding these modes

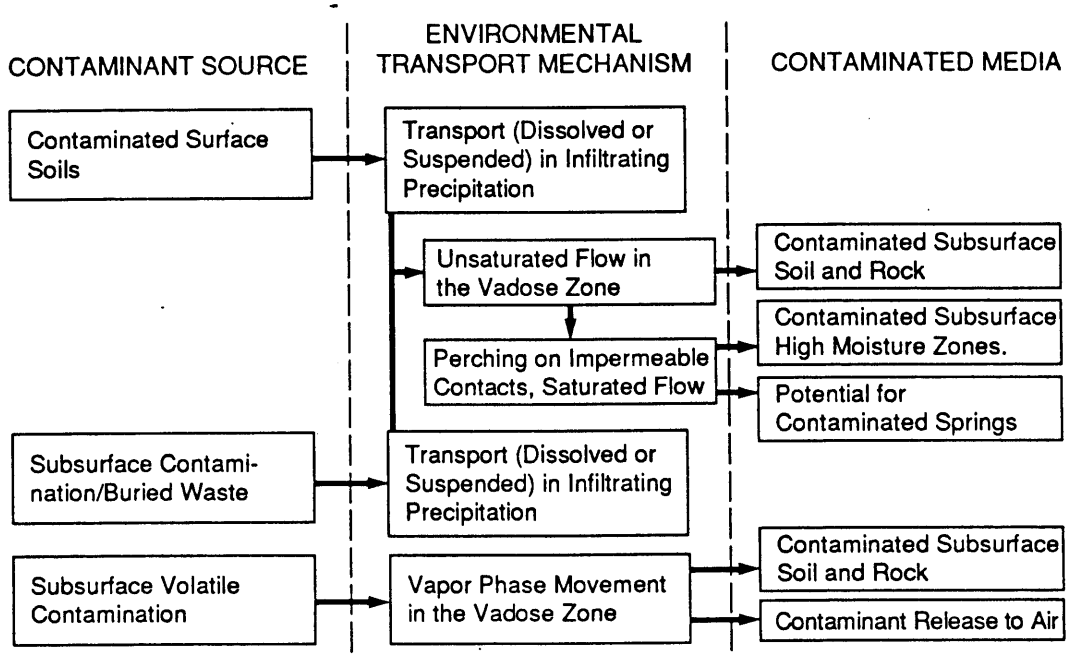


Fig. 5.2-9 Diagram of precipitation infiltration and vadose zone pathway.

of movement in the Bandelier Tuff. No additional data specific to TA-21 are available.

Liquid migration. The existing studies described in Sec.4.1.7 support the assessment that liquid-phase migration in the vadose zone may be a dead-end pathway in the Bandelier Tuff. That is, while some migration into the tuff may have occurred during the time when significant volumes of liquids were released, such migration ceased soon after the liquid releases ceased and cannot occur again in the absence of significant input of water. Those studies also indicated that infiltration of natural precipitation cannot provide the necessary quantities of water.

Uncertainties that remain include the role and importance of joints and fractures in the tuff that could act as enhanced routes for precipitation infiltration and the presence and importance of impermeable zones within the tuff (perhaps at unit contacts) where liquids input to the tuff may have perched and may potentially move horizontally to a release point on a canyon wall.

Data needs. Investigation of subsurface SWMUs at TA-21 that were formed by liquid discharges are needed to determine the distribution of contaminants in the subsurface and to address the status of the water in the contaminated zone. Specific attention should be given to identifying the presence of zones of elevated moisture content, especially in the context of paths for horizontal movement of water.

Vapor migration. Migration of tritium through tuff as tritiated water vapor has been documented near deep tritium disposal shafts at TA-54 (Purtymun 1973; Abeele et al. 1981). The subsurface distribution pattern indicates influences from the presence of open joints and fractures may be important. Migration of volatile organic compounds through tuff has been documented around chemical disposal pits, also at TA-54 (Devaurs 1985; Devaurs and Bell 1986). These studies are summarized in IWP Sec.2.6.3.4.4, Tritium Migration Studies, and Sec.2.6.3.4.7, Organic Plume Migration Studies (LANL 1990). No additional data are available for TA-21.

Depending on the magnitude of the source term for tritium and volatile organic compounds at the different SWMUs at TA-21, vapor phase migration may be a release pathway of interest. The importance of the pathway is dependent on the concentrations of contaminants moving as vapors and the availability of release points into the atmosphere.

Data needs. Investigations are needed to determine the source term for contaminants that may move in the vapor phase. Such investigations should evaluate the existing distribution of such contaminants in the subsurface and address the importance of joints and fractures as migration paths.

5.2.4. Erosive Exposure of Subsurface Contamination

Two major mechanisms exist for the long-term exposure of subsurface contaminated soils or buried wastes at TA-21, as identified in Fig.5.2-10. These are

- loss of surface soil cover by wind and water erosion and
- mass-wasting of canyon walls leading to the exposure of wastes from the side.

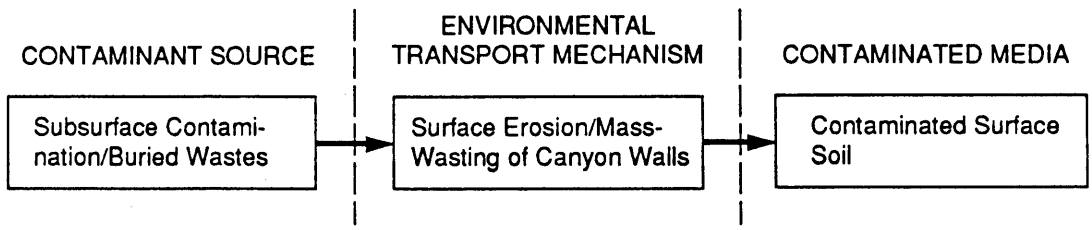


Fig. 5.2-10 Diagram of erosive exposure pathway.

These mechanisms would lead to contaminated surface soils that could be dispersed in the environment by the other transport pathways described above. The surface erosion mechanism is being investigated as part of cover-design pilot studies conducted Laboratory-wide and specifically at MDA B at TA-21 (see Sec.10.4.1, Capping). Mass-wasting of canyon walls is a very long-term process, which is also of interest Laboratory-wide. The continuing presence of 600- to 800-year-old prehistoric Indian cave dwellings in the mesa walls of the Pajarito Plateau is one indication of the time scale for this process.

Data needs. Data relevant to erosive exposure processes at TA-21 will be obtained from studies conducted Laboratory-wide by the ER Program. Continuation of pilot studies at MDA B will be needed for this purpose.

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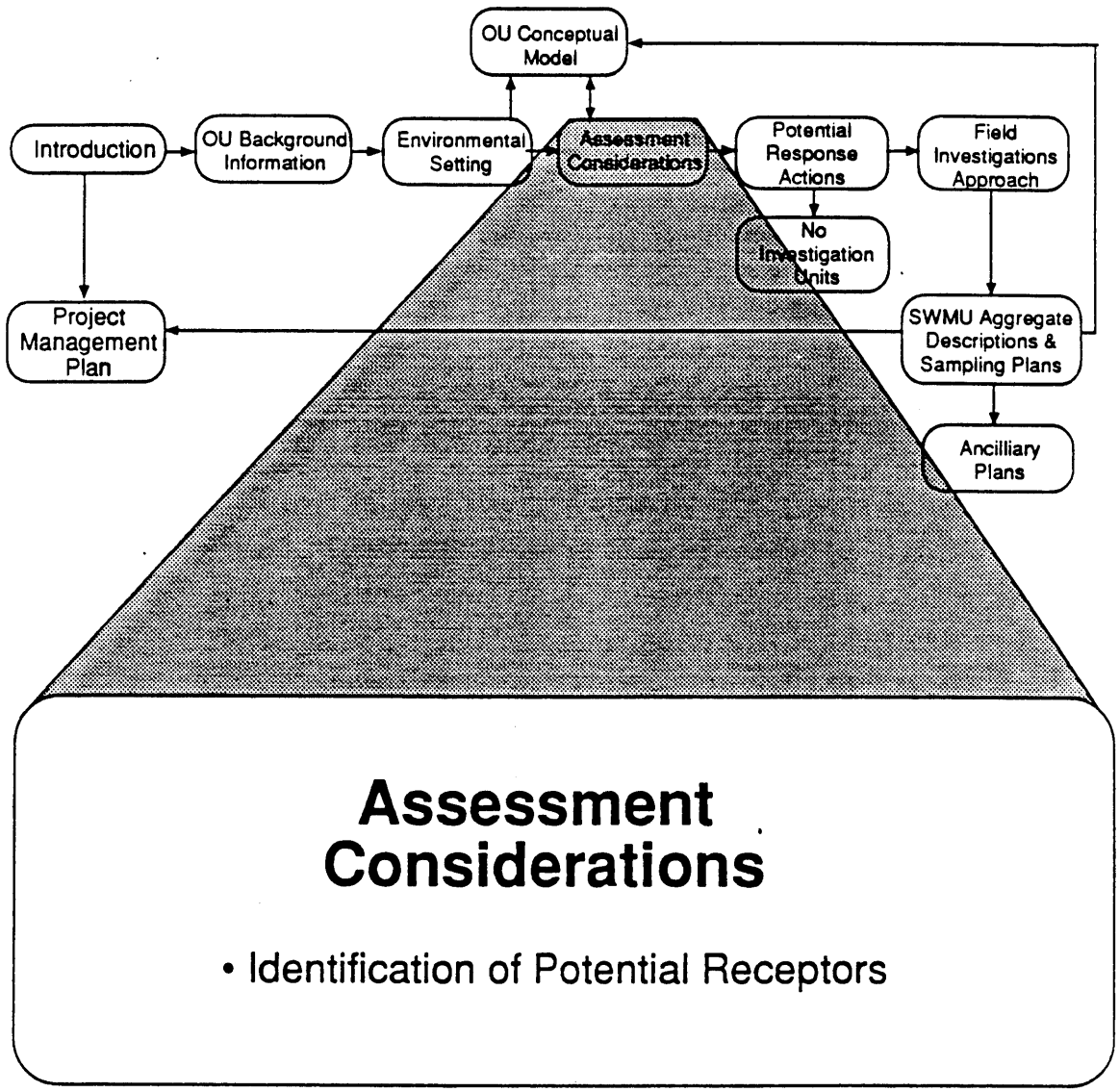
CHAPTER 6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• Identification of Potential Receptors

6. IDENTIFICATION OF POTENTIAL RECEPTORS

The identification of populations representing potential receptors for contaminants released from SWMUs at TA-21 is based on the pathways described in Chapter 5, Potential Migration Pathways. Several subjects are addressed in this section as follows:

- local human populations are identified, including on-site workers at TA-21;
- potential exposure routes are determined;
- pathway-specific receptors are considered; and
- present and future land use patterns are discussed.

This chapter presents available information and identifies additional data needed for assessing threats to human health or the environment. The identified data needs will be acquired during the facility investigation. In future activities, these data will be used to assess the need for interim corrective measures, to perform baseline risk assessments for evaluation of no-action alternatives, and to evaluate the relative benefits of competing remedial alternatives.

6.1. Local Populations

The IWP (LANL 1990) describes the population distribution within a 50-mile radius of the Laboratory (Sec. 2.5.4, Population Distribution). The IWP presents a table documenting population density in 9 distance intervals for 16 compass directions, based on 1989 projections from 1980 census data.

The closest residents to TA-21 are located within 1 km to the north-northwest, in an area of Los Alamos referred to as the Eastern Community. Residences are also located within 1 km to the northwest. In this area are located several businesses, churches, recreational facilities (community pool and park), and a nursing home. The rest of the town of Los Alamos lies within a radius of 6 km in the quadrant from due north to due west. The IWP gives the population of Los Alamos as 12,100.

The town of White Rock lies within Los Alamos County approximately 7 km to the southeast. The IWP gives the population of White Rock as 7,200. Several isolated rental dwellings are located at Totavi, approximately 8.5 km east of TA-21 in the lower reaches of Los Alamos Canyon.

More than 100 Laboratory employees currently have offices and laboratories at TA-21, which remains an operational facility. The Laboratory's long range plans call for decontamination and

decommissioning of DP West (see Sec. 2.4.1); therefore, the number of Laboratory employees at TA-21 will decrease in the future.

Data needs. A more refined distribution of population close to TA-21 is needed. Identification of sensitive population groups, maximally exposed groups, and other similar categories is needed.

6.2. Land Use

Land use in the vicinity of the Laboratory (including TA-21) is described in IWP Sec. 2.5.1, Land Use Patterns. For the TA-21 OU, land use in the immediate vicinity is unlikely to change while present social and political institutions continue to function. Land presently occupied by TA-21 and the neighboring canyons is expected to remain under DOE/Laboratory control. Outside of the immediate vicinity of TA-21, land use patterns can be expected to remain within the constraints imposed by the environment: little large-scale agriculture is anticipated, home gardens are typical, residences will be primarily in developed areas, low-intensity cattle grazing will occur in the lower reaches of the canyons on Indian land to the east.

Because the primary purpose of the town of Los Alamos is to support the Laboratory, the land would probably revert to National Forest or National Park Service (Bandelier National Monument) control if the Laboratory ceased to exist (i.e., loss of institutional control). In this case, recreational users and direct contact would need to be considered.

Data needs. An assessment of potential land use scenarios needs to be developed. This should address land use options that are tied to specific remedial alternatives. For example, future land use options may differ depending on whether a material disposal area is capped in place or removed. Detail is required on present land uses. This detail should include estimates of the intensity of recreational use of canyon areas and identification of specific areas used for cattle grazing.

6.3. Routes of Exposure

Under the current land use patterns in the vicinity of the TA-21 OU, no pathways or receptors are of concern. However, if land use patterns change in the future (i.e., loss of institutional control), exposure pathways would be of concern. For each contaminated medium identified in Chapter 5, routes of exposure for potential receptors have been identified (Fig. 6.3-1). For airborne contaminants, both inhalation and dermal contact have been identified. Tritium may be absorbed through the skin, and that is a route of exposure for some chemicals. For contaminated soil surfaces,

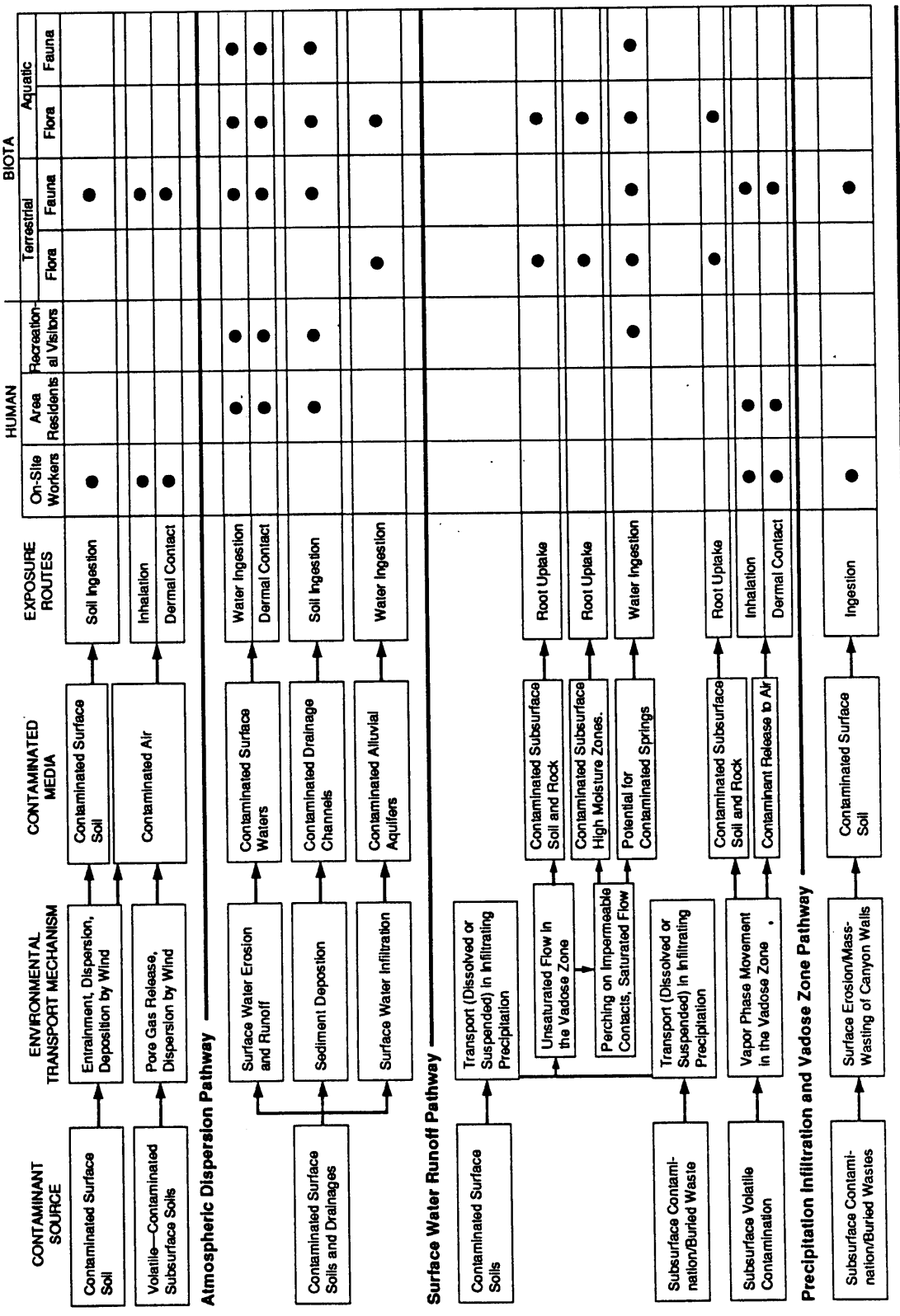

Fig. 6.3-1 Exposure routes and potential receptors for each contaminant transport pathway.

ingestion has been cited as the potential route of exposure to account for accidental ingestion of soil by adults and the often intentional ingestion by children. Ingestion of water is listed as a potential exposure route for running surface water as well as seeps and springs, although the potential for such ingestion is considered small. Ingestion is also a possible exposure route for the alluvial aquifers although, again, little potential exists. No human exposure routes for contaminants held in deep soil and rock were identified; only deep rooted plants are considered to have access to such contaminants.

Data needs. For several routes of exposure, there is a need to identify specific points of exposure and critical population groups that may have access to those locations. The exposure points may change depending on assumptions regarding future land uses. Identification of contaminants being transported in specific environmental pathways is an important data need — several pathways and exposure routes have been postulated on a conceptual basis and may not in fact be operable pathways.

6.4. Pathway Specific Receptors

For each contaminated medium and route of exposure, potential receptors have been identified in Fig. 6.3-1. The human populations exposed to airborne contaminants and contaminated surface soils include both onsite workers and area residents. Human receptors exposed to surface water run-off and drainage sediments are probably limited to those living downstream (Totavi) or persons hiking along the drainages. In the absence of institutional controls, the exposed human population would consist primarily of recreational users and possible residents. No human receptors could be identified for the contaminated alluvial aquifer or for contaminants retained in the liquid or vapor phase in subsurface rock and soil. A remote potential exists for human ingestion of contaminated water from seeps or springs. This route would be limited to persons hiking along a drainage.

Biota are also identified as potential receptors. Terrestrial biota are predominant because of the climate and the ephemeral nature of flow in the drainages. An exception is a small marshy area with aquatic vegetation in DP Canyon where the discharge from the sewage treatment plant reaches the canyon floor. Deep-rooted flora are the only potential receptors for contaminants in subsurface soil and rock. Small mammals, birds, reptiles, and insects are common terrestrial fauna throughout the area near TA-21.

Data needs. These receptors have been identified on the basis of conceptual evaluations of the pathways and limited available information regarding contaminant distribution at TA-21. As

results of contaminant source and distribution studies are assessed, the focus on particular receptors may need to be reconsidered. A particular data need is for specific information on the presence of contaminants at points of exposure. Detailed exposure scenarios need to be developed based on identified exposure points, specific populations having access to the exposure points, and the identified contaminants of concern. For biota, a baseline biological survey of flora and fauna is needed.

6.5. Risk Assessment Issues

The considerations described above set the groundwork for health risk assessments that may be used to identify a need for immediate corrective actions or to assess the relative benefits offered by several remedial alternatives. To conduct such risk assessments, additional information is required that is independent of the facility investigation.

Data needs. Data are needed on the physiochemical nature of the contaminants that are determined to be migrating in the environment and available, or potentially available, at points of exposure. Action levels and other regulatory levels should be identified for those contaminants (some action levels have already been identified in the IWP), as well as the reference doses, slope factors, and other parameters required to estimate health risks from the particular radiological and chemical contaminants. An additional need is for the development of a standard method for combining radiological and chemical risk estimates to allow comparable decisions to be based on risks from either type of contaminant.

6.6. Current Risk Estimates

As a part of the Laboratory's annual environmental surveillance activities, estimates are made of the radiation exposures and health risks presented by Laboratory operations to local populations. These estimates are based on known releases from operating facilities and on the data collected at the environmental monitoring stations on and around the Laboratory. Data from some of those stations that are close to TA-21 are discussed in Sec. 4.2, Background Environmental Data and Sec. 5.2, Environmental Pathways. Although the estimates are prepared for the Laboratory as a whole, they are summarized here to provide a perspective on potential risks related to the TA-21 OU, which is small part of the Laboratory.

The environmental surveillance report documenting activities for 1988 (ESG 1989), indicates that the DOE Radiation Protection Standard (RPS), under which the Laboratory operates, limits radiation doses (effective dose equivalent) to 100 mrem/yr from all exposure pathways. In

addition, exposure by the air pathway is limited to 25 mrem/yr in accordance with EPA requirements. The report states that the estimated dose to the maximum individual was 6.2 mrem in 1988 and was delivered primarily by the air pathway. The primary source of the airborne radioactivity was the Los Alamos Meson Physics Facility (LAMPF) located 1 km southeast of TA-21. For comparison, the average background radiation exposure to individuals living in Los Alamos is approximately 336 mrem/yr from all sources.

The environmental surveillance report estimates that the incremental risk of cancer to residents of Los Alamos due to 1988 Laboratory operations was 1.2×10^{-8} (ESG 1989). Of that risk, the TA-21 OU can represent only a small part.

The risk assessment data needs described in preceding sections of this chapter are pertinent even in the light of the small risks currently estimated. Those data are required to assess risks for chemicals in addition to radionuclides, and they are needed to assess exposure scenarios that differ from the current land uses.

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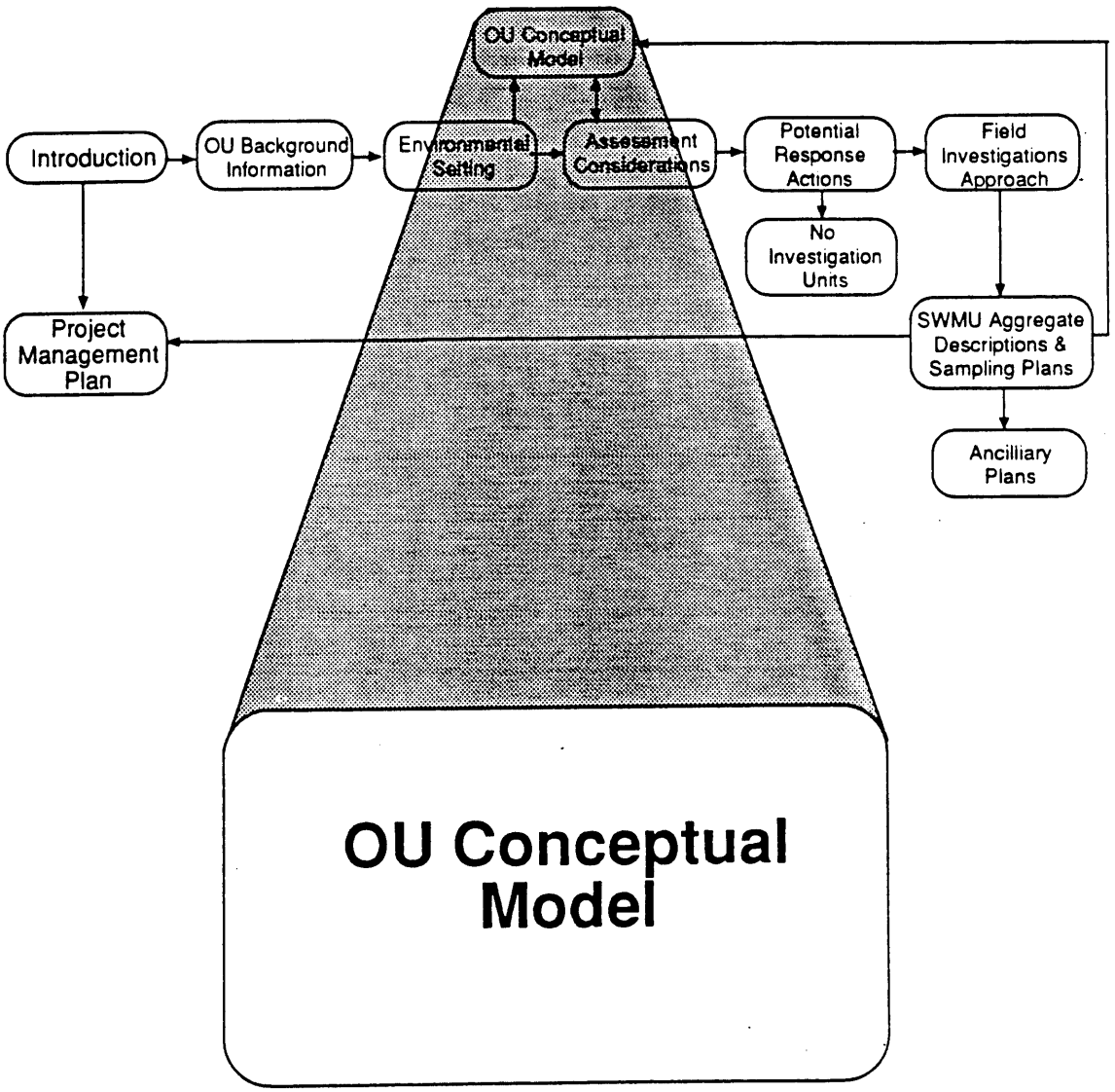
CHAPTER 7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7. CONCEPTUAL SITE MODEL

7.1. Development of the Conceptual Model

A conceptual site model has been developed through the discussions in the preceding three chapters and is summarized here. In diagram form, the conceptual model of contaminant release and transport and potential routes of exposure is presented in Fig. 7.1-1. The model is based on the present understanding of the TA-21 environment as presented in Chapter 4. The major pathways included in the model are based on present knowledge of the types of SWMUs present at TA-21 (four conceptual categories are identified in Sec. 5.1). The pathways descriptions include the primary release mechanisms, the environmental transport process, and the resulting contaminated media for each pathway (four pathway networks are described in Sec. 5.2). Exposure routes and potential receptors for the contaminated media resulting from each pathway are described in Chapter 6.

The data acquired from the field investigations planned in this RFI work plan will provide needed information to allow assessment of conditions at each SWMU. It is expected that initial assessments of the data will allow the current list of SWMUs to be reduced to those that actually have had releases of contaminants and those with source terms with the potential to migrate. The field investigations will also identify the magnitude of contaminant transport along each pathway and will allow the relative importance of the various pathways to be assessed. When these assessments have been made, the need for quantitative, mathematical models to describe contaminant transport will be determined.

At present, the site model is conceptual and serves to focus the investigations on the contaminant sources, contaminant properties, and environmental processes believed to be important at TA-21. If acquired data demonstrate that a different focus is appropriate, the conceptual model will be revised and the new focus will be pursued in subsequent investigations.

7.2. Elements of the Conceptual Model

Key concepts for each element of the conceptual model are summarized in the following paragraphs and amplified in Table 7.2-I. Figure 7.1-1 illustrates the overall conceptual model for TA-21.

Under the current land use patterns in the vicinity of the TA-21 OU, no pathways or receptors are of concern. However, if land use patterns change in the future (i.e., loss of institutional control),

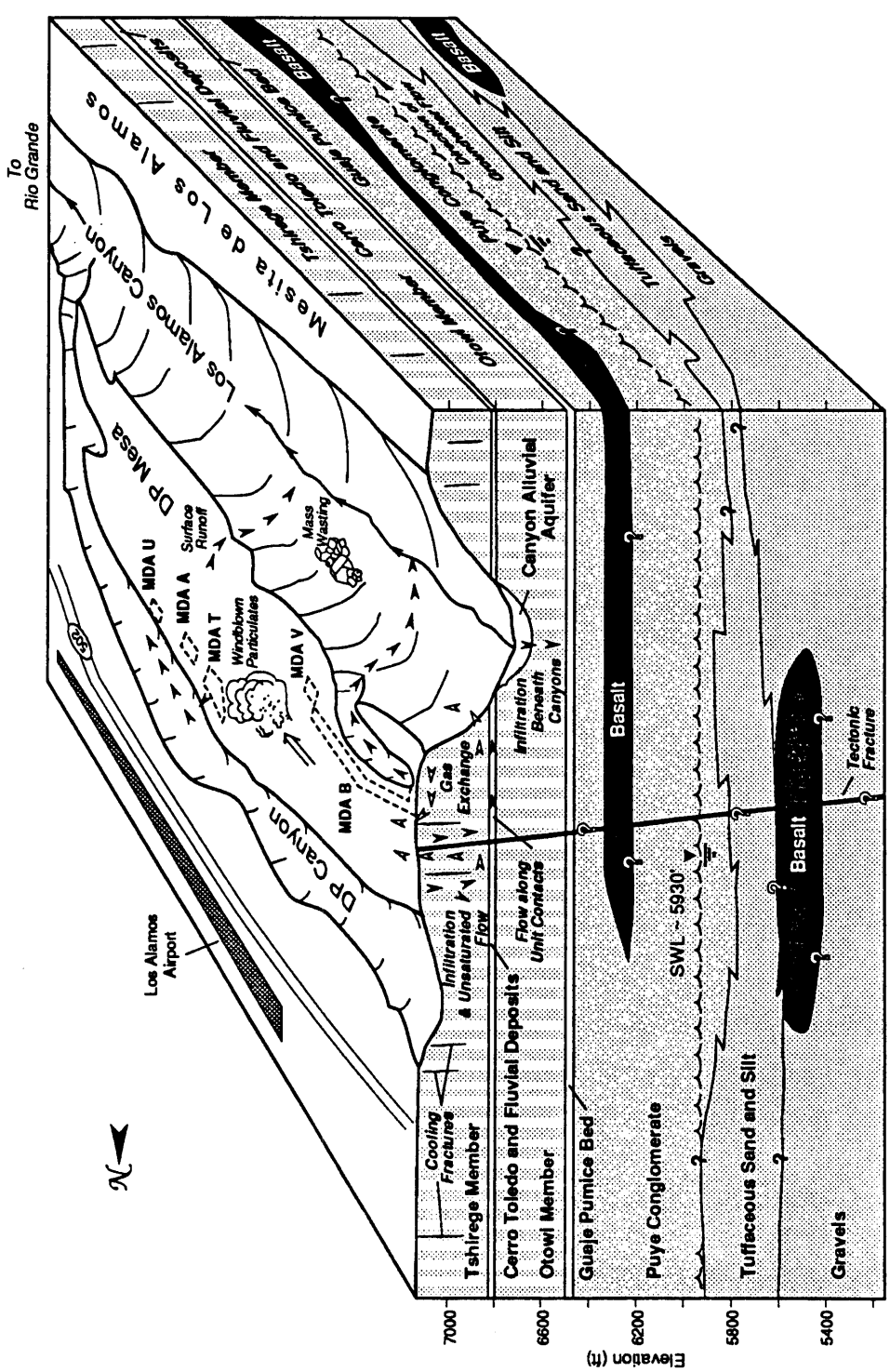


Fig. 7.1-1 Three-dimensional conceptual model of TA-21.

the primary exposure pathways of concern would be

- surface run-off and sediment transport and
- erosion and surface exposure.

Both unsaturated zone transport (in both the liquid and vapor phase) and the groundwater pathway are not of direct concern, based on the great depth and no known pathway to the main aquifer system.

Surface run-off and sediment transport. Water is perceived as the key component for contaminant migration at TA-21. Precipitation infiltration, run-off and soil erosion, and the subsequent movement and fate of the water and transported contaminants in the TA-21 environs constitute the basic components for understanding the system at TA-21.

Erosion and surface exposure. Erosive exposure processes are long-term release mechanisms serving to expose to the environment previously contained contaminants or to provide access of water to previously protected wastes. An understanding of these processes is necessary primarily for the design of certain remedial measures.

Should loss of institutional control occur, direct contact as a result of either recreational use or gardening will become the primary potential exposure rate.

Although not believed to be a significant pathway, wind entrainment of soil-borne contaminants, tritiated water vapor, or volatile organic compounds can be a pathway for widespread dispersal of contaminants. Dispersal is limited to surficial deposits, and gases and vapors exchanged to the atmosphere from soil pore-gas.

7.3. Conceptual Model Refinement

Site characterization data will enable further refinement of the conceptual model by providing data that either support the current model or redefine the site conceptual model. Not all data to support the conceptual model refinement will be collected at TA-21. The ER Program is currently developing regional characterization studies. Results of these studies will be integrated into the TA-21 OU conceptual model development.

Correctly defining the 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, to test hypothesis, and to support the CMS.

TABLE 7.2-I SUMMARY OF CONCEPTUAL MODEL ELEMENTS

Pathway/Mechanism	Concepts/Hypotheses
Atmospheric Dispersion	
Particulate Dispersion	• Entrainment is limited to contaminants in surface soils. • Entrainment and deposition are controlled by soil properties, surface roughness, vegetative cover and terrain, as well as atmospheric conditions. • Atmospheric conditions affecting entrainment, dispersal and deposition include wind speed, direction, stability class, and precipitation.
Gas/Vapor Dispersion	• Gas exchange between the subsurface and atmosphere provides the release mechanism for volatile contaminants, such as tritium or volatile organic compounds. • Gas exchange between the rock and atmosphere is a function of temperature gradients and barometric pumping. • Fractures may be facilitators of gas exchange between the rock and the atmosphere. • Atmospheric conditions affecting dispersal include wind speed, direction, stability class, and precipitation.
Surface Water Run-off	
Surface water	• Precipitation that does not infiltrate will become surface run-off. • Surface run-off is concentrated by natural topographic features, or man-made diversions, and flows towards the canyons. A topographic low can cause the water to pond on the mesa top, but in most cases the water will flow into the canyon. • Contaminant transport by surface run-off can occur in solution, sorbed to suspended sediments, or as mass movement of heavier bed sediments. • Surface run-off may carry contaminants beyond the TA-21 OU boundary. • Contaminated surface run-off may infiltrate the canyon bottom alluvium.

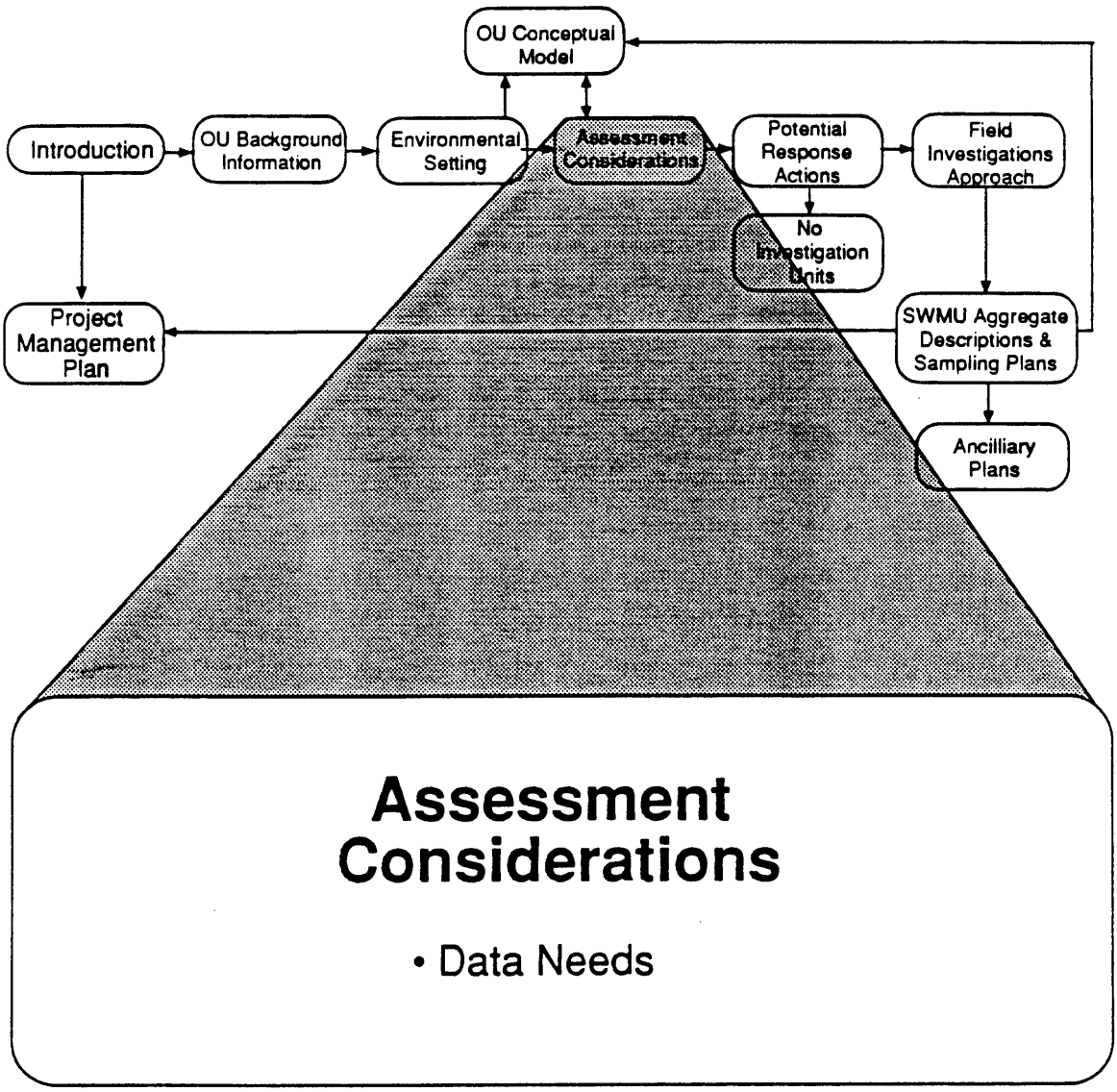
Sediments	• Surface soil erosion and sediment transport is a function of run-off intensity and soil properties. • Contaminants dispersed on the soil surface can be collected by surface water run-off and concentrated in sedimentation areas in drainages. • Erosion of drainage channels can extend the area of contaminant dispersal in the drainage way.
Alluvial aquifers	• Surface run-off discharged to the canyons may infiltrate into sediments of channel alluvium. • Flow in the alluvial aquifer under saturated conditions will be down channel, and can be represented by a porous media continuum model. • Retardation of contaminants will be primarily by sorption in the alluvium or on organic material that is present in the alluvium. • Water in the alluvial aquifer may enter the underlying tuff. The process will depend on the properties of the interface between the saturated alluvium and unsaturated tuff.

Infiltration and Vadose Zone Transport.

Infiltration	• Infiltration into surface soils depends on the rate of precipitation or snowmelt, antecedent soil water status, depth of soil, and soil hydraulic properties. • Infiltration into the tuff depends on the unsaturated flow properties of the tuff. • Joints and fractures in the tuff may provide additional pathways for infiltration to enter the subsurface regime.
Unsaturated flow - liquid phase	• Movement of liquids in the Bandelier Tuff is dominated by unsaturated flow processes. • Transient rather than steady state conditions may describe the hydraulic character of the near-surface tuff. The influences include surface water infiltration and evapotranspiration. • Liquid water flow under ambient conditions can be represented by a porous media continuum model. • A condition of non-flow may be present in the tuff below the influence of transient surface moisture effects. • The movement of contaminants by liquids in the unsaturated zone may be in solution or as suspended solids.

	• Retardation of contaminants will be primarily due to sorption on the tuff or organic material that is present on the tuff. • Fractures may affect liquid transport. Their role is hypothesized to be dependent on the soil water content. Above a critical water content, fractures are expected to facilitate flow and transport. Below the critical water content, rock matrix properties will dominate the hydraulic response.
Unsaturated flow - vapor phase	• Vapor phase processes are important as a transport process for certain contaminants. Matrix influences include porosity, permeability, moisture content and other properties of the tuff. • The exchange of pore gas with atmospheric air is a release mechanism for vapor phase contaminants, and is influenced by temperature gradients and atmospheric pressure changes. • Fractures may be facilitators of gas exchange both within the rock and with the atmosphere.
Lateral flow at unit contacts	• Contrast in hydraulic properties between layers or due to inclusions may divert flow laterally, or may cause a perched water zone to develop. • Laterally diverted flow may find surface expression as springs or seeps. • Perched water zones may provide localized areas where saturated flow conditions may occur.
Erosive Exposure	
Soil Erosion	• The erosion of surface soils is dependent on soil properties, vegetative cover, slope and aspect, exposure to the force of the wind, and precipitation intensity and frequency. • Erosion may be controllable by natural or man-made surface features. • Depositional areas as well as erosional areas exist, and erosive loss of soil may not occur in all locations.
Mass Wasting	• The loss of rock from the canyon walls is discontinuing, observable process. • The rate of the process is extremely slow.

CHAPTER 8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8.0 DATA NEEDS

This chapter succinctly summarizes the overall data needs for the TA-21 OU generated from discussions of available information on the environmental setting, potential migration pathways, and risk assessment in Chapters 4 through 6, respectively (Table 8-I). Specific plans for obtaining the needed data are presented in the field sampling plans (Chapters 12–18). The SWMU-specifi, contaminant-related data needs are also identified in Chapters 12-18, and summarized in Table 8-II.

TABLE 8-I. SUMMARY OF DATA NEEDS FOR THE TA-21 OU RFI WORK PLAN

Objective	Data Need
Characterize Site Hydrogeology	
1. Determine site stratigraphy, depth and nature of unit contacts for upper vadose zone.	• Select locations across entire OU for subsurface characterization investigations. • Borehole coring and lithological logging to identify units and characterize unit contacts in the upper 300 ft of tuff.
2. Determine physical, mineralogic and hydrologic properties important to unsaturated and vapor phase migration for upper units of the Bandelier Tuff.	• Mineralogic analysis of borehole cores. • Physical/hydrological measurements on borehole core samples. • Downhole logging of boreholes to identify changes in moisture, density, mineralogy with depth. • Downhole video to inspect fractures, joints, unit contacts. • Downhole air permeability tests.
3. Investigate rate of water/vapor migration using dating of native water in tuff.	• Isotope ratios on water extracted from bulk tuff and fractures/joints.
4. Investigate nature of joints and fractures in the tuff as potential barriers or migration routes	• Measurements of moisture content and mineralogical differences. • Evidence of impermeable layers and elevated moisture zones. • Measurements of air permeability differences *in situ*. • Geochemical characterization of core samples.
Characterize Site Morphology	
1. Identify surface geology, unit contact expressions, expressions of paleo-erosional surfaces.	• Geologic map of entire OU. • Measurements of exposed units in DP and Los Alamos Canyon cliffs.
2. Characterize morphology of drainages.	• Locations of erosional and depositional areas, drainage paths. • Measurements of chemical and radiological contaminant levels in sediment samples.
3. Investigate presence of fault expressions and fracturing to confirm or refute projection of a possible fault beneath MDA V.	• Field studies and drilling to determine location and character of possible fault beneath MDA V.

4. Determine if faults affect the distribution of subsurface units, or provide potential pathways for contaminant migration.	• Field investigations, fracture mapping, observation of contact offsets to identify any expression of faulting in the upper units of the tuff.

Characterize Mesa-wide Surface Contamination

1. Characterize contaminant levels in surface soils across the entire OU to form a basis for comparison.	• Establish a grid for mesa-wide investigations. • Establish a grid for mesa wide investigations. • Collect surface soil samples (6 in.) for chemical and radiological analysis, use same sample interval as will be used for all SWMU investigations. • Make measurements with radiological survey instruments to determine ambient readings across the mesa.
2. Characterize contaminant levels in near-surface soils across the entire OU to form a basis for comparison.	• Collect near-surface soil samples for chemical and radiological analysis, use same sample intervals (6 in,) and typical depth (24 in.) as will be used for individual SWMU investigations.
3. Characterize contaminants in a thin layer at the soil surface as an indication of wind deposited contaminants from past stack releases.	• Use site wide grid. • Collect deposition layer samples (1 in.) for comparison to thicker surface soil samples (6 in.) to identify if contaminants are confined to a thin layer on the soil surface.

Characterize Contaminant Sources

1. Identify the presence of contaminants at each SWMU.	• Sampling at release points. • Field screening at point of collection for health and safety, and to flag grossly contaminated samples. • Use field laboratory analyses to aid in directing field work.
2. Identify the contaminants.	• Laboratory analyses using standard methods for radiological contaminants. • Laboratory analyses using SW-846 methods for chemical contaminants.

Characterize Nature and Extent of Contamination

1. Identify any evidence of migration of contaminants away from each SWMU.	• Sampling along preferential paths of migration. • Additional sampling to document other avenues of migration and extent of generalized contaminant spreading (boreholes at radial increments, surface grids).

	• Field screening as above. • Field laboratory measurements as a screening tool for identified contaminants to reduce analytical laboratory burden, and to aid in guiding field work.
2. Identify mobile contaminants.	• Laboratory analysis to identify the contaminants that are migrating. • Analysis methods as above.

Provide Data for Baseline Risk Assessment

1. Identify potential receptors for each pathway.	• Exposure points for each major pathway. • Population distribution, access to exposure points. • Future land use scenarios.
2. Determine contaminant fate and transport.	• Data on the physiochemical processes associated with site contaminants based on the literature and site specific information.
3. Assess contaminant levels against action levels and other guides.	• Action levels or other regulatory levels for contaminants at the site.
4. Assess threat to public health and the environment from the no action remedial alternative.	• Reference doses and slope factors for contaminants at the site. • Exposure scenarios.
5. Assess potential remedial measures.	• Data regarding the effectiveness of each remedial alternative. • Reference doses and slope factors for contaminants at the site. • Exposure scenarios.

Provide Data for Assessing Remedial Alternatives

1. Assess potential remedial measures.	• Information on migration pathways to be blocked. • Information on effectiveness of the remedial measure. • Information on ease of implementation, long term effectiveness, cost.

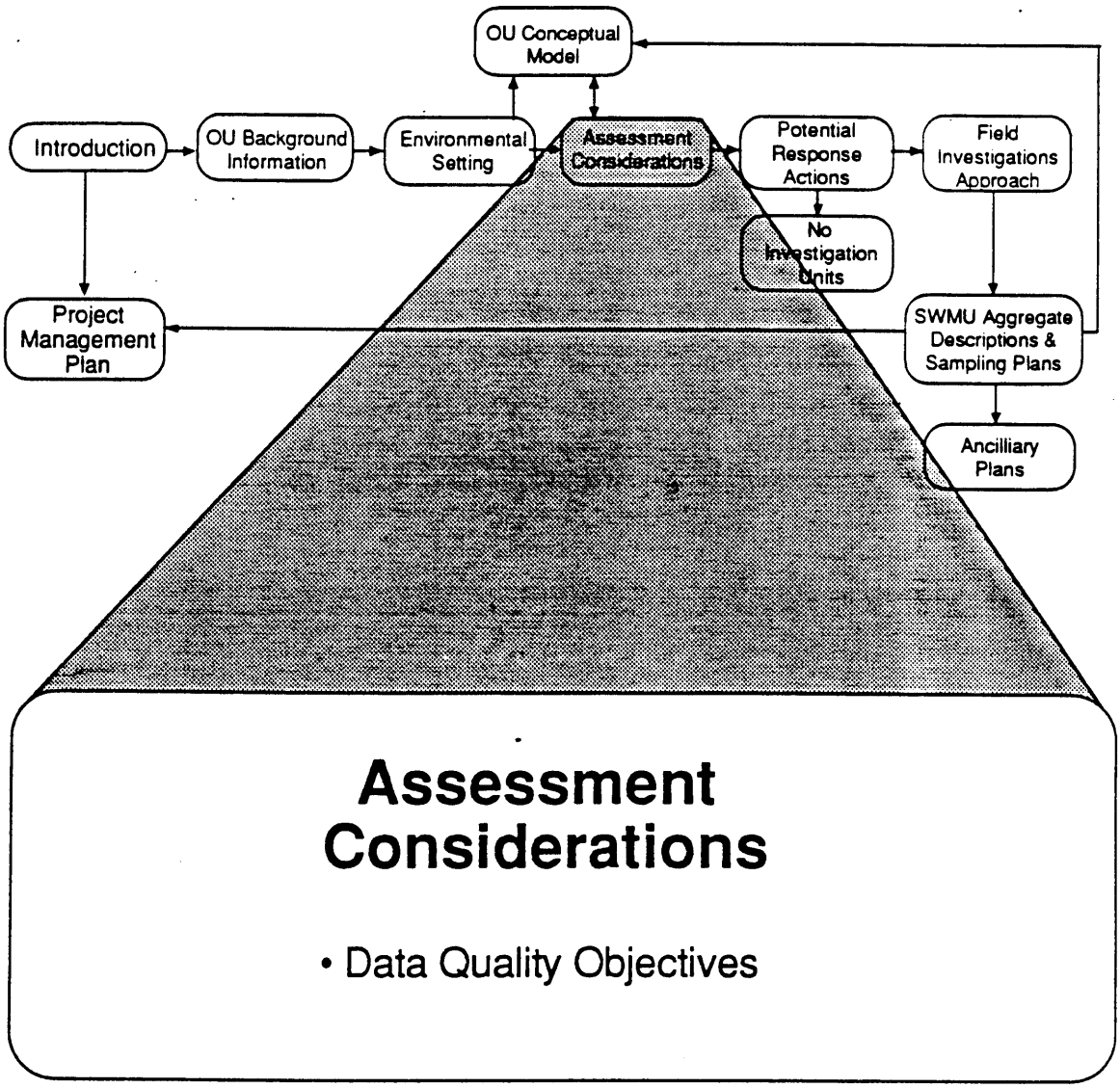
TABLE 8-II. SUMMARY OF SWMU-SPECIFIC DATA NEEDS

Investigation Unit	SWMU #	Determine location of unit	Identify presence/absence of contaminants in unit	Establish contaminant suite related to unit	Determine lateral extent of contamination	Identify depth of contamination	Estimate source volume/concentration	Estimate contaminant plume volume/concentration	Assess interaction of contaminants with air pathway	with surface water pathway	with groundwater pathway	with biotic pathway	Determine direction and rate of transport by air	by surface water	by groundwater	by biota	Estimate potential impact on human health	on environment	No further action
Storage Areas and Tanks	-002	x	x	x	x	x		x		x		x		x		x	x		x
	-003		x	x	x	x		x		x		x		x		x	x		x
	-004		x	x	x	x		x	x		x				x	x		x	x
	-028 (d),(e)		x	x	x	x		x	x		x				x	x	x		x
	-029		x	x	x	x		x		x		x		x		x			x
Surface Disposals	-013 (b)–(f)	x	x	x	x	x	x	x		x		x	x		x		x		x
Stack Emissions	-007, -008 -019, -020 -021		x	x	x	x	x	x		x		x		x		x	x		x
No Investigation Units	-025																		x
	-012(a)																		x
	-028(e)																		x
	-029(b)																		x

TABLE 8-II (continued)

Investigation Unit	SWMU #	Determine location of unit	Identify presence/absence of contaminants in unit	Establish contaminant suite related to unit	Determine lateral extent of contamination	Identify depth of contamination	Estimate source volume/concentration	Estimate contaminant plume volume/concentration	Assess interaction of contaminants with air pathway	with surface water pathway	with groundwater pathway	with biotic pathway	Determine direction and rate of transport by air	by surface water	by groundwater	by biota	Estimate potential impact on human health	on environment	No further action
Outfalls	-023(c), -024 -027, & outfalls	x	x		x	x	x	x		x		x		x		x		x	x
MDAs	-014 to -018, -001, &028(a)		x		x	x	x	x		x		x		x		x		x	x
Subsurface Units	-005, -006(b)		x		x	x	x	x		x		x		x		x		x	x
	-009		x		x	x	x	x		x		x		x		x		x	x
	-012		x		x	x	x	x		x		x		x		x		x	x
D & D Units	-006(a),(c)–(f)	x	x		x	x	x	x		x		x		x		x		x	x
	-022				x	x	x	x		x		x		x		x		x	x
	-023(a),(b),(d)	x	x		x	x	x	x		x		x		x		x		x	x
	-028(b),(c)		x		x	x	x	x		x		x		x		x		x	x
Areas of Concern		x	x		x	x	x	x		x		x		x		x		x	x

CHAPTER 9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• Data Quality Objectives

9. DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are qualitative and quantitative statements that specify the type, quality, and quantity of data collection needed to guide the decisions that will achieve the objectives of the RFI (EPA 1987). In Chapter 2 (see Sec 2.3.2, TA-21 Objectives and Approach) the SWMU-specific and OU-wide objectives of the TA-21 OU RFI were established as follows:

- Identify contaminants (if any) present at each SWMU.
- Determine the nature and extent of contamination for each SWMU.
- Identify pathways of contaminant migration from each SWMU and for the operable unit as a whole.
- Characterize the TA-21 environment sufficiently to allow quantitative migration pathway and risk assessment analyses, as necessary.
- Provide necessary data for initial assessment of remedial alternatives.
- Provide the basis for planning detailed corrective measures studies.

In the course of planning each aspect of the facility investigation, specific data needs were identified for achieving the objectives. These data needs have been listed in each section of Chapters 4–7 and 12–18, and have been summarized in Chapter 8, Data Needs. In Chapter 11, Methods, and in Appendix A, TA-21 Quality Assurance Project Plan, the analytical or other methods required to provide the needed level of data quality have been identified in specific detail.

This chapter documents in summary form the results of the application of the DQO process to the planning of investigations at TA-21. The summary addresses these issues as follows:

- The definition of required data quality for each data type to achieve the objectives and data needs given in Chapter 8. This is addressed by specifying the methods to be used to provide data sufficient for the intended use.
- Definitions of data quality levels (DQO Levels) to be used as abbreviated descriptions of data quality in the field sampling plans (Chapters 12–18).

9.1. DQOs for Identified Data Types

The purpose of the DQO process is to provide a method for determining the amount and quality of data required to support decisions during the RFI. The data requirements are integrated with the development of field sampling plans and are represented there by specifying the number and analytical level of data points required at individual SWMUs (Chapters 12–18). This section summarizes, by data type and intended data use, the level of quality needed to meet the objectives of investigations at each SWMU and the overall data needs and data use objectives given in Chapter 8.

Table 9.1-I summarizes data types for OU-wide characterization activities. As can be seen in Table 9.1-I, high quality data are required for all OU-wide characterization activities. Two reasons account for the emphasis on higher quality data over less expensive types of information as follows:

- OU-wide measurements of hydrogeological parameters provide the basis for contaminant transport modeling and may be instrumental in health risk analyses.
- Surface and subsurface "background" contaminant levels will be established OU-wide. These values will be used as a basis of comparison for identifying SWMU-related contaminant levels. These data need to be of high quality because they are used as a basis for the decision to take no further action at an individual SWMU.

For SWMU-specific investigations, four general types of data will be collected: field screening, field survey, field laboratory, and analytical laboratory (see Chapter 11 for detail). The intended data usage and required data quality for these data types are summarized in Table 9.1-II, and fall into several categories as follows:

- Field identification of sources of contamination
- Health and Safety-related information
- Early identification of grossly contaminated samples
- Delineation of contaminated zones prior to sampling for high quality analysis

- Guidance for making decisions regarding the effectiveness of the sampling plan during the course of field operations
- High-confidence-level analysis for contaminant species

9.2 Definition of Analytical Level DQOs

Four analytical data quality levels (DQO Levels) are used as abbreviated statements in describing SWMU-specific, contaminant-related data needs in the field sampling plans (Chapters 12–18). Characteristics of the four categories (EPA 1987) are given in Table 9.2-I. As defined for use in this document, the categories include:

- Level I — data from survey methods used to identify contaminants *in situ* or field sample screening methods to be used at the point of sample collection.
- Level II/III — field laboratory measurement methods used to provide rapid quantitative or semiquantitative sample analyses during the course of field operations.
- Level III/IV — analytical laboratory methods used to provide accurate, precise, defensible data.

TABLE 9.1-I DATA TYPES FOR TA-21 OU-WIDE CHARACTERIZATION ACTIVITIES

Data Type	Intended Uses	Required Data Quality
OU-Wide Subsurface Characterization		
Mineralogy/geochemistry (e.g., clay mineral content , zeolite mineralogy, cation exchange capacity, sulfate mineral content, etc.)	Predict contaminant movement through tuff.	Standard laboratory methods. Standard operating procedures. The intended use is consistent with normal use of these data, thus standard methods provide appropriate data quality.
Hydrogeological parameters (e.g., moisture content, bulk density, porosity, permeability, moisture characterization curve, hydraulic conductivity)	Estimate flux through vadose zone.	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.
	Estimate velocity in vadose zone.	
	Estimate contaminant movement in vadose zone.	
	Input to a flow and transport model.	
Pore gas sampling (e.g., straddle packer tests, isotope characterization af water extracted from bulk tuff)	Delineate depth of migration of water that has infiltrated into the subsurface below DP Mesa.	Standard field and laboratory methods are to be used. These were developed for the intended data uses and provide data of sufficient quality.
	Determine absolute ages of pore water in vertical hydrostratigraphic section of 300 ft deep boreholes.	
	Characterize vapor transport pathways by determining in situ permeability.	

TABLE 9.1-I DATA TYPES FOR TA-21 OU-WIDE CHARACTERIZATION ACTIVITIES

Data Type	Intended Uses	Required Data Quality
OU-Wide Surface Characterization		
Geomorphology (e.g., geologic base map, drainage patterns, sediment deposition areas)	Identify surface geologic features that may influence contaminant movement, contaminant distribution, and the capping/stabilization-in-place remedial option.	Standard geological field methods will be used. Procedures used will be documented. This will provide sufficient quality for the identified uses.
	Determine potential contaminant collection areas.	
	Determine if overland or channel flow can result in offsite transport, and if flow patterns identify contaminant transport pathways.	
Fault/fracture mapping	Determine the potential for contaminant transport via faults and fractures.	Standard geological field methods will be used. Procedures used will be documented. This will provide sufficient quality for the identified uses.
	Determine potential impact on site stability and feasibility of stabilization-in-place remedial options.	
Surface contaminant characterization.	Provide a basis for comparison to determine whether individual SWMUs are contaminated.	Analytical laboratory analyses providing Level III/IV data are required.

TABLE 9.1-II DATA TYPES FOR SWMU-SPECIFIC CHARACTERIZATION ACTIVITIES

Data Type	Intended Uses	Required Data Quality
Field surveys (e.g. gross gamma, phoswich, geophysical)	Direct reading/recording instruments to scan land surface and measure in situ conditions.	Level I data are acceptable for identifying sources of contamination.
Field screening (e.g., gross gamma, gross alpha, organic vapor, lithological logging)	Point of collection sample measurements.	Level I data are acceptable for identifying contaminated samples and other intended data uses.
	Identify grossly contaminated samples.	
	Document sample lithology.	
	Support Health and Safety operations.	
Field laboratory measurements (gross alpha, gamma spectrometry, tritium, volatile organics, PCBs, soil moisture)	Guidance to field operations (i.e., borehole stopping criteria)	Primarily Level II data will be used since a significant number of confirmatory analytical laboratory measurements will be obtained.
	Aid in selecting judgmental sampling locations (e.g., to select "hot" samples for contaminant identification, or to select "no detect" samples for analytical laboratory confirmation)	Some of the techniques may be Level I or Level III, as well.
	Analytical sample load reduction.	
Analytical laboratory measurements (SW846, radiochemistry)	Provide the fundamental high quality, defensible data.	Level III and IV data are considered to be appropriate for these uses. In some circumstances, well-supported Level II data may be acceptable.

TABLE 9.1-II DATA TYPES FOR SWMU-SPECIFIC CHARACTERIZATION ACTIVITIES

Data Type	Intended Uses	Required Data Quality
	Give a broad list of identifiable species. Accurate, precise quantitation. Regulatory agency acceptance. May be used for risk assessment purposes.	

TABLE 9.2-I. SUMMARY OF ANALYTICAL LEVELS APPROPRIATE TO DATA USES[a]

Data Uses	Analytical Level	Limitations	Type of Analysis	Data Quality
Site characterization, monitoring during implementation	Level I	Field screening for organic vapor and radiological detection using portable instruments	Instruments respond to naturally occurring compounds	If instruments calibrated and data interpreted correctly, can provide indication of contamination
		Field test kits		
Site characterization, evaluation of alternatives, engineering design monitoring during implementation	Level II	Variety of organics by GC, inorganics by AA, XRF	Tentative identification	Dependent on quality assurance/quality control steps employed
		Tentative identification, analyte specific	Techniques/instruments limited mostly to volatiles, metals, some radionuclides	Data typically reported in concentration ranges
		Field laboratory analyses for some radiological constituents	Tentative identification and quantification	Dependent on quality assurance/quality control steps employed
		Detection limits vary from low ppm to low ppb		
Risk assessment, site characterization, evaluation of alternatives, engineering design, monitoring during implementation	Level III	Organics/inorganics, using EPA procedures other than CLP, can be analyte specific	Specific identification; tentative identification in some cases	Similar detection limits to CLP
		RCRA characteristic tests	Can provide data of same quality as Level IV	Less rigorous quality assurance/quality control
		Radiological constituent	Specific identification; detection limits below background; with suitable QC, gives comparable quality to SW846 methods	Quality assurance/quality control is comparable to SW846 methods
Risk assessment, evaluation of alternatives, engineering design	Level IV	TCL/TAL organics/ inorganics by GC/MS, AA, ICP	Tentative identification of non-TCL parameters	Goal is data of known quality
		Low ppb detection limit	Some time may be required for validation of packages	Rigorous quality assurance/quality control
Risk assessment	Level V	Nonconventional parameters	May require method development modification	Method-specific
		Method-specific detection limits	Mechanism to obtain services requires special lead time	
		Modification of existing methods		

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

[a]EPA (1987).

References

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

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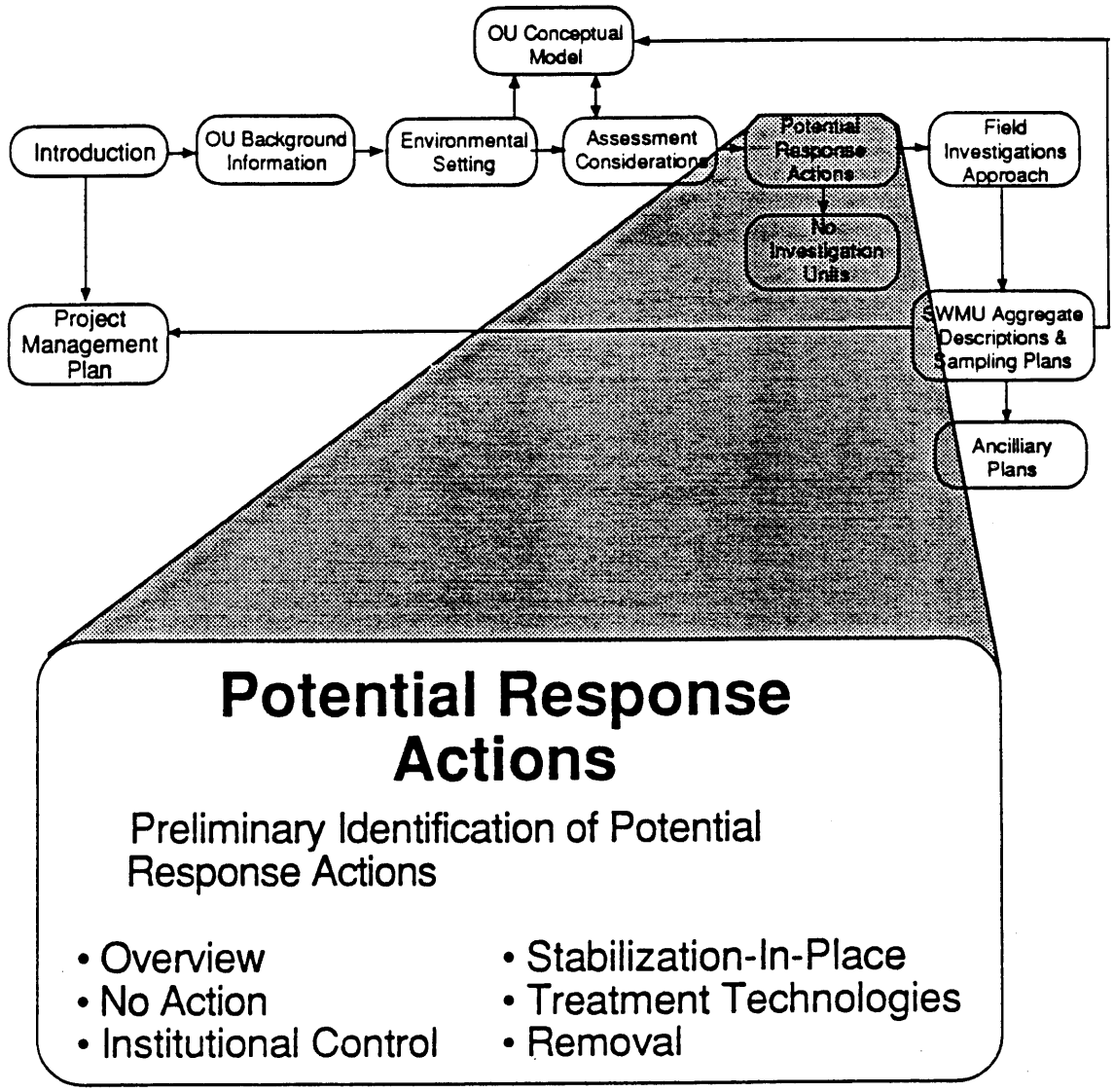
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• Institutional Control
• Stabilization-In-Place
• Treatment Technologies
• Removal

10 PRELIMINARY IDENTIFICATION OF POTENTIAL RESPONSE ACTIONS

10.1 Overview

The IWP Sec. 3.5.2.3 (LANL 1990) details the Laboratory's approach to the RFI to focus field investigations to determine whether a CMS is necessary and to support the performance of a CMS or the design and implementation of a corrective measure. The staged investigative approach being employed for the RFI at TA-21 encourages identification of key data needs as early in the process as possible (see Chapter 8) to ensure that data collection is always directed toward providing information relevant to selection of a remedial action. This chapter provides a preliminary development and screening of technologies and alternatives for TA-21 SWMUs, but detailed screening and analysis cannot be performed until additional data are collected.

Following RCRA Subpart S guidelines and the observational approach, it is appropriate to identify response actions that are probable based on existing data as early as possible in the site characterization process. This helps focus RFI activities to collect data to support and evaluate possible remedial alternatives. After initial site characterization sampling is conducted, potential remedial alternatives for corrective action will be re-evaluated. Any subsequent sampling may differ according to the results of this initial evaluation.

Although uncertainty with regard to both the nature and extent of potential contaminants present at TA-21 SWMUs varies, as detailed by SWMU or SWMU aggregates in Chapters 12 to 19, the following general response actions are believed to be technically feasible and appropriate for use at TA-21 SWMUs, as summarized in Table 10-I:

- no action,
- institutional control (monitoring, fencing, deed control),
- stabilization-in-place (containment such as capping),
- treatment, and
- removal (excavation to RCRA mixed-waste or radioactive-waste landfill).

This section does not give an all-inclusive list of potential remedial alternatives. It focuses on the most likely response actions for TA-21 SWMUs based on existing data. As additional data are collected as part of the RFI, applicable remedial action technologies will be re-evaluated by SWMU or SWMU aggregate. These data will provide for a thorough comparative evaluation of

the technologies with respect to implementation, effectiveness, and cost, and allow for informed decisions to be made with respect to selection of remedial alternatives.

10.2. No Action

The no-action category signifies complete inaction at a given site. It allows conditions and processes currently occurring at the site to continue.

The no-action alternative may be applicable if field investigation results indicate the following conditions:

- not a SWMU;
- no contaminants are present;
- contaminants are present but at concentrations below regulatory action levels; or
- risk assessment demonstrates that the extent of contamination and the associated exposure pathways result in no risk or acceptable risk using the risk assessment methodology to be developed and implemented in the RFI report and the CMS work plan and report.

The no-action alternative also serves as a basis for comparison with other alternatives.

To undertake no action is to refrain from intervening in the fate and transport of contaminants. No action does not necessarily perpetuate the status quo because natural processes may be transforming a site. In this context, the no-action alternative is known as passive remediation. Passive remediation recognizes the effects of natural processes such as biodegradation, volatilization, photolysis, leaching, and absorption that may have beneficial effects on contaminants present at a specific site.

At the majority of TA-21 SWMUs listed in Table 10-I, the no-action alternative may apply for varying reasons detailed in the field sampling plans. The outfall sampling strategy (see Chapter 15) assumes that the no-action alternative is most likely. It is also likely to apply to most surface SWMUs discussed in Chapter 14 and to the ER sampling sites in Chapter 19. If surface soil contamination from stack emissions (Chapter 13) is below action levels or poses no risk to human health and the environment, no action may be required. If risk assessment shows subsurface units pose either no risk or an acceptable risk, it may also apply to Chapter 17 SWMUs.

10.3 Institutional Control

If field investigation results indicate that contaminants are present in concentrations above regulatory action levels or if waste is left in place at a given site, other response actions or combinations of response actions, such as monitoring, fencing, or deed control, may be required. For example, the site could be fenced and monitored to evaluate migration of contaminants over time.

10.3.1 Monitoring

Monitoring involves no substantial action on contaminated media, but it does provide information about the status of contaminants. In situations where no other action is taken, monitoring can serve not only to document passive remediation but also to provide early warning in the event that passive remediation fails to adequately protect human health and the environment. Monitoring may also be needed in situations where containment, collection/removal, or treatment actions are undertaken. Its purpose in these situations would be to document the effectiveness of the remedial actions and to provide early warning in the event the remedial action fails.

The monitoring technology applies to the perched aquifer systems, surface drainage within the area canyons, and the MDAs (see Table 10-I). Monitoring of these entities has already been performed, to varying degrees. At the MDAs, the most likely remedial alternative is believed to be stabilization-in-place followed by long-term monitoring. Additional site-specific monitoring at other SWMUs is technically feasible and may be warranted following evaluation of SWMU-specific data.

10.3.2 Restrictive Use

No technology is required to implement restrictive access (i.e., fencing or deed restrictions). Fencing exists at certain SWMUs, such as the MDAs. Additionally, most community developments near the Laboratory are confined to the mesa tops. The surrounding land is largely undeveloped, with large tracts north, west, and south of the laboratory site held by the Santa Fe National Forest, Bureau of Land Management, Bandelier National Monument, General Services Administration, and Los Alamos County. San Ildefonso Pueblo borders the Laboratory to the east. Because most of the surrounding land is controlled by government entities, with the exception of San Ildefonso Pueblo, land use restrictions have been applied and can be enforced.

Restrictive use may apply to those SWMUs to be addressed in coordination with building D&D, depending upon what D&D/ER decisions are made about future use and cleanup levels once the buildings are removed.

10.4 Stabilization-In-Place

10.4.1 Capping

Capping entails placing a horizontal, low-permeability cover over an area of surficial or below-ground contamination. Engineered caps are designed to reduce infiltration, biointrusion, run-off, and erosion and to physically isolate contaminants from the above-ground environment and prevent direct contact by man or biota.

Past and ongoing research at the Laboratory has developed an enhanced capping design using cobble-gravel biobarriers that is applicable to the arid setting of the Laboratory (Hakonson et al. 1986; Nyhan et al. 1984; Nyhan 1989a, 1989b, and 1989c; Nyhan and Barnes 1989; and Nyhan et al. 1989a, 1989b, and 1989c). The ER Program capping pilot study program is discussed in greater detail in the IWP, Appendix Q (LANL 1990).

Capping studies at MDA B at the TA-21 OU were installed in 1987 to evaluate the design and performance of different soil and rock materials in landfill cover systems. In 1990, ER Program support of the MDA B cover demonstration study was initiated as a pilot study. This study demonstrates the interactive effects of surface mulches, vegetative cover, and soil profile design on site water balance.

Analyses of 1987–89 MDA B data suggest a balance of erosion control and desirable soil water storage dynamics can be achieved by manipulating both the soil profile characteristics and the species mix in the vegetative cover. Gravel mulches are effective in reducing run-off and erosion on a waste site, at least during summer months. Soil moisture throughout the soil profile can be reduced by using deeper rooting shrubs in addition to the grass cover usually emplaced on a site. Sediment transport rates from winter snowmelt run-off events are much lower than rates observed in summer.

Given the knowledge and experience with capping technology at the Laboratory, this technology presently provides a response action potentially applicable to the TA-21 environment, particularly at the MDAs. The MDA B pilot study will be invaluable for evaluating capping-in-place as a

remedial alternative for all five TA-21 MDAs. At the MDAs, the most likely remedial alternative is believed to be stabilization-in-place followed by long-term monitoring (see Table 10-I).

10.4.2 Additional Containment Technologies

Additional containment alternatives, such as vertical barriers, bottom sealing, or surface management technologies, may be applicable at TA-21 OU SWMUs. However, additional site characterization data for individual SWMUs and better definition of potential migration pathways are required to determine whether these alternatives are appropriate and merit further consideration. If applicable they will be addressed during the CMS.

10.5 Treatment Technologies

There are numerous technologies associated with general response actions involving treatment of soils or water, either *in situ* or combined with removal. Examples of *in situ* contaminated soils treatment technologies that may be applicable at the TA-21 OU are immobilization, soil flushing, vapor extraction, vitrification, and biological treatment. With available data, groundwater treatment technologies are not believed to be applicable.

Insufficient SWMU data are available to determine which of these technologies may be applicable. However, treatment may be a remedial alternative at the majority of TA-21 SWMUs, as identified in Table 10-I. For example, treatment may be required at liquid waste MDAs, particularly MDA T, before stabilization-in-place can be implemented. As appropriate, treatment technologies will be evaluated during the CMS. Analytical laboratory and pilot scale tests will be used as needed to confirm feasibilities of treatment technologies.

10.6 Removal

Removal would be paired with either treatment and/or disposal. Removal/disposal without site characterization is applicable for SWMUs that are inactive, small units, such as septic tanks. With existing data, removal is a possible remedial alternative for the majority of TA-21 SWMUs (see Table 10-I). However, it is most likely to be applied as removal/disposal for inactive septic tanks and perhaps for other relatively small SWMUs. Additionally, surface soil contamination from stack emissions could be remediated by removing contaminated soil. Although possible for large SWMUs such as MDAs, removal is not advantageous because of the large volumes of radioactive and/or mixed waste.

TABLE 10-I
PRELIMINARY REMEDIAL ALTERNATIVES FOR SWMUS AT TA-21

Chapter	SWMU Number	Not a SWMU	No Action	Institutional Controls	Monitor	Cap-in-Place	Treatment	Remove and Dispose	Remove and Treat
13	21-007		x					x	x
	21-008		x					x	x
	21-019		x					x	x
	21-020(a,b)		x					x	x
	21-021								
14	21-002(b)	x	x				x	x	x
	21-003	x	x						
	21-004(a-c)	x	x						
	21-028(d-e)	x	x						
	21-029	x	x						
	21-013(b-g)	x	x	x	x				
	21-026(a-c)		x	x	x		x	x	x
	21-013(a)		x						
15	21-004(d)	x	x						
	21-006(b)	x	x				x	x	x
	21-010					x	x	x	x
	21-011					x	x	x	x
	21-011(k)		x				x	x	x
	21-022(h)		x				x	x	x
	21-023(c)		x				x	x	x
	21-024(a,g,l)		x				x	x	x
	21-024(b-e,i)		x				x	x	x
	21-024(f)	x	x				x	x	x
	21-024(h)	x	x						
	21-024(j,k)	x	x						
	21-024(m)	x	x						
	21-024(n,o)		x						
	21-026(d)		x						
	21-027(a)	x	x						
	21-027(b)		x						
	21-027(c,d)		x						
	NPDES Systems	x	x				x	x	x

TABLE 10-1
PRELIMINARY REMEDIAL ALTERNATIVES FOR SWMUS AT TA-21

16	21-010 21-011 21-014 21-015 21-016 21-017 21-018			XXXXXX	XXXXXXXX	XXXXXXXX	X X X X X X X	XXXXXXXX	
17	21-005 21-006(b) 21-009 21-012(b) 21-022(a,f)	X XX XX	XXXXXX	X X	X X	X X	X	X X	
18	21-002(a) 21-006(a, c-f) 21-022(b-e,g,h-j) 21-023(a,b,d) 21-028(c)	XXX XXX X	XXXXXX		XX	XXXX			
19	Areas of Concern	X	X				X		
20	21-012(a) 21-025 21-028(b,e)	XXX	XXX						

References

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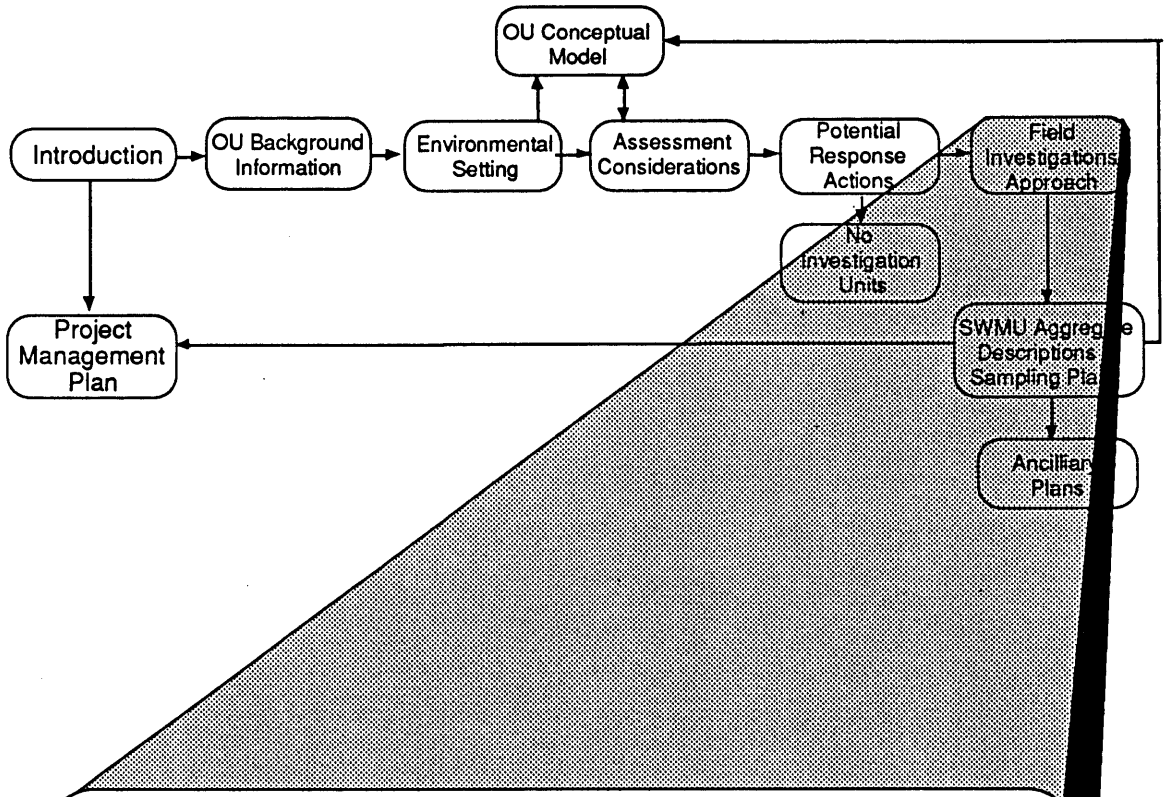
CHAPTER 11



Field Investigation Approach

- Field Operations
- Standard Survey, Screening, and Analytical Table
- Field Surveys
- Sampling Methods
- Field Screening
- Field Laboratory Measurements
- Analytical Laboratory Methods
- Data Analysis

11. METHODS

11.1 General

This chapter has been prepared to describe, in one place, the common elements that apply to the conduct of field investigations at all TA-21 SWMUs. The intent of pulling this information together in a single discussion is to reduce the repetition in each sampling plan of certain details that must be present but are the same for most of the plans. As discussed in Sec. 2.5.2, the large number of individual units to be addressed in this work plan has led to the use of several measures to streamline this document. This chapter represents one of those measures.

The objectives and technical approach for investigations at the TA-21 OU are described in Sec. 2.3, TA-21 RFI Approach. Key concepts presented there that are supported by the sampling plans include the following:

1. OU-wide investigations focus on general environmental characteristics and ambient levels of certain contaminants.
2. SWMU-specific characterizations focus on contaminant identification, extent, and migration of contamination.
3. OU-wide characterization data serve as a framework within which SWMU-specific contaminant data will be evaluated.
4. Explicit phases of investigation are identified and planned for (sequential sampling).
5. Evaluation of analytical data and reassessing data needs at intermediate stages is expected (decision analysis and observational approach).

Several general concepts apply to all of the field investigations presented in the following chapters. They include the following:

1. Radiological contamination is a general characteristic of TA-21 and a primary focus of SWMU-specific investigations. Releases of radioactive materials may have occurred without release of hazardous constituents.
2. For most SWMUs, the release of any hazardous constituents would have been associated with the release of radioactive materials.
3. Field surveys and field screening of samples can be used to identify gross contamination and to serve as Level I data.
4. Field laboratory analyses can be used to quickly provide Level II/III data to help guide field operations.

Field Operations. This chapter identifies several aspects of the Laboratory's implementation of the field sampling process that are not mentioned again in the SWMU-specific field sampling plans. Such aspects include the standard activities that will be used to support field operations (see Sec. 11.2, Field Operations) as follows:

- health and safety aspects of field operations;
- Laboratory-required preliminary activities and support procedures;
- identifying and documenting locations that have been sampled;
- sample handling and laboratory coordination procedures;
- equipment decontamination procedures; and
- management of wastes generated by sampling activities;

Investigation Methods. The primary focus of this chapter is on field investigation methods. It is tiered to the field sampling methods section of the Laboratory's Installation Work Plan (IWP), as presented in Sec. 3.5.3 of that document (LANL 1990). The methods presented in this chapter are specific examples of the options identified in the IWP. In addition, this chapter references the Laboratory's ER Program Standard Operating Procedures (SOPs) (LANL 1991). Each of the brief method descriptions given herein refers to the applicable SOPs for detailed methodology. The methods described in this chapter include (see Secs. 11.4–11.8)

- sampling methods;
- field survey methods to identify contaminants *in situ* (Level I);
- field sample screening methods to be used at the point of sample collection; (Level I);
- field laboratory measurement methods to provide rapid quantitative or semi-quantitative sample analyses Level II/III); and
- analytical laboratory methods (Level III/IV).

The method descriptions are simple and brief and provide some of the specific information that defines the application of the method. The specific information on each method is provided by the individual field sampling plan (such as sampling location or target depth of a borehole). Significantly, the method descriptions presented here are not intended to supplant or reduce the importance of the Quality Assurance Project Plan (Appendix A) and the governing SOPs (LANL 1991).

Data Analysis. The final section of this chapter gives a general discussion of data analysis concepts that will be applied in assessing the meaning of collected information. These concepts include (see Sec. 11.9)

- comparisons to local ambient contaminant levels, to background levels, and to action levels;
- decisions to conduct additional sampling or to stop sampling;
- role of the decision analysis and observational approaches; and
- statistical methods.

11.2 Field Operations

As indicated in the project schedule (Chapter 21), several investigations will be conducted concurrently because of the large area of TA-21 and the number of investigations to be completed. The organizational structure for each field investigation team is identified in Fig. 11.2-I. Each team will have individual responsibilities for health and safety, sample identification, sample handling and chain of custody, and related activities. Other operations may be shared across field teams, such as the field laboratory or an equipment decontamination facility. One field laboratory will be operated to perform all field laboratory analyses required by the Field Sampling Plans in Chapters 12–18. The field laboratory will be managed independently to assure rigorous QA/QC.

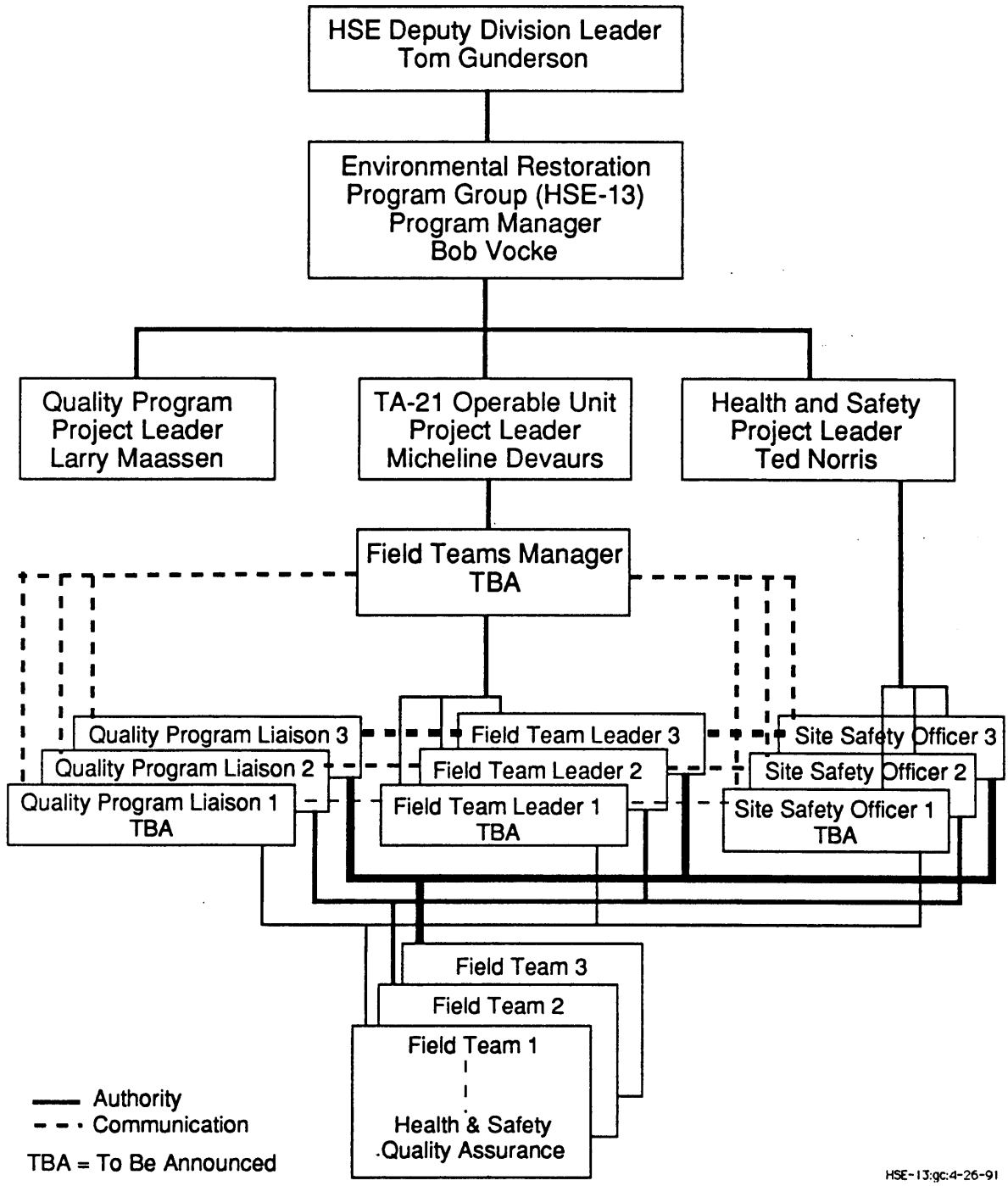
In this section, several aspects of field operations are described that will hereinafter be assumed to occur as a part of all field operations. This assumption will be implied and not restated in each sampling plan in Chapters 12–19.

11.2.1 Health and Safety

Appendix B presents the Health and Safety Plan for all field activities within the TA-21 OU. The plan gives SWMU-specific information regarding known or suspected contaminants and personnel protection required for different activities. Samples acquired under this RFI work plan will be screened at the point of collection to identify the presence of gross contamination or conditions that may pose a threat to the health and safety of field personnel. The techniques listed in Sec. 11.6, Field Sample Screening will be used. In particular, gross alpha and gross gamma radiation

FIG. 11.2-1

TA-21 Operable Unit Field Work Organization, Showing Health and Safety and Quality Assurance Responsibility



surveys and organic vapor surveys will always be conducted. Open excavations and borehole headspace will also be routinely monitored using organic vapor instruments and combustible gas and oxygen detectors. Applicable SOPs are contained in The ER Program SOP, Chapter 2, Health and Safety in the Field (LANL 1991) as follows:

- Health and Safety Monitoring of Organic Vapors with a Photoionization Detector
- Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector
- Health and Safety Monitoring of Combustible Gas Levels
- Total Alpha Surface Contamination Measurements
- Measurement of Gamma Radiation Using a Sodium Iodide Detector

11.2.2 Archaeological, Cultural, and Ecological Evaluations

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 prior to initiation of field work as part of the Laboratory's ES&H Questionnaire process. Dependent upon the results of the archaeological and ecological evaluations, a DOE Environmental checklist for either categorical exclusion or an environmental assessment will be completed.

11.2.3 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.

11.2.4 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.

11.2.5 Sample Control and Documentation

Guidance for sample handling is provided in the IWP's Sec. 3.5.5 and Annex IV. 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

11.2.6 Sample Coordination

A sample coordination facility has been established by the ER Program in HSE-9 to provide consistency for all investigations. The system is detailed in the IWP's Sec. 3.5.5 and Appendix O, respectively. The applicable SOP is

- Sample Control and Documentation

11.2.7 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 Appendix A, Quality Assurance Project Plan (QAPjP). The frequency with which each type of field QA sample is to be collected is detailed in the Field Sampling Plans in Chapters 12–18.

11.2.8 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

11.2.9 Waste Management

This discussion is based on the guidance provided in Sec. 3.5.4 and 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-21, 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

11.3 Standard Survey, Screening and Analytical Table

In all sampling plans of this RFI work plan, a standard table has been used to identify certain field operations as well as sample analytical requirements. Table 11.3-I is an example of the standard table. It will be referred to in several remaining sections of this chapter. It contains four columns to identify each sample and sampling method and four groups of measurement or analysis identification columns.

11.3.1 Samples and Sampling Methods

The four columns on the left side of Table 11.3-I identify the SWMU, the sampling or activity to be conducted, the sampling location, the depth interval (as appropriate), and provide space for recording the sample identification number. The sampling methods or activities identified in the first column are specifically defined below in Sec. 11.5, Sampling Methods.

11.3.2 Survey, Screening and Analysis Methods

Very precise language has been adopted in this work plan to refer to four categories of measurements. Some of the terms defined below often are used interchangeably; however, in this plan they are used consistently, as defined below, to avoid confusion regarding the type of measurement being discussed. The four measurement types are defined as follows:

Table 11.3-I

STANDARD SURVEY, SCREENING AND ANALYSIS TABLE.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Example site #1																																	
Vertical Borehole	1	0.0 – 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			
		5.0 – 10.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			
		10.0 – 15.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			
		15.0 – 20.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			
		20.0 – 25.0 ft						X	X		X	X	X	X	E	E	E					E	E	E	E		E	E	E	E			
Rinsate Blank															X	X	X					X	X	X	X		X	X	X	X			
Field Blank															E	E	E					E	E	E	E		E	E	E	E			
		25.0 – 30.0 ft						C	C				C	C	C	C	C					C	C	C	C		C	C	C	C			
		30.0 – 35.0 ft						C	C				C	C	C	C	C					C	C	C	C		C	C	C	C			
		35.0 – 40.0 ft						C	C				C	C	C	C	C					C	C	C	C		C	C	C	C			
Example Site #2																																	
Area Survey	1			X	X																												
Trench Excavation	1					X	X				X																						
Near Surface sample	1	0.0 – 6.0 in						X	X																								
		6.0 – 12.0 in						X	X																								
		12.0 – 18.0 in						X	X																								
Shallow Borehole	1	0.0 – 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			
		2.5 – 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			
		5.0 – 7.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			
Surface Sample	1	0.0 – 6.0 in						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			
	2	0.0 – 6.0 in						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			
Field Duplicate								X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			
Trip Blank																																	

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 data. Gamma radioactivity is a common target of field surveys. Land surveys and borehole logging 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 contaminants or determine other properties of the sample. Usually, screening provides Level I data. Alpha radioactivity and organic vapors are common targets of field screening. Lithological logging of core samples is included in this category.

3. **Field Laboratory Measurements** (or "field laboratory analyses"). These are sample analysis methods that require minimal sample preparation and use desk top analysis equipment. They 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 techniques are also used. Gamma spectrometry on dried soil samples placed in a fixed, shielded geometry is a typical example.

4. **Laboratory Analysis** (or "analytical laboratory analyses"). This category represents the primary analysis for which samples are collected, preserved, and sealed. Level III or IV data are usually expected. Commonly provided by offsite analytical laboratories.

Each of these four categories of measurements is shown in Table 11.3-I. For each category, several measurement techniques are identified by vertical columns. These represent the techniques that will be used most commonly at TA-21 for the majority of the SWMUs. The individual measurement techniques represented by each vertical column are identified in the sections that follow: Sec. 11.4, Field Surveys; Sec. 11.6, Field Screening; Sec. 11.7, Field Laboratory Measurements; and Sec. 11.8, Laboratory Analysis.

Figure 11.3-1 is a generic flow diagram that presents the interaction between the four categories of measurement during the performance of field investigations. The diagram presents logic flow from initiation of field investigations. The exact logic flow and categories of measurements implemented in an individual field investigation may vary from the generic logic flow presented in Fig. 11.3-1. However, the structure that controls interaction between measurement types is uniformly applied in all field investigations. Flow diagrams for the actual plan to be implemented at a given field investigation are presented in each of the field investigation chapters. In individual field sampling plan flow diagrams, only those decision flow paths used are diagrammed.

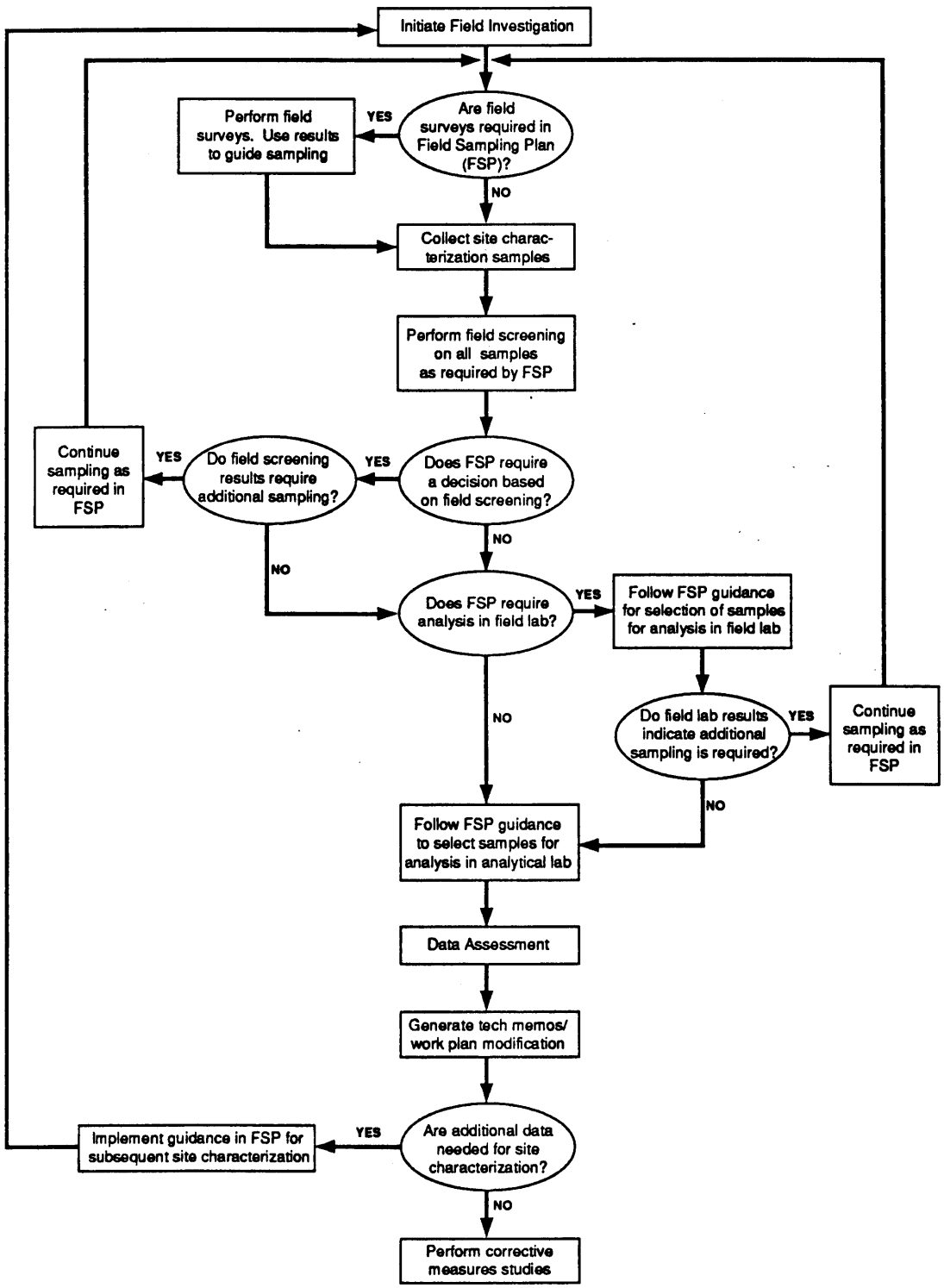


Fig. 11.3-1 Logic flow for field investigations.

11.3.2.1 Use of the Standard Screening and Analysis Table

The standard survey, screening, and analysis table serves two major purposes. First, it clearly and concisely summarizes the details of a sampling plan. It gives locations; indicates sampling methods and intervals; identifies the survey, screening, and analysis measurements for each sample detailed in Chapters 12–18; explicitly identifies the collection and analysis of field quality assurance samples; and gives a representation of certain options and uncertainties in the plan. Second, the table provides the detail needed to estimate the costs of the investigation.

As used in the individual sampling plans given in Chapters 12–19, the table identifies three types of sample selections. These are illustrated in Table 11.3-I and defined below:

- **X.** Planned sample screening and analysis are marked with an X at the intersection of the sample row with the analysis column.
- **E.** An example selection of samples is marked with an E in the table. This is used for cases where a plan allows an option or provides guidance to field personnel for selecting the particular samples to be submitted for analysis. The particular samples selected in the field may differ from those indicated by an E, but the number selected should be the same as the number marked. Where a sample marked E has an associated field QA sampling requirement, the QA requirement will be applied to the actual sample selected.
- **C.** A C is marked in the table for sample analyses that are provided by the plan as a contingency against foreseeable uncertainties that may be encountered in the field. For example, the drilling of boreholes will continue beyond the nominal depth set in the plan if contaminants are still detectable in cores. It can be expected that this will occur in an unknown fraction of the boreholes. Explicit inclusion of contingency samples to account for such occurrences has been used in some of the plans. While the contingency samples are usually marked in conjunction with particular boreholes, they may be used as needed in any portion of the plan.

11.3.2.2 The "Full Suite" of Analyses

In many of the sampling plans, the lack of past data from a SWMU leads to a need to evaluate the presence or absence of a wide spectrum of possible contaminants. In many cases, the analytical suite is simply specified as a "full suite of analytes." In the context of this plan, this means the following list of analytical laboratory methods will be applied to the samples. The specific analyses are defined in Sec. 11.8, Laboratory Analysis:

- gamma spectrometry
- tritium

- total uranium
- isotopic plutonium
- strontium-90
- volatile organic compounds (SW 8240)
- semivolatile organic compounds (SW 8270)
- metals (SW 6010)

As appropriate, additional laboratory analyses (e.g., PCBs, isotopic thorium) will be conducted on samples as detailed in Sec. 11.8.

11.3.2.3 Additional Analyses

For certain SWMUs, additional analyses are appropriate beyond those listed above. Some of the common additional analyses are shown in Table 11.3-I. Blank columns are provided in the table for listing other additional analyses required at particular SWMUs. Analyses identified in those columns are also described in the appropriate section of this chapter, below.

11.4 Field Surveys

Field surveys were defined in Sec. 11.3, above. These are primarily walking scans of the land surface using direct reading or recording instruments. For this work plan, these surveys include gamma radiation surveys and electromagnetic geophysical surveys. For convenience, land surveys to identify and mark locations from old drawings are included here. Field survey data other than that from land surveys are used to identify the presence of contaminants or structures in the field. In some plans, these techniques are used to identify locations for biased sampling. In some plans, these techniques are used as a preliminary assessment for areas where contaminants are not expected. While negative results from field surveys are not conclusive evidence of the absence of contaminants, positive results obtained at an early stage can allow timely redirecting of a sampling plan.

11.4.1 Radiological Surveys

11.4.1.1 Gross Gamma Survey. Several instruments are available that are suitable for these surveys: micro R meters, NaI detectors of various sizes with ratemeters or scalers, and Geiger-Muller detectors. The preferred instruments are microR meters with the ability to measure to 5

μR/hr, and 2-in. by 2-in. NaI detectors with a ratemeter capable of displaying 100 cpm. Some discrete-measurement or continuous-measurement recording instruments are also available using the same detectors. Surveys are conducted by carrying the instrument at waist height at a slow walking pace and observing and recording the ratemeter response. Measurements may also be made at the ground surface to aid in identifying the presence of localized contamination. The applicable SOP is

- Measurement of Gamma Radiation Using a Sodium Iodide (NaI) Detector

11.4.1.2 Low-Energy Gamma Survey. Two instruments are commonly used for these surveys, the FIDLER and the PHOSWICH. Both are optimized for the detection of low energy photons, such as the 60 keV gamma emission from ^{241}Am or the x-rays that accompany the decay of most heavy radionuclides, such as uranium, thorium, plutonium, and other transuranic radionuclides. Either instrument may be used for this work plan. Discrete- or continuous-measurement recording options are available. Surveys are conducted by carrying the instrument close to the ground surface and observing the ratemeter or scaler. Measurements may also be made at the ground surface to aid in identifying the presence of 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

11.4.2 Geophysical Surveys

11.4.2.1 Electromagnetic Surveys

Field surveys will be performed with an electromagnetic instrument to confirm the location of buried structures that contain metal and to trace the path of buried metallic waste lines. The selected geophysical instrument will be able to detect all types of metal (ferrous and nonferrous). It will be of a design that will detect a 2-in.–diameter metal line buried at a depth to 5 ft. The instrument will provide a direct meter readout of changes in the electromagnetic response. The instrument will also have an RS-232 port, so that the electromagnetic response may be recorded electronically in an automated data recorder.

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. An appropriate spacing of the parallel traverse lines is 20

ft. A geophysical survey to locate buried metal structures is typically performed by taking measurements on a grid established over the suspected location of the structure. The spacing for measurements is determined by the size of the structure; the required spacing may be as close as measurements taken at nodes on a 2.5- by 2.5-ft grid. Applicable SOP is

- General Surface Geophysics

11.4.3 Land Surveys

Land surveys will be used for two purposes: first, to document all sampling locations and second to locate either former or buried structures where needed. Only land surveys to find former structure locations are identified on the analytical table described in Sec. 11.3, because this surveying will only be done for certain units. However, because sampling location surveying will be done for all sampling, it is not specifically identified in the analytical table. In all cases, the documentation requirements for the surveys are the same: plus or minus 1-ft horizontal and plus or minus 0.1-ft vertical. The conventional survey procedures used are documented by Facilities Engineering personnel.

11.5 Sampling Methods

11.5.1 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 carefully defined. For example, a "surface soil sample" in this document is specifically defined as representing a 0- to 6-in. layer of soil collected by a hand scoop (see Subsec. 11.5.2.1), and a "vertical borehole core sample" is specifically defined as a 5-ft core interval taken with a particular length and diameter split-barrel sampler (see Subsec. 11.5.3.2).

Setting these common definitions and using them uniformly in all of the field sampling plans provides several benefits: consistency of field operations, comparability of sample analysis results from location to location at TA-21, and the ability to have each sampling plan refer to a method definition 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).

11.5.2 Soil Sampling Methods

11.5.2.1 Surface Soil Sample

Surface soil samples are defined as samples taken from the first 6 in. of soil. This type of soil sample will be gathered using a stainless steel or Teflon scoop. Care will be used to take the sample to a full 6-in. depth and to cut the sides of the hole vertically to ensure equal volumes of soil are taken over the full 6-in. depth. Applicable SOP is

- Spade and Scoop Method

11.5.2.2 Near-Surface Soil Sample

The spade-and-scoop method will be used to obtain near surface soil samples from depths to 30 in. Sample collection from depths greater than 30 in. can become labor-intensive. Collection of samples is accomplished with spades, shovels, and scoops. Spades and shovels are used to remove surficial material to the required depth. Then a stainless steel or Teflon scoop is used to collect the sample. Care will be used to take the sample to a full 6-in. depth and to cut the sides of the hole vertically to ensure equal volumes of soil are taken over the full 6-in. depth. Unless otherwise specified, the sample interval will be 6 in. Devices plated with chrome or other materials are not acceptable for sample collection. The applicable SOP is

- Spade and Scoop Method

11.5.2.3 Undisturbed Surface Soil Sample

Undisturbed soil samples will be gathered from the first 6 in. of soil using the ring sampler method. This method involves driving a 4-in.-diameter stainless steel tube (ring sampler) vertically into the area to be sampled. The soil around the ring sampler is then excavated so that the tube can be removed. An undisturbed core sample is obtained by pushing out the soil in the ring sampler. The applicable SOP is

- Stainless Steel Surface Soil Sampler

11.5.2.4 Deposition-Layer Soil Sample

Deposition-layer soil samples are those samples collected from the first 1 in. of soil. The method is used to collect samples that represent wind- or air-deposited contaminants on the soil surface

(i.e., contaminants dispersed and deposited from stack emissions). They will be collected using a stainless steel or Teflon trowel to scrape off the upper 1 in. of soil. The applicable SOP is

- Spade and Scoop Method

11.5.2.5 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. It is usually not practical to use a hand auger or thin-wall sampler at depths below 10 ft. Applicable SOP is

- Hand Auger and Thin-Wall Sampler

11.5.3 Borehole Core Sampling Methods

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 or field laboratory measurements in either of the last two core intervals above the nominal depth, drilling will continue until background concentrations are detected in two successive sample intervals. This stopping criterion will be applied to all boreholes 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 just described.

11.5.3.1 Shallow Boreholes

A number of the sampling plans call for core samples to be collected from limited depths to investigate subsurface migration of contaminants where little potential for deep migration exists. This shallow borehole method is intended for boreholes of limited depth; 30 ft is a reasonable maximum. Because these boreholes are primarily used for areas where minimal penetration of contaminants into the soil is expected, a major feature of this method is the specification of a 2.5-ft core interval as a sample. For ease of setup and rapid drilling, the use of the light-weight drilling rig may be preferred for all shallow boreholes, regardless of site access.

The stopping criterion described in Sec. 11.5.3 will be used, and the applicable SOP is

- Hollow-Stem Auger

11.5.3.2 Vertical Boreholes.

This is the standard hollow-stem auger, split-barrel core sampling method. A 5-ft core interval is specified as the standard sample. Drilling equipment is specified in Sec. 11.5.3, Borehole Core Sampling Methods. The stopping criterion described in Sec. 11.5.3 will be used. The applicable SOP is

- Hollow-Stem Auger

11.5.3.3 Angled Boreholes

Angle drilling is employed to access contaminant locations when placement of the rig directly over the point of interest is not feasible. As for vertical core sampling, a 5-ft core interval is specified as the standard sample. The auger rig used in this type of investigation should have mechanical specifications comparable to a Failing F-10 or CME-85, with angle drilling capability. In setting up for angle drilling, the drill rig will begin a borehole at a location specified in the sampling plan. The drilling angle and direction specified in the sampling plan will direct the auger string beneath the area to be investigated at the desired depth. The stopping criterion described in Sec. 11.5.3 will be used. The applicable SOP is

- Hollow-Stem Auger

11.5.3.4 Deep Core Sampling

For tuff coring deeper than 150–200 ft., a drilling rig is needed with capabilities greater than those used for the hollow-stem auger methods described above. Initial plans presented in Chapters 12–19 call for very few boreholes greater than 200 ft. Selection of rig and drilling method are matched to the goals of the investigation, according to the applicable SOP, which is

- Air Rotary Drilling

11.5.3.5 Rock Coring

Rock samples can be recovered from indurated rock formations with the use of a diamond-studded bit. In this method, the diamond bit cuts a small diameter core of rock 5 or 10 ft in length. As the rock is cut, it is pushed into an inner barrel of the drill string and retrieved by a wire-line

apparatus. This method works best in rock that is hard, relatively free of bedding planes, lithology changes, and fractures. This method will be used in the lower reaches of deep boreholes beneath the relatively soft Bandelier Tuff. The applicable SOPs are

- Air Rotary Drilling
- Cable Tool Drilling

11.5.3.6 Shallow-Angled Boreholes. Several investigations specific to the MDAs require core sampling of boreholes placed at shallow angles beneath the disposal pits. Such boreholes cannot be drilled with the standard hollow-stem auger rigs specified above. For these holes, air rotary drilling with continuous coring will be used. The stopping criterion described in Sec. 11.5.3 may be used. The applicable SOP is

- Air Rotary Drilling

11.5.4 Trenching

Trenching is used in this work plan for several purposes: to identify the location of buried structures prior to drilling, to expose buried structures to be sampled, and to expose deeper soils for investigation or sampling. Trenching will be performed by a back-hoe or track-hoe capable of excavating to a depth of 15 ft. The bucket width and type will be determined by the equipment operator based on the structure to be exposed and the soil conditions. The trench must be wide enough for soil sampling and field surveys and screening to be safely performed. If the trenching is at a depth of 4 ft or greater, OSHA standards, 29 CFR 1926.650, for shoring and sloping will be followed (OSHA). Because the tuff at TA-21 is in a stable rock, shoring and sloping will generally not be necessary, but each trench should be inspected by a competent engineer to ensure that there is no sign of potential cave-ins. The maximum depth of a trench will be 15 ft. The applicable SOP is

- Excavating Methods

11.5.5 Tank Sampling Methods

11.5.5.1 Liquids

Samples of liquids contained in tanks will be gathered by filling sample bottles from a spigot or valve draining the tank. If a tank drain does not exist or cannot be used, then the tank must be opened and a sample gathered using a weighted bottle or COLIWASA (an acronym for

COmposite LIquid WAste SAmpler). At a minimum, two samples will be gathered from each tank to be investigated. One sample will be of any precipitate and associated liquid at the bottom of the tank. The other sample will be of the liquid contained in the tank. If there is evidence of vertical stratification (such as viscosity changes), then a liquid sample from each layer will be taken. Applicable SOPs are

- COLIWASA Sampler for Liquids and Slurries
- Weighted Bottle Sampler for Liquids and Slurries in Tanks

11.5.5.2 Dry Tanks

An extendible telescoping probe will be used to access the inside of dry tanks for sampling. A standard filter paper swipe will be attached to the end of the probe to sample the inside walls and bottom of the tank. Three replicate swipes will be taken on the inside of the tank. Whenever possible, swipes will be taken from an area of 100 cm^2. When it is not possible to cover this area, an estimate of the surface area sampled will be made in cm^2. For convenience, 100 cm^2 can be approximated by a square that is 4 in. on each side. Sufficient pressure should be used on the swipe to pick up loose contamination without tearing or separating the swipe. Applicable SOP is

- Sampling for Removable Alpha Contamination

11.5.6 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. Applicable SOP is

- Surface Water Sampling

11.5.7 Well Installation and Groundwater Sampling

The installation and sampling of groundwater wells is included in the general characterization of the TA-21 OU. Due to the depth to groundwater and the relatively unlikely chance that contamination has migrated to such depths, the number of wells is limited. If perched water zones are encountered in any drilling at TA-21 OU, they will also be sampled. The applicable SOPs for these investigations are

- Well Installation
- Well Development
- Purging of Wells for Representative Sampling of Ground Water
- Field Analytical Measurements on Ground Water Samples

11.6 Field Screening

Field screening is defined in Sec. 11.3, above. Screening measurements are applied at the point of sample collection, in borehole headspace, and in excavations to identify gross contamination and to assess conditions affecting the health or safety of field personnel. Application of screening for personnel health and safety is detailed in the Appendix B Health and Safety Plan. Individual sampling plans may not explicitly identify the use or role of sample screening measurements; however, the standard analytical table for each investigation will show the methods to be used. In general, every sample taken at TA-21 will be screened for gamma and alpha radioactivity, and all excavations and boreholes will be monitored for combustible gases, organic vapors, and tritiated water vapor. In addition, a noninstrument form of sample screening, lithological logging, will be performed for all borehole samples.

In addition to the role of sample screening in monitoring for gross contamination or situations of concern for health and safety, certain sampling plans use the sample screening information explicitly as Level I data for making decisions on further sampling or for selecting sample analysis options.

11.6.1 Radiological Screening

11.6.1.1 Gross Gamma

Field screening of samples for gamma radioactivity will be done using a hand-held NaI detector probe and ratemeter. The detector is held close to the sample or core and is capable of identifying elevated concentrations of certain radionuclides as an increased ratemeter reading above instrument background levels. Quantification of the response is difficult and is best interpreted as a gross indicator of potential contamination. The applicable SOP is

- Measurement of Gamma Radiation Using a Sodium Iodide (NaI) Detector

11.6.1.2 Gross Alpha

Field screening of samples for gross alpha contamination is conducted using a hand-held alpha scintillation detector and a ratemeter. The detector is held close to contact with the sample or core and is capable of detecting on the order of approximately 100-200 pCi/g for a damp soil sample. The instrument cannot identify specific radionuclides. The applicable SOP is

- Total Alpha Surface Contamination Measurements

11.6.2 Nonradioactive Screening

11.6.2.1 Organic Vapor Detectors

Organic vapor detectors will be used to screen 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, will be used to improve the probability of detecting a wide range of vapors.

PID. A Model PI 101 photoionization detector (PID), or its equivalent, will be used. It is a general survey instrument capable of detecting real-time concentrations of many complex organic compounds and some inorganic compounds in air. The instrument can be calibrated to a particular compound; however, it cannot distinguish between detectable compounds in a mixture of gases. Applicable SOP is

- Health and Safety Monitoring of Organic Vapors with a Photoionization Detector

FID. A Foxboro Model OVA-128, or its equivalent, will be used. It is a flame ionization detector (FID), which can be used as a general screening instrument to detect the presence of many organic vapors. Its response to an unknown sample is relative to the response to a gas of known composition to which the instrument has been calibrated. Applicable SOP is

- Health and Safety Monitoring of Organic Vapors with a Flame Ionization Detector

11.6.2.2 Combustible Gas/Oxygen Detector

A Gastech Model 1314, or its equivalent, will be used to determine the potential for combustion or explosion of unknown atmospheres during drilling and intrusive activities. A typical combustible gas indicator (CGI) determines the level of organic vapors and gases present in an atmosphere as a percentage of the lower explosive limit (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 CGI will be used to monitor atmospheres during all intrusive activities for health and safety purposes. Applicable SOP is

- Health and Safety Monitoring of Combustible Gas Levels

11.6.2.3 Lithological Logging

Lithological logging of drill core will be performed to describe the physical nature of borehole cores. Lithological logging will be performed by a geologist capable of describing subsurface lithologies and differentiating the various strata of the Bandelier Tuff. Applicable SOP is

- Lithological Logging of Borehole Cores

11.7 Field Laboratory Measurements

The scope and nature of field laboratory measurements to be used in support of investigations at TA-21 are defined in Sec. 11.3. The field laboratory will provide fast turn-around analysis of samples for a limited number of analytical methods. The techniques used in the field laboratory give primarily Level II data, although some are Level I or near Level III as noted for the particular analysis method below. The field laboratory methods provide better quality information or lower detection limits than can be obtained with field screening. In some cases, they provide a type of information that cannot be obtained with field screening techniques. The intended uses of the

field laboratory results vary from one sampling plan to the next. Three major uses dominate as follows:

1. **Guidance to Field Operations.** To provide fast turn-around results to aid in directing the course of field work. This use of the field laboratory can increase the efficiency of field operations. An example is the use of field laboratory measurements to determine when to cease drilling a borehole after it has exited a contaminant plume.

2. **Biased Sample Selection.** To focus analytical efforts on samples best suited to achieving investigation objectives. Depending on the goals of the investigation, samples having particular characteristics can be selected: select those with no detectable contaminants to assess the edge of a plume; select those with the highest levels to identify contaminants during source characterization. Knowledge-based sample selection can enhance the effectiveness of the investigation.

3. **Analytical Sample Load Reduction.** To provide the ability to quickly and inexpensively assess a large number of samples for easily detectable contaminants. In this case, the few samples submitted to the analytical laboratory can be supported by a broad base of lower quality measurements providing some assurance that the few high quality measurements are representative and sufficient for decisionmaking. This can limit the number of samples that must be sent for more costly analysis at an analytical laboratory.

The selection of samples to be submitted to the analytical laboratory on the basis of field laboratory results is required by several of the field sampling plans. The criteria to be used for making this selection depend on the focus and goals of the particular investigation. Three criteria are used as follows:

1. Where the goal of the investigation is primarily to identify contaminants by characterization at the source, the samples selected for submission in an analytical laboratory should primarily be those in which contaminants were identified in the field laboratory.

2. Where the goal is to determine the extent of contamination, the selection should be made from the samples at the edges of a contaminated zone, those with low concentrations as determined in the field laboratory, and those with results below the detection limits of the field laboratory instruments that would consist of the first samples outside the contaminated zone.

3. If the goal is to document the absence of contamination, the first priority is to select for analysis any sample for which the field laboratory results indicate the presence of a contaminant. In addition to this, a random or uniform (unbiased) selection from among all other samples should be made.

Situations can be envisioned that complicate the application of these criteria. Such situations might include samples from a borehole that sequentially passes through the contaminant source, a contaminant plume, and uncontaminated substrata. In such situations, all three criteria may

apply, and in order for a sufficient number of samples to be submitted in each category, the percentage specified in the plan may need to be overridden by the field team leader in consultation with the OU project leader.

In the field sampling plans, a percentage of samples to be submitted for further analyses is recommended. The percentage is commonly 25 to 30% but may be as low as 10% or as high as 50%. The distinction between 25 or 30% is not intended to be significant and is often used to give a more easily implemented sampling scheme (i.e., 25% may be used to select one sample from each borehole that generates four samples, or 30% may be used to select one of the three near-surface samples from each 18-in.-deep near-surface investigation).

When 10% is used, it is commonly to provide a minimal level of confirmation regarding a contaminant that is considered only remotely possible to be present.

Higher percentages, such as 50%, may be specified when only a small number of samples are collected in order to increase the number of results from the analytical laboratory. This would be used only when there seems to be little need for analytical laboratory confirmation on all samples and is primarily used only if the potentially present contaminants are easily detected in the field laboratory.

A common expectation for many SWMUs at TA-21 is that any release of contaminants will have included radionuclides. Because these are relatively easily detected at reasonably low-detection limits in a field laboratory, more use of the field laboratory as a decision tool has been employed in this plan.

In the event that the confirmatory analyses in the analytical laboratory indicate that decisions made on the basis of field laboratory measurements could be misleading (i.e., contaminants of interest are found that were not detected in the field laboratory), then the role of the field laboratory, or the techniques used therein, will be modified for subsequent investigations. To provide for this confirmation, there is no circumstance in this work plan where field screening or field laboratory data are used without a percentage confirmation in the analytical laboratory.

The text of the individual sampling plans may not explicitly identify the use of field laboratory measurements. However, the standard analytical table for each investigation will show the methods to be used.

11.7.1 Radiological Measurements

11.7.1.1 Gross Alpha

Measurements of gross alpha radioactivity can be used to assess the presence of plutonium, uranium, and thorium in samples, although identification of the individual radionuclides is not possible. The alpha emissions from ^{238}Pu are indistinguishable from those of ^{241}Am. A typical method uses dried soil samples in a fixed geometry to detect alpha-emitting radionuclides at concentrations on the order of 25 to 40 pCi/g. These Level II measurements can be used to guide field operations or to bias sample selection. Following the drying of the soil, a measurement time of approximately 15 to 20 min is typical. Large area ZnS alpha scintillation detectors and a scaler are used. An instrument such as a Ludlum Model 2200 with a Model 43-10 alpha scintillation detector, or the equivalent, is appropriate. The applicable SOP is

Screening Soil Samples for Alpha Emitters

11.7.1.2 Gamma Spectrometry

Gamma radiation spectrometry can be used to quantify particular radionuclides present in soil samples such as ^{137}Cs, ^{60}Co,^{234}U, ^{235}U, and ^{238}U. Additionally, the 59 keV gamma from ^{241}Am can be detected. Such identification is important for guiding field work or biasing the selection of samples for laboratory analysis. Rapid turn-around analysis can be Level II or close to Level III quality using personal computer-based, multichannel analyzers (MCA) and NaI or germanium photon detectors. An example is a Canberra MCA with a Ludlum 44-10 NaI detector; and many equivalent instruments are available. Dried soil samples in fixed geometries can be analyzed in approximately 20 to 30 min with detection limits on the order of 5 pCi/g for radionuclides such as ^{137}Cs. The applicable SOP is

- Use of Gamma Spectrometry Systems as a Screen for Gamma Ray-Emmitting Radionuclides in Soil Samples

11.7.1.3 Tritium by Liquid Scintillation

Level II, overnight turn-around measurements of tritium in soil moisture or water samples can be obtained by liquid scintillation techniques. These measurements are needed for guiding field operations, primarily drilling operations. The distillation of soil moisture from soil samples is done in a ventilated hood in the field laboratory, as part of the process of drying soil samples for gross alpha measurements. Liquid scintillation measurements will be done by either HSE-1 or HSE-9 using documented laboratory procedures for this measurement of tritium in soil moisture.

11.7.2 Organic Chemical Measurements

11.7.2.1 Volatile Organic Compounds

Rapid turn-around analysis for volatile organic compounds with Level II quality is needed to guide field operations, primarily drilling. An instrument with the ability to distinguish between various organic compounds is preferable. The Laboratory's transportable purge-and-trap GC/MS can provide qualitative and quantitative analyses of most volatile organic compounds with boiling points below 200°C that exhibit low or slight solubility in water. Volatile water-soluble compounds can also be detected with higher detection limits. Applicable SOP is

- Portable Gas Chromotography for Field Screening of Volatile Organic Compounds

11.7.2.2 PCBs

Documented PCB contamination at TA-21 is limited to the vicinity of a single building and storage pad. The extent and variability of the contamination is unknown. An inexpensive, fast turn-around measurement technique at levels less than the regulatory limit (25 ppm) is needed. It will be used to define the areal extent of contamination with numerous Level II analyses and to minimize analytical laboratory Level III data. A 10 ppm detection level is achievable with available analytical techniques that provide quick turnaround in a field laboratory and is below regulatory requirements. A DEXSIL L2000 PCB/Chloride Analyzer or an alternative method with suitable detection limit can be used. The L2000 uses a chloride-specific electrode to quantify PCBs in oil or soils. Sample preparation involves extracting the PCBs from the soil and reacting the sample with a sodium reagent to transform the PCBs into chloride, which can be quantified by the instrument. Oil samples take about 5 min to prepare and soils about 10 min. Documented field laboratory procedures for measurement of PCBs in soil will be used.

11.8 Laboratory Analysis

Section 11.3 gives the definition of laboratory analysis as used in this work plan. These are intended to be the highest quality (Level III/IV) data acquired. As described in Sec. 11.2, samples to be submitted to an analytical laboratory will be coordinated, handled, and tracked by the ER Program Sample Coordination Facility.

Certain sampling plans rely entirely on Level III/IV data to support their objectives. Other plans rely heavily on Level I/II data for field guidance and use the higher quality results from an analytical laboratory for limited purposes. As discussed in Sec. 11.3, the standard survey, screening and analysis table identifies the analyses for which each sample is submitted. Identification of the methods listed as headings in the standard table follows. The common full suite of analytes is discussed first, followed by constituents identified in the table that are called out as required analyses in the field sampling plans infrequently.

Gamma Spectrometry. Quantification of radionuclides by measurement of photon emissions. Standard commercial laboratory procedures will be modified as described in Appendix A.

Tritium. Measurement of tritium in soil moisture. Soil moisture is distilled from soil, and the low energy beta emission from tritium is measured by liquid scintillation techniques. Standard commercial laboratory procedures will be modified as described in Appendix A.

Total Uranium. Analysis done by LANL HSE-9 methods following sample digestion using EPA method 3050.

Strontium-90. Radiochemical separation using multiple selective precipitation and counting of beta activity by gas proportional detectors.

Isotopic Plutonium. Radiochemical separation of plutonium from soil is followed by alpha spectrometry to quantify each isotope of plutonium. Standard commercial laboratory procedures will be modified as described in Appendix A.

If special counting techniques with modern detectors and software are developed to provide plutonium isotopic data in soil and sediment at low activity levels, as appropriate, these techniques will be substituted for radiochemistry.

Volatile Organics (SW 8240). EPA standard method for quantification of volatile organic compounds. The standard list of analytes and quantitation limits is given in Appendix A.

Semivolatiles (SW 8270). EPA standard method for quantification of semivolatile organic compounds. The standard list of analytes and quantitation limits is given in Appendix A.

Metals (SW 6010). EPA standard method for quantification of metals and cyanide. The standard list of analytes and quantitation limits is given in Appendix A.

The following four analyses are called out in selected field sampling plans for reasons detailed therein but are not part of the common full suite of analyses.

- **PCB (SW 8080)**. EPA standard method for quantification of PCBs and pesticides. Only the PCB results are of interest for this work plan. The standard list of analytes and quantitation limits is given in Appendix A.

- **TCLP Metals**. EPA standard method for defining a hazardous waste. The TCLP method includes metals and other compounds; only the metals are of

interest for this work plan. The standard list of analytes and quantitation limits is given in Appendix A.

- **Isotopic Uranium.** Radiochemical separation of uranium from soil is followed by alpha spectrometry to quantify each isotope of uranium. Standard commercial laboratory procedures will be modified as described in Appendix A.
- **Isotopic Thorium.** Radiochemical separation of thorium from soil is followed by alpha spectrometry to quantify each isotope of thorium. Standard commercial laboratory procedures will be modified as described in Appendix A.

11.9 Measurements at Geohydrologic Characterization Boreholes

Boreholes to characterize the site geohydrology are planned for eight locations (see Fig. 11.9-1). Five of the boreholes are located in background areas away from sources of contamination. In addition, separate boreholes are located near each of the three MDAs that received liquid wastes. An additional borehole may be located at each of the three MDAs as an option dependent upon the findings at the initial borehole.

The measurements to be taken in the site geohydrologic characterization program are grouped into five categories (see Table 11.9-I) and presented in Table 11.9-II. A description of each measurement type listed in Table 11.9-II follows.

11.9.1 Hydrogeological Measurements

Gravimetric water content. Quantitative measurement of water content in undisturbed core by weighing moisture loss due to oven drying. ASTM method (ASTM D-4531-86)

Bulk density. Calculated value from gravimetric water content test data. ASTM method (ASTM D-4531-86)

Dry density. Calculated value from gravimetric water content test data. ASTM method (ASTM D-4531-86)

Porosity. Calculated value from gravimetric water content test data. ASTM method (ASTM D-4531-86)

Porosity (He Injection). Quantitative measurement of porosity in undisturbed core sample. American Petroleum Institute Method (API 40,Sec. 3.58)

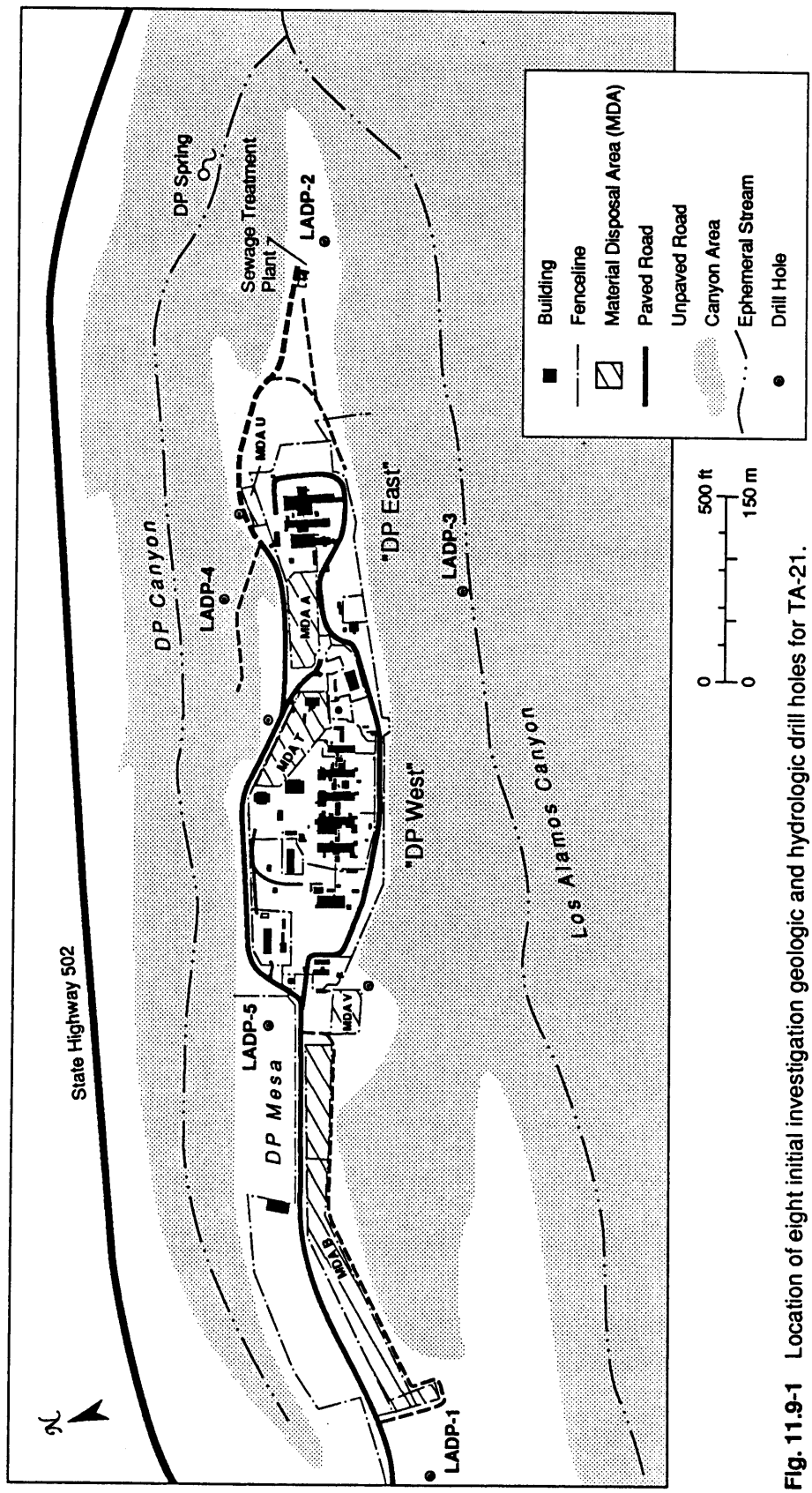


Fig. 11.9-1 Location of eight initial investigation geologic and hydrologic drill holes for TA-21.

TABLE 11.9-I
FIVE CATEGORIES OF GEOHYDROLOGIC CHARACTERIZATION

Measurement Category	Measurements performed	
	Background Characterization (5 holes)	MDA Characterization (3 holes)
Hydrogeological	all	selected[a]
Geochemical	all	all
Environmental Isotope	all	none
Straddle Packer Tests	all	all
Openhole Geophysics	all	all

[a]Hydrological tests performed at the MDAs include gravimetric water content, bulk density, dry density, and porosity.

Table 11.9-II

STANDARD GEOPHYSICAL PARAMETER

	Sample Type	Sampling Location	Interval	Sample Identification
Hydrogeological and Geochemical				
Gravimetric Water Content				
Bulk Density				
Dry Density				
Porosity				
Porosity (Hg injection)				
Saturated Hydraulic Conductivity				
Air Water Relative Permeability				
Moisture Characteristic Curve				
Clay Mineralogy				
Zeolite Mineralogy				
Matrix Mineralogy				
Carbonate Mineralogy				
Fe and Mn Mineralogy				
Total Organic Compound				
Cation Exchange Capacity				
Slurry PH				
Environmental Isotopes				
Chloride-36/Chloride-37				
Carbon-12/Carbon-13				
Bromium-88/Bromium -87				
Hydrogen/Deuterium				
Oxygen-18/Oxygen-18				
Tritium				
Carbon-14				
Chloride-36				
Open Hole Tests: Straddle Packer Tests				
In Situ Permeability				
VOA's - Pore Gas				
CO2 - Pore Gas				
CFC - Pore Gas				
C-12/C-13 - Pore Gas				
Relative Humidity - Pore Gas				
SF-6				
Open Hole Tests: Geophysics				
Thermal Neutron (moisture)				
Gamma Gamma (density)				
Caliper				
Axial Boreole Video				
EM Induction (Geonics EM-39)				
Magnetic Susceptibility				
Natural Gamma				
Spectral Gamma (U, Th, K)				
Prompt Fission Neutron				
Geochemical (Californium-252)				
Side Scan Video				

Saturated hydraulic conductivity. Quantitative measurement in intact, undisturbed core sample. ASTM method (ASTM D-2434-68)

Moisture characteristic curve. Quantitative measurement on intact, undisturbed core sample with the standard method to characterize wetting and drying cycles and verification at the dry end with the psychrometer method. American Society of Agronomy method (Chapter 24)

Air/water relative permeability. Calculated value determined by method of van Genuchten using data from saturated hydraulic conductivity test and moisture characteristic curves.

11.9.2 Geochemical Measurements

Clay mineralogy. X-ray diffraction test on powdered rock samples to determine type and relative abundance of clay minerals: kaolinite, illite, and montmorillonite.

Zeolite mineralogy. X-ray diffraction test on powdered rock samples to determine type and relative abundance of zeolite minerals.

Matrix mineralogy. X-ray diffraction test on powdered rock samples to characterize silica polymorphs, alkali feldspars, and volcanic glass.

Carbonate mineralogy. X-ray diffraction test on powdered rock samples to characterize carbonate minerals.

Iron and manganese mineralogy. X-ray diffraction tests on powdered rock samples to characterize iron and manganese minerals.

Total organic carbon. Measurement of total organic carbon in crushed rock samples by combustion in a muffle furnace. ASTM method (ASTM D-2974)

Cation exchange capacity. Measurement of cation ion exchange capacity on crushed samples of core by sodium absorption. EPA method 9080

Slurry pH. Measurement of Ph in a slurry of crushed core and deionized water. ASTM method (ASTM DG657)

11.9.3 Environmental Isotopes Measurements

Chloride-35/chloride-37. Isotope ratio measurement by accelerator mass spectrometer on soluble chloride leached with deionized water from crushed core samples.

Carbon-12/carbon-13. Isotope ratio measurement by mass spectrometer on pore water extracted under vacuum from crushed core samples.

Strontium-86/strontium-87. Isotope ratio measurement by mass spectrometer on pore water extracted under vacuum from crushed core samples.

Hydrogen/deuterium. Isotope ratio measurement by mass spectrometer on pore water extracted under vacuum from crushed core samples.

Oxygen-18/oxygen-16. Isotope ratio measurement by mass spectrometer on pore water extracted under vacuum from crushed core samples.

Tritium. Measurement of tritium activity in pore water extracted under vacuum from crushed core samples by direct counting with liquid scintillation method.

Carbon-14. Isotope age determination by accelerator mass spectrometer analysis on pore water under vacuum from crushed rock samples. Analytical results are corrected for carbon-13.

Chloride-36. Isotope age determination by accelerator mass spectrometer analysis on soluble chloride leached with deionized water from crushed core samples.

11.9.4 Straddle Packer Tests

***In situ* air permeability tests.** Tests performed over discrete depth intervals in open boreholes to measure *in situ* air permeability. Test is performed by vacuum extraction. Method for test is from Donahue and Erekian (1982).

Volatile organic compounds. Quantitative measurement on *in situ* gas samples extracted from discrete depth intervals in an open borehole. Analysis by US EPA Test Method (EPA TO14).

Carbon dioxide. Quantitative measurement on *in situ* gas samples extracted from discrete depth intervals in an open borehole. Analysis by ASTM Method (ASTM 1946).

Methane. Quantitative measurement on *in situ* gas samples extracted from discrete depth intervals in an open borehole. Analysis by ASTM Method (ASTM 1946).

Carbon-12/carbon-13. Isotope ratio analysis by mass spectrometer on *in situ* gas samples extracted from discrete depth intervals in an open borehole.

Relative humidity. Quantitative measurement on *in situ* gas samples extracted from discrete depth intervals in an open borehole. Analysis using thermocouple psychrometry method in Agronomy Monograph #9, Chapter 4.

Sulfur hexafluoride. Quantitative analysis performed on gas samples extracted from discrete depth intervals in an open borehole. Test is performed to evaluate contamination of the subsurface environment by air from air rotary drilling. Sulfur hexafluoride will be introduced as a tracer gas in the air supply used for drilling.

11.9.5 Open Hole Geophysical Measurements

Thermal neutron log. Continuous measurement in open borehole of the rock properties that capture thermal neutrons. Neutron capture is directly related to moisture content in unsaturated rocks and to porosity in saturated rocks.

Gamma gamma density log. Continuous measurement in an open borehole of rock properties that alternate and scatter gamma radiation. The measured values are directly related to bulk density of the rock. Instrument borehole sample uses a 100 mCi ^{137}Cs source.

Caliper log. Continuous mechanical measurement of the diameter of an open borehole. The measurements identify zones of fractured rock.

Axial borehole video log. A continuous television record of the walls of an open borehole. A wide angle lens provides a 360° view of the borehole wall. A compass mount provides directional orientation of discrete features such as fractures and joints.

Sidescan borehole video log. A continuous television record of a segment of the wall of a borehole. The sidescan lens is motor driven and will rotate 360° to provide complete viewing. A compass mount provides directional orientation of discrete features such as fractures and joints.

Electromagnetic induction log. A continuous measurement of the electrical properties of the bulk rock medium in an open borehole. The measurement may be taken in unsaturated or saturated environments.

Magnetic susceptibility log. A continuous measurement in open boreholes of the magnetic susceptibility of the rock matrix. The log is used for stratigraphic correlation.

Natural gamma radiation log. A continuous measurement in open or cased boreholes of the natural gamma radiation emitted by the rock matrix. The log is used for stratigraphic correlation.

Spectral gamma radiation log. A continuous measurement in open or cased boreholes of the natural gamma radiation emitted by the rock matrix. The gamma radiation spectrum is divided into three separate energy "windows" to differentiate abundances of uranium, thorium, and potassium. The log is used for stratigraphic correlation and to evaluate presence of radioactive contamination.

Prompt fission neutron log. A continuous measurement in the open hole of fissionable isotopes in the rock that may be related to radioactive contamination.

Geochemical (californium-252) log. Continuous measurement in the open borehole of the following suite of elements present in the rock matrix: aluminum, calcium, iron, silicon, sulfur, titanium, carbon, oxygen, hydrogen, chloride, potassium, thorium, and uranium. The method is measurement of gamma emissions that result from bombardment of the rock matrix by neutrons from a ^{252}Cf source.

11.10 Data Analysis

Several aspects of data analysis are integral to the use of the sequential sampling and decision analysis approaches described in Sec. 2.3 and the manner in which the field sampling plans have been structured. An overview of several important aspects of data analysis for the TA-21 OU is given below. Sequential sampling is briefly described first because this approach will cause data analysis to occur iteratively by sampling phase.

11.10.1 Sequential Sampling Approach

Sequential sampling involves the initial collection of one set of samples, with the results of measurements from this first set used to determine if additional sets of samples are required; the initial samples guiding the selection of the second set, and so on. Although unbiased estimates of population parameters can be based on a single set of samples, efficient and cost-effective data collection uses the first set of samples to determine the number of additional samples and their optimum locations for the required accuracy of the estimates. The second and further stages of the sequential sampling are used to give a more detailed characterization of the area, if required, and to confirm the predictions and parameter estimates of the earlier stages.

Sequential sampling will also be used to guide sample collection and chemical analysis when possible. Analytical results for the first set of the samples collected will be evaluated to determine

if further analysis is necessary and to provide guidance for minimizing required analyses on subsequent samples. This is an efficient and cost-effective way to complete the analysis, particularly if adequate decisions can be made during the early stages.

11.10.2 Approaches to Data Analysis

Comparison to Local Levels. Due to the long history of operations at TA-21, with routine and accidental airborne releases and spills of liquid and solid materials, there is a concern for the presence of low-level contamination across the entire OU. In many of the SWMU-specific sampling plans, a major objective is the identification of suspected or unknown environmental releases of contaminants. In these situations, it is important not to confuse local contaminant levels because of historical OU-wide releases with evidence of a release from a particular SWMU. For this reason, all SWMU-specific data must be assessed against local contaminant levels in the area of the SWMU. Because there may be great variability across TA-21 of OU-wide contaminants, the suite of local data points against which a SWMU must be assessed will vary from SWMU to SWMU.

Use of Background Levels. The term background is used here in the context of Sec. 4.2.4 and means the ambient level of naturally occurring or nonsite-related elements, chemicals, or radionuclides. Comparison of sample analysis results or field instrument readings to background levels can be used to assess the presence of contaminants in certain media or at particular SWMUs. It is important to maintain the distinction between "local levels" discussed above and "background levels." The former is used to evaluate the presence of contaminants released from a particular SWMU versus the OU-wide contamination potentially present at TA-21. The latter provides one means for assessing the absolute presence of contamination versus ambient levels of a material in the environment.

Use of Action Levels. The use of action levels in assessing data obtained at TA-21 will be in accordance with the usage described in Sec. 3.5.2.2 of the IWP (LANL 1990). The action level concept is based on the EPA's proposed 40 CFR 264, Subpart S, and available action levels that have been proposed are listed in Appendix F of the IWP. Action levels will be used in conjunction with local levels and background levels to assess the presence, magnitude, and importance of environmental contamination from individual SWMUs. The comparison of sample analysis results to action levels will figure in the assessment of options for further characterization or the need for remediation.

Decisions to Conduct Additional Sampling. Within many of the individual sampling plans, options are presented to expand the scope of sampling based on immediate information from sample screening (Level I) and field laboratory measurements (Level II). These options allow the area covered by a sampling program to be adjusted as data become available and allow boreholes to be drilled deeper while contaminants are being detected.

In addition, many of the sampling plans provide plans or guidance for subsequent investigations. As part of the sequential sampling approach, subsequent investigations will be undertaken after review and evaluation of analytical data from initial sampling. In some cases, comparisons to action levels or a risk assessment may be part of the evaluation of the initial analytical data. A decision to conduct subsequent investigations will be based on a need to further characterize contaminant concentrations, vertical and lateral extent, or migration along particular pathways, dependent upon objectives of the given SWMU investigation.

Decisions Not to Conduct Additional Sampling. Characterization investigations may be terminated on the basis of one of several points as follows:

1. At many SWMUs, contamination is unknown or only suspected. In a number of these cases, initial results will be sufficient to determine that no significant contamination is present and that no further action is necessary.

2. In some cases, data from initial characterization may identify significant levels of contamination, but the nature and probable extent of contamination may indicate an easily remediated situation. A commonly encountered example is underground waste lines. In such cases, it may be judged more cost effective to remove the contaminated soil with careful monitoring to control excavation than it would be to do further characterization.

3. Initial characterization may identify waste types or contaminant situations for which the most appropriate approach is a pilot study to assess options for treatability or remedial alternatives.

4. In a few cases, further characterization may be curtailed so that effective planning of a corrective measures study can provide additional guidance.

Decision Analysis Approach. In all of these situations, the decision analysis approach, described in Sec. 2.1 above and in Appendix I of the IWP, will ensure that the decision-making

process, with regard to additional characterization sampling, will be systematic. This will be documented by formal reports of data assessment. These will be prepared as technical addenda to the TA-21 OU work plan to document on-going activities.

References

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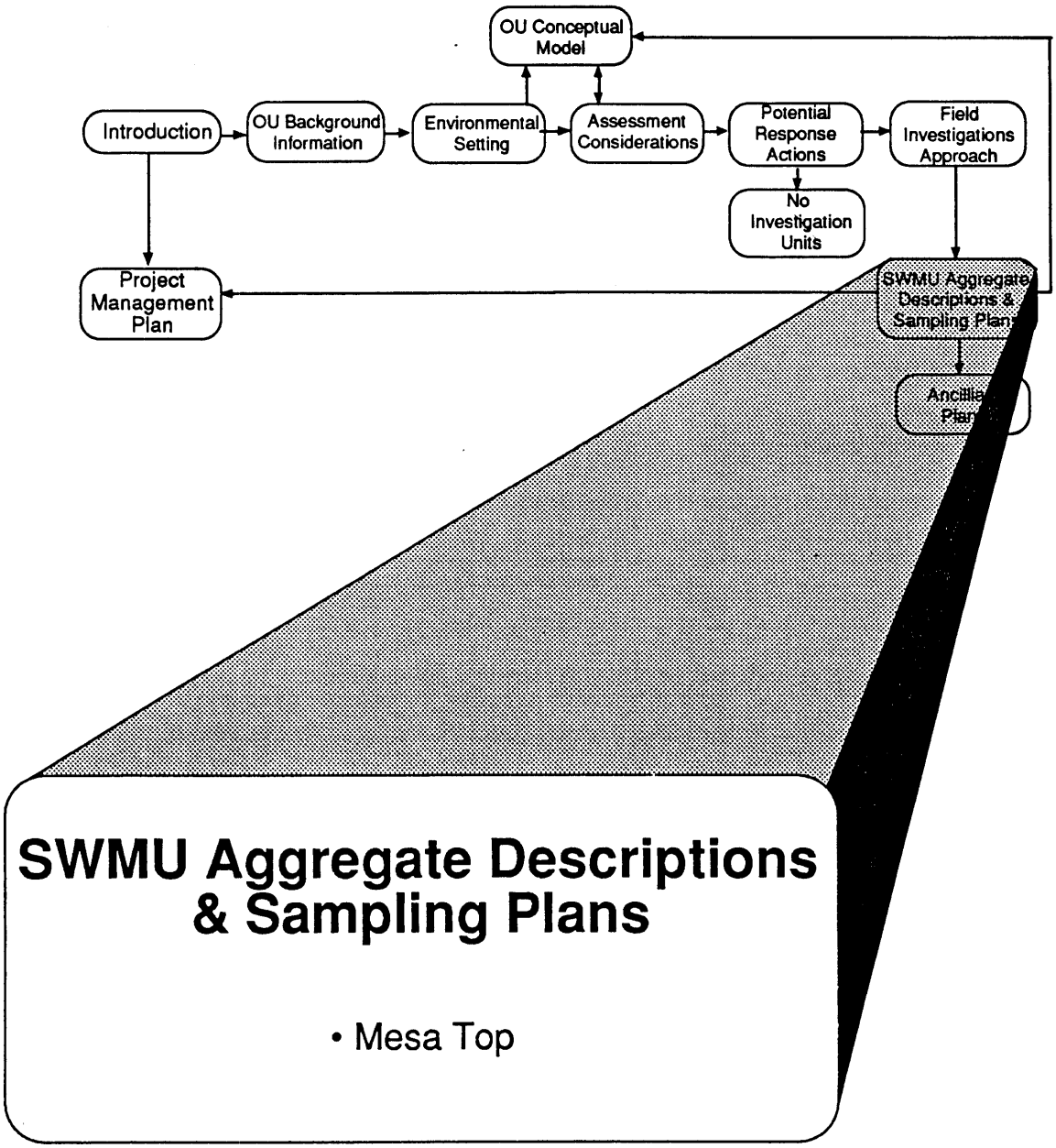
CHAPTER 12


OU Conceptual Model
Introduction
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Environmental Setting
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Potential Response Actions
Field Investigations Approach
No Investigation Units
Project Management Plan
SWMU Aggregate Descriptions & Sampling Plans
Ancillary Plans
SWMU Aggregate Descriptions & Sampling Plans
• Mesa Top

12 MESA TOP SAMPLING PLAN

12.1 Introduction

The mesa top characterization effort is designed to characterize the surface and subsurface environmental setting of the entire OU.

The surface characterization is to document the local contaminant levels in surface soils across the OU. The field investigation is coordinated with the field investigation to investigate deposition of radionuclides across the surface of the TA-21 OU from stack emissions (see Chapter 13). The two field investigations will collect samples at the same locations defined by a surveyed grid established over the OU. The strategy for the field investigation to characterize surface soils is presented in Sec. 12.4 and is summarized in Fig. 12.1-1. (See all tables and figures at the end of this chapter). Tables 12.1-I through 12.1-IV summarize field measurements and laboratory analyses.

The subsurface characterization effort is designed to provide a fundamental understanding of the hydrogeologic framework within which TA-21 and its associated SWMUs lie. The strategy for the subsurface field investigation is presented in Sec. 12.5 and is summarized in Fig. 12.1-2. The measurement methods used in the characterization and the type and number of samples collected for analysis are summarized in Tables 12.1-I through 12.1-VI. The methods for field measurements and laboratory analyses are discussed in Chapter 11.

Because one of the primary potential remedial alternatives to be evaluated for SWMUs with subsurface contamination (e.g., MDAs; see Chapter 16) is capping-in-place with *in situ* stabilization, vadose zone characterization below the existing depth of contamination for the entire OU is important. Therefore, the subsurface characterization investigation includes six vertical drill holes to a depth of 300 ft that are located strategically around the top of the mesa. Three of these holes are in background areas and three are located between the three liquid MDAs and the mesa edge.

In addition, the initial investigation includes one drill hole in Los Alamos Canyon and one drill hole in DP Canyon to determine the potential presence of deep perched water. It also includes tracer tests to characterize the hydrogeologic setting of DP Spring. A required subsequent investigation includes two drill holes in DP Canyon to investigate the presence of an alluvial aquifer. If needed for hydrogeologic characterization, an additional vertical drill hole will be located at each of the liquid MDAs in the subsequent investigation.

The subsurface studies are designed to characterize the three-dimensional hydrogeology of the unsaturated zone at the OU. The field investigation includes tests to quantitatively characterize fracture flow, matrix flow, and vapor phase flow. Environmental isotope analyses of pore fluids through vertical profiles will characterize the history of groundwater in the subsurface. Geochemical and chemical characterization on core samples will provide required input for modeling contaminant transport and will also provide background concentration levels for contaminants of concern at TA-21 SWMUs.

The results of the hydrogeologic characterization to 300 ft from both OU-wide and MDAs' drill holes will be evaluated to determine the need for subsequent investigations to further characterize the physical setting related to subsurface contaminant migration.

12.2 Mesa Top Sampling/Investigation Rationale

A fundamental understanding of the hydrogeologic framework within which TA-21 and its associated SWMUs lie is necessary for characterization, assessment, and remediation of TA-21 SWMUs. The sampling plan presented in this chapter is intended to provide data to further define the OU conceptual model presented in Chapter 7 by addressing data needs stated in Chapter 8. This chapter presents the regulatory and technical rationale for this approach.

12.2.1 Regulatory

First, general hydrogeologic characterization is required in the Laboratory's RCRA Part B permit (EPA 1990), which details required RCRA facility investigation activities in Section P, Task III, Facility Investigation. A.1 of this section requires a program to evaluate hydrogeologic conditions, which will provide the following information:

a. A description of the regional and facility specific geologic and hydrogeologic characteristics affecting groundwater flow beneath the facility;

b. An analysis of any topographic features that might influence the groundwater flow system. (Note Stereographic analysis of aerial photographs may aid in this analysis);

c. An analysis of fractures within the tuff, addressing tectonic trend fractures versus cooling fractures;

d. Based on field data, tests, (gamma and neutron logging of existing and new wells, piezometers and borings) and cores, a representative and accurate classification and description of the hydrogeologic units which may be part of the migration pathways at the facility (i.e., the aquifers and any intervening saturated and unsaturated units);

e. Based on field studies and cores, structural geology and hydrogeologic cross sections showing the extent (depth, thickness, lateral extent) of hydrogeologic units which may be part of the migration pathways identifying;

   i) Unconsolidated sand and gravel deposits,

   ii) Zones of fracturing or channeling in consolidated or unconsolidated depos its, and

   iii) Zones of high permeability or low permeability that might direct and restrict the flow of contaminants.

f. Based on data obtained from groundwater monitoring wells and piezometers installed upgradient and downgradient of the potential contaminant source a representative description of water level or fluid pressure monitoring;

g. A description of manmade influences that may affect the hydrogeology of the site; and

h. Analysis of available geophysical information and remote sensing information such as infrared photography and Landsat imagery.

The RCRA Part B permit also details a soils program to characterize soil and rock units above the water table in the vicinity of contaminant release(s). Section P, Task III, A.2 specifies that this characterization program will include, but is not limited to, the following information:

a. Surface soil distribution;

b. Soil profile, including ASTM classification of soils;

c. Transects of soil stratigraphy;

d. Saturated hydraulic conductivity;

e. Porosity;

f. Cation exchange capacity (CEC);

g. Soil pH;

i. Particle size distribution;

j. Depth of water table;

k. Moisture content;

l. Effect of stratification on unsaturated flow;

m. Infiltration;

n. Evapotranspiration;

o. Residual concentration of contaminants in soil;

p. Mineral and metal content;

q. Trace element geochemistry as a means of differentiating units within the tuff; and

r. Water balance scenarios.

In summary, the RCRA Part B Permit requires comprehensive hydrogeological and soils characterization of the vadose zone to the water table as stated in Section P, Task III, A.1.d.:

> ...a representative and accurate classification and description of the hydrogeologic units which may be part of the migration pathways at the facility (i.e., the aquifers and any intervening saturated and unsaturated units).

The following sections detail required technical data to meet these regulatory requirements.

12.2.2 Technical

A technical understanding is necessary to assess potential movement of contaminants within the hydrogeologic system. A systematic study of the general hydrogeology of the TA-21 OU using a sequential sampling approach will provide an understanding of the general framework, which is essential for defining the nature and extent of contamination from SWMUs. This investigation will define pathways and migration mechanisms critical for performing long-term risk assessments required as a part of the evaluation of remedial alternatives at individual TA-21 SWMUs.

TA-21 is one of the most complicated of the Laboratory's ER Program OUs. General hydrogeological data are crucial to determine remedial alternatives for SWMUs. The preferred remedial alternative in the majority of situations, detailed in Chapter 10, will likely be in-place stabilization. Supporting this passive remedial alternative will require demonstration that offsite contaminant migration will not occur. As discussed in Chapter 4, available geohydrologic characterization data for TA-21 pertain to only a 100-ft depth (Nyhan et al. 1984). Deeper geologic zones and their hydrologic properties will affect potential contaminant migration to greater depths.

Geologic and hydrologic studies of DP Mesa include surface and subsurface characterization. Surface studies are an important component of site characterization because surface water, stream sediments, and airborne particulates are likely media through which contaminants could be transported to potential receptors. These surface pathways need to be characterized because contaminated materials can be readily exposed by erosion of shallow waste disposal beds. Certain MDAs (see Chapter 16 for detail) are vulnerable to erosion because of their locations

near canyon rims; these canyon rims are areas of headward and lateral erosion and may be susceptible to mass wasting. Subsurface studies are designed to determine the geologic framework of the site and to understand the hydrologic processes controlling water movement through the mesa. Possible perched water and groundwater movement and subsurface vadose zone movement, probably in the vapor phase, are important media for contaminant transport in the subsurface environment.

Site remediation recommendations will be based in large part on evaluating the ability of natural geologic barriers to contain contaminants. For example, there is the potential that contaminants, including long-lived radionuclides, may be isolated in the thick vadose zone for thousands of years because of the low permeability of unsaturated tuffs and because of the retardation of contaminant movement by rock-water and rock-contaminant interactions. Thus, the removal of buried waste from SWMUs may not be warranted if geologic and hydrologic conditions make it unlikely that contaminants will be transported to adjacent canyons or to the water table. On the other hand, if remedial work is necessary, the geologic and hydrologic studies detailed in this chapter will provide information about the physical and chemical properties of rocks; characterization of these properties will affect potential remediation technologies for the site and enhance long-term monitoring programs.

12.2.3 Sampling Objectives

Surface geologic and hydrologic studies at TA-21 will determine lateral and vertical variations in rock properties and delineate structural and geomorphic features that can affect contaminant transport in the uppermost part of the vadose zone. Data from surface studies will be integrated with drill hole data to produce geologic cross sections for a three-dimensional model of the site geologic framework. These data will be used to support models that require lithologic and structural information to constrain calculations of geochemical transport. Subsurface characterization of TA-21 combines field and laboratory studies to determine the geologic and hydrologic properties of rock units that presently contain waste or that lie between waste disposal facilities and the main aquifer beneath the site.

Specific sampling objectives of geologic and hydrologic studies at TA-21 are

- to develop a three-dimensional conceptual model of the geology and hydrology of DP Mesa by determining vertical and lateral changes in stratigraphy, lithology, and mineralogic and hydrologic characteristics;
- to characterize faults, fractures, partings, stratigraphic contacts, welding zones, and other features that may affect contaminant transport pathways;

- to provide measurements of physical properties of rock units for use in transport and groundwater travel time calculations;
- to identify potential natural barriers to contaminant transport;
- to document the nature of the surficial materials and the surface transport processes and pathways on the mesa tops and canyon sides that relate to possible contaminant transport; and
- to identify perched water in the vadose zone and characterize the chemical and isotopic composition of any water encountered.

12.3 Geomorphologic Sampling Plan

12.3.1 Geologic Base Map

Surface studies will initially entail the preparation of a detailed geologic map on a 1:3600 scale topographic base using the Geologic Mapping of Bedrock Units SOP to show the distribution of all rock units and surficial materials and to show the orientation and dip of contacts, bedding planes, foliations, faults, and other discontinuities. In addition, the location of springs and other major hydrologic features will be shown. The map will show the lateral extent and thickness of rock units and major subunits and the relative offsets, orientations, and fracture density. The map will be used to support subsequent surface and subsurface studies by summarizing baseline geologic information for the site.

12.3.2 Stratigraphic Sections

At least two stratigraphic sections will be measured in the upper Bandelier Tuff at outcrops on the south side of DP Mesa. Similar stratigraphic sections will be measured for the lower Bandelier Tuff in Pueblo Canyon. Characterization will include detailed descriptions and measured positions of lithologies, stratigraphic contacts, welding and devitrification features, and zones of vapor phase crystallization. Structures, such as cooling joints and tectonic fractures, will be mapped, and their orientations will be measured. These sections will identify the major hydrogeologic subunits whose matrix and fracture properties control the movement of moisture and contaminants. Secondary minerals in matrix and fracture materials will be determined to identify groundwater pathways and to identify potential mineralogic barriers that may retard contaminant migration.

Additional stratigraphic sections will be compiled for the epiclastic rocks in the Cerro Toledo rhyolite and on the fluvial sedimentary rocks that occur in the Puye Formation and the Santa Fe

Group. Tuffaceous sediments of the Cerro Toledo rhyolite were deposited between the upper and lower members of the Bandelier Tuff throughout the DP Mesa area and include intercalated lenses of coarse boulder conglomerates and undulating channel fills that may provide permeable horizontal pathways of 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. These rock units do not crop out at DP Mesa, but excellent exposures of these rocks occur in Los Alamos, Pueblo, Guaje, and White Rock canyons.

12.3.3 Geomorphic Characterization

Geomorphic characterization of DP Mesa (using the Geomorphic Characterization SOP) and vicinity will identify significant erosional processes that may compromise the integrity of SWMUs near the mesa edge, such as the MDAs, and affect the residence times of contaminants in sediment storage sites downslope of these SWMUs. The geomorphic characterization will involve preparation of a 1:3600 scale map of surficial deposits on DP Mesa and in the adjacent canyons and an additional 1:3600 scale map of landforms and drainage patterns, including sites of active erosion and sites of groundwater emergence and potential infiltration. Surficial deposits to be mapped include colluvium and artificial fill on the tops and sides of the mesa and colluvium and alluvium in the canyon bottoms. During the mapping of drainage channels, local sediment storage sites will be delineated. Sediment deposition areas will be sampled as part of associated SWMU investigations, as detailed in Chapters 15 and 16.

Sediments in DP Canyon and Los Alamos Canyon will be studied to determine the magnitude, location, and timing of erosional events. As appropriate, this information collection will be integrated with the ER Program Canyons' Task. Colluvial and alluvial deposits will be described from soil pits and trenches. The locations of these pits and trenches will be determined after the maps of surficial deposits have been prepared. Estimates of the ages of the different surficial deposits will be made using methods such as radiocarbon dating, the degree of soil profile development, and other techniques. During the mapping, evident erosional features including rills, gullies, and landslide scars will be located and used to describe the major erosional processes in the area and to identify areas susceptible to erosion.

12.4 Surface Grid Sampling Plan

Surface characterization will be conducted by sampling the entire OU on a 40-m by 40-m grid. The purpose of this sampling is twofold: first, to characterize any surface soil contamination

resulting from airborne stack emission SWMUs by sampling the top 0 to 1 in. (see Chapter 13 for detail); and second, to sample 0 to 6 in. at the same grid points to establish the local contaminant levels across the TA-21 OU. The 0- to 6-in. sampling will establish a reference point to distinguish the "TA-21 OU local background" from elevated contaminant levels at SWMUs and uses the same sample depth increment as will be used at the SWMUs to ensure data comparability.

Only the 0- to 6-in. sampling is discussed here; the rationale and details for 0- to 1-in. sampling at grid points is discussed in Chapter 13. Surface characterization will consist of surface soil sampling (for method, see Sec. 11.5.2.1) at the nodes of the gridded area shown in Fig. 13.3. For the areas with buildings, samples will be taken from the center of overlapping circles, as described in Sec. 13.2.4.1 (see Fig. 13.4). The rationale for the grid and sampling density is detailed in Sec. 13.2.3.

There are approximately 210 sampling locations in the surface grids. An additional 20 samples will be taken at points 10 m from the grid points to provide a measure of spatial variation. All samples will be field-screened at the time of collection (for method see Sec. 11.6.1.1 and 11.6.1.2) and will be submitted to an analytical laboratory for radionuclides, semivolatiles, and metals analysis as detailed in Table 12.4-I. Twenty-five percent of the samples will be analyzed in the analytical laboratory for isotopic uranium and isotopic thorium.

To provide "TA-21 OU local background" data for field surveys at the SWMUs, measurements will be made at each sampling location with radiation survey instruments as indicated in Table 12.4-I.

12.5 Subsurface Sampling Plan

Hydrogeologic data are currently available only to a depth of 100 ft beneath TA-21. Certain SWMUs received liquid waste that has driven contaminants into the vadose zone (e.g., at MDA T where contamination has been found to 100 ft; see Sec. 16.3). However, because of the approximate 1150-ft thickness of the vadose zone, as stated in the OU conceptual model, the groundwater pathway is unimportant at the TA-21 OU. Nonetheless, because one of the primary potential remedial alternatives to be evaluated for SWMUs with subsurface contamination (e.g., MDAs, see Chapter 16) is capping-in-place with *in situ* stabilization, vadose zone characterization below the existing depth of contamination for the entire OU is important.

Subsurface OU-wide characterization is phased as follows:

1. Five deep vertical holes will be drilled at the perimeter of the TA-21 OU to identify potential transport pathways and migration mechanisms in the vadose zone and to characterize the lateral and vertical variations of geologic and hydrologic properties of

deeper stratigraphic units beneath existing vadose zone contamination. Three of the holes, located on top of the mesa, will be drilled to 300 ft. One drill hole located in DP Canyon will be 675-ft deep. One drill hole in Los Alamos Canyon will be 400-ft deep.

2. Three 300-ft holes will be drilled, one each at each liquid waste MDA (T, U, and V) to further define hydrogeological properties in proximity to these SWMUs.

3. If needed, based on evaluation of initial results, an additional 300-ft hole may be drilled at each of the three liquid waste MDAs to further define hydrogeological properties.

4. A tracer test will be performed to define the source for elevated concentrations of tritium present in DP Spring. A subsequent investigation will include two drill holes to 200 ft to characterize the hydrogeologic setting of DP Spring.

5. The results of hydrogeological property characterization from both OU-wide and MDA boreholes will be evaluated. The OU conceptual model will be updated (the current conceptual model states that deep vadose zone movement and the groundwater pathway are relatively unimportant), and the need for deeper subsurface characterization data will be evaluated. Drilling holes to groundwater is contingent upon what is learned from the above characterization.

12.5.1 Initial Investigation

The subsurface studies presented in this section are designed to characterize the three-dimensional hydrogeology of the unsaturated zone at the TA-21 OU. The importance of fracture flow, matrix flow, and vapor-phase flow is to be characterized. The needed data are acquired through a program of laboratory analyses performed on rock samples. The characterization includes the rock units within the Bandelier Formation because this formation extends from the top of DP Mesa to beneath the floors of DP Canyon and Los Alamos Canyon. The studies are based on stratigraphy developed for the Bandelier Formation discussed in Chapter 4.

The subsurface studies presented in this section will develop the data required for characterization of the physical system related to migration of contaminants through the unsaturated zone. Depending on the results of this investigation, additional characterization studies of the hydrogeologic and geochemical controls on the migration pathways and mechanisms may be conducted at MDAs or OU-wide.

The studies included in this section do not include K_d tests on rock samples. However, bulk rock samples for representative lithologies will be archived as part of the studies. The samples will be available for the performance of K_d tests that, if needed, will be designed using the results of investigations at the MDAs and SWMUs to identify contaminants of concern.

12.5.1.1 Drilling Program for Subsurface Characterization

Eight geologic and hydrologic characterization holes in the upper 750 ft of the vadose zone (measured from the mesa top elevation) will be drilled at TA-21. Five are located to bound OU-wide conditions (Fig. 12.5-I), and three are located adjacent to the liquid waste MDAs (T, U, and V). The holes are located away from TA-21 SWMUs to minimize the possibility of encountering subsurface contamination or opening potential transport pathways.

Table 12.5-I presents the approximate stratigraphy to groundwater for the five OU-wide drill holes. As shown, some holes may penetrate the Otowi Member of the Bandelier Formation. Continuous core will be collected for the entire depth of all five drill holes because this stratigraphic section is most important for characterization of contaminant transport within the unsaturated zone. The core will be sampled to perform laboratory tests to characterize representative hydrostratigraphic units of the Bandelier Formation (see Table 12.5.-II). Collection of continuous core for stratigraphic units within the Bandelier Formation is achievable based on previous drilling experience at the Laboratory.

Drilling Method Requirements for Subsurface Characterization. The characterization activities presented in this section place special requirements on the drilling methods used for the geologic and hydrologic characterization holes. These requirements include the following:

1. Continuous core sampling through the Bandelier Formation.
2. Discrete core sampling within the Puye Formation to characterize all lithologies.
3. Core must not be contaminated with drilling fluid or dried by contact with drilling air.
4. Isotopic characterization of water extracted from rock pores in the unsaturated zone would require a large volume of rock sample that has not been contaminated with drilling fluid or dried by air used for drilling. This characterization is most important for the stratigraphic units from ground surface to a depth of 200 ft. Cuttings from drilling with a hollow-stem auger method would be suitable for analysis.
5. An open drill hole is required through the Bandelier Formation for *in situ* packer tests to collect soil gas samples and to measure *in situ* permeability. The open drill hole is also required for a suite of borehole geophysical logs. The walls of the drill hole must be free of contamination by drilling fluids or by air used for drilling.
6. The diameter of the finished drill hole must be of suitable diameter for installation of monitor well casing. A 10-in. diameter is preferred for the drill hole.

12.5.1.2 Eight Bandelier Formation Characterization Holes

Eight deep drill holes will be drilled to identify potential transport pathways in the vadose zone and to characterize the lateral and vertical variation of geologic and hydrologic properties of the rock section.

Three Liquid Waste MDA Drill Holes. Three 300-ft holes are located adjacent to the liquid waste MDAs T, U, and V. Geohydrologic characterization will be conducted as detailed in Secs. 12.5.1.4 and 12.5.1.5 for these holes. Background contaminant levels will not be determined on core from these holes because of the proximity of these holes to the MDAs.

Five OU-wide Drill Holes. Five holes at varying depths are located at areas selected as representative of the entire OU. Their depths were selected to include zones of potential perched water in adjacent side canyons and to intersect the top of a potential basalt zone, based on general stratigraphic information obtained from the nearest boreholes to groundwater (Boreholes T-2 and 0-4; see Sec. 4.1.).

Drill holes LADP-3 and -4, located in Los Alamos and DP Canyons, respectively, will be drilled first to see whether a deep perched water zone is encountered and to determine whether it is at the same elevation in each drill hole. If a perched zone is encountered at the same elevation in each of these holes, drill holes on the mesa top (i.e., LADP-1, -2, and -5) may be deepened beyond the 300-ft depth in a subsequent investigation to determine whether perched water is continuous beneath the mesa. The general rationale for the location of each of the drill holes is given below.

Because subsurface variations are expected to be greatest in an east-west direction, holes LADP-1 and -2 will be drilled at the extreme western and eastern ends of the site, respectively (Fig. 12.5-1). The third deep drill hole on the Mesa (LADP-5) is located north of MDA V near the suspected location of a fault that strikes north-south in the vicinity of MDA V.

Drill hole LADP-3 is located in Los Alamos Canyon south of MDA A (Fig. 12.5-1). This drill hole will characterize potential perched water pathways beneath the canyon floor. In addition, information from LADP-2 and -3 will be compared to geologic and hydrologic data from water well Otowi 4 to determine the variability in the geology and hydrology of the stratigraphic section below the Bandelier Tuff. LADP-3 will be drilled to 400 ft because it is projected that a perched zone could be encountered at approximately 340 ft and that the top of the basalt layer should be at approximately 380 ft.

Drill hole LADP-4 is located in DP Canyon in a "swampy" area north of MDAs A and T (Fig. 12.5-1). The drill hole will investigate the presence of perched water in this part of DP Canyon and will characterize the geologic and hydrologic properties of stratigraphic units present beneath DP Canyon. This hole will be drilled to a 675-ft depth because it is estimated that perched water could be encountered at 625 ft and that the top of the basalt lies at 665 ft.

If perched groundwater is encountered during drilling of any of the five drill holes, then drilling will stop and the hole will be completed as a monitor well in the perched zone. This does not include shallow alluvial aquifers. The deep drill hole will be moved to a new location at least 100 ft away from the perched zone monitoring well. Any deep perched water encountered near the nominal borehole depth will cause drilling to cease and the hole to be completed as a monitoring well. Any perched water encountered will be sampled, analyzed for the full suite of contaminants, and analyzed for stable isotope variation in water, as detailed later in Sec. 12.6.1.2.

12.5.1.3 Characterization of Background Concentrations in Core Samples

Rock samples will be collected from each of the drill holes to characterize background concentrations. The analytical suite for chemical and radionuclide characterization is presented in Table 12.5-III. Background contaminant levels will not be determined on core from the three MDA drill holes because of the proximity of these holes to the MDAs.

Five background samples will be collected from each of the drill holes. The exact samples that are selected from a given drill hole will be determined by geologic description of the core as it is collected. If present, fracture zones will be sampled. Analytical tables assume three fracture samples per borehole. The field staff will collect samples to provide a real and vertical coverage of hydrostratigraphic units listed in Table 12.5-II for the Bandelier Formation.

12.5.1.4 Characterization of Hydrogeological Parameters on Core Samples

Intact, high quality core will be submitted to a geotechnical laboratory for the following suite of analyses:

- gravimetric moisture content;
- porosity (helium injection test);
- bulk density;
- saturated hydraulic conductivity;

- air-water relative permeability; and
- moisture characteristic curves (wetting and drying [analysis with laboratory thermocouple psychrometer method]).

Characterization of the vertical variation in moisture content is an important parameter to evaluate transport of contaminants. Other investigations at the Laboratory have determined that moisture content can vary greatly over a short vertical distance. Therefore, core samples for moisture content would be collected on an average interval of 5 ft from land surface to the total depth of the drill holes (see Table 12.5-III). Core samples will be distributed so that all hydrostratigraphic units are sampled as represented in Table 12.5-II; samples will be collected close to open joints, from clay-filled joints, and distant from joints in welded and nonwelded rocks.

Bulk density, dry density, and porosity values will be calculated for each core sample for which moisture content is determined (every 5-ft-core interval). The analytical results would be used along with information from geologic characterization and borehole geophysics to select core samples to determine porosity (helium gas injection), water characteristic curves, air-water relative permeability, and saturated hydraulic conductivity. Sample interval for these tests will be every 20 ft (Table 12.5-IV).

The hydrogeological parameter tests can be sequentially performed in a geotechnical laboratory on intact high-quality core that is collected for the gravimetric moisture test. The discrete core samples must be sealed in air tight containers at the time of collection in order to prevent changes in moisture content. Sample collection and laboratory tests will be performed using either the following LANL ER Program SOPs or conventional laboratory methods identified in parentheses below (e.g., ASTM):

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

- laboratory method (thermocouple psychrometer method) to determine moisture characteristic curves (wetting and drying cycles) on intact, undisturbed rock core samples (American Society of Agronomy Method, Chapter 24).

12.5.1.5 Characterization of Mineralogy and Geochemical Parameters on Core Samples

Geochemical characterization on rock samples is needed as input for geochemical models (using numerical codes such as PHREEQE) to predict migration of contaminants. The analytical suite includes the following parameters:

- clay mineralogy,
- zeolite mineralogy,
- rock matrix mineralogy,
- carbonate mineralogy,
- iron and manganese mineralogy,
- total organic carbon,
- cation exchange capacity, and
- slurry pH.

The analyses may be performed on crushed samples. The interval for sample collection in the drill holes will be every 20 ft (Table 12.5-IV). Additional samples of the core will be selected to characterize fracture-lining minerals, changes in lithology, or zones of sorptive minerals. An additional three samples per borehole are assumed. Where possible, mineralogic and hydrologic testing will be done on the same suite of samples. The number and distribution of samples for the characterization of fracture-lining minerals are dependent on the number and nature of fractures encountered by the drill holes; core samples appropriate for characterization will be identified after inspection of the drill core. Sampling will be guided by geologic descriptions to characterize all hydrostratigraphic units presented in Table 12.5-II.

Sample collection and laboratory tests will be performed using either the following LANL ER Program SOPs or conventional laboratory methods (e.g., ASTM):

- field methodology to collect and preserve rock core samples for geochemical parameters tests;
- pulverizing rock samples for chemical and mineralogic analyses;
- purification of zeolite samples for mineralogic identification;

- procedure for collecting mineralogic data by x-ray diffraction;
- laboratory method to determine total organic carbon content in rock samples;
- laboratory method to determine cation exchange capacity in rock samples (EPA Method 9080); and
- laboratory method to determine slurry pH in rock samples.

12.5.1.6 Logs In Open Boreholes

A suite of borehole logs will be collected in open boreholes. The logs will be performed to extend information gathered from geologic description and tests performed on core samples. The logs would enhance stratigraphic correlation, identify and map orientation of fractures and joints, define the relative variation in moisture within the unsaturated zone, and the variation in bulk density within the vertical hydrogeologic section. In addition, the logging suite includes logs to investigate the presence of radioactive and chemical contaminants. Running these logs in these uncontaminated background holes would establish a baseline for comparison to logs that may later be collected in areas of suspected contamination. Table 12.5-V lists the logs to be collected in open boreholes and describes the objective of each log.

All borehole geophysical logging activities will be performed in accordance with either LANL ER Program SOPs or conventional field procedures as follows:

- Borehole Gamma Logging
- Borehole Neutron Logging
- Borehole Caliper Logging
- Borehole Gamma Gamma Logging
- Borehole Video Logging (Axial and Sidescan)
- Borehole Induction (Geonics EM-39) Logging
- Borehole Magnetic Susceptibility Logging (Romulus Instrument)
- Borehole Spectral Gamma Logging
- Borehole Prompt Fission Neutron Logging
- Borehole Geochemical Logging with Neutron Activation and Elastic Scattering
- Borehole Temperature Gradient Logging

12.5.1.7 Characterization of Stable Isotope Variation in Water

Characterization of a suite of stable isotopes in the vertical stratigraphic section on water extracted from rock samples and on water samples collected from springs, seeps, and perched zones would provide the needed information to delineate the depth of migration of water that has infiltrated into the subsurface below DP Mesa and below the floor of Los Alamos Canyon and DP Canyon. The suite of stable isotopes includes ratios for the pairs listed in Table 12.5-VI. In addition, analysis will be performed on a suite of radioactive isotopes (listed in Table 12.5-VI) to determine absolute ages of groundwater in the vertical hydrostratigraphic section of each drill hole. The sample interval for analysis will be every 20 ft for the depth interval from land surface to 100 ft. At depths greater than 100 ft, sampling will be approximately every 40 ft or at zones of high moisture content as determined by the gravimetric moisture content tests on core samples. This is because the isotopic characterization requires extraction of pore water from a large volume of rock sample when the *in situ* moisture content is at low values. Moisture contents would be less than 10% in much of the vertical stratigraphic section. Therefore, this activity requires drilling with a hollow stem auger method and collection of the auger cuttings on a 10 ft depth interval. The cuttings must be immediately drummed in an air tight container. Argon gas is used to purge atmospheric air from the container before sealing. The purging and sealing are required to prevent contamination of the cuttings by atmospheric moisture.

Sample collection and laboratory tests will be performed using either the following LANL ER SOPs or conventional laboratory methods:

- field methodology to collect and preserve rock samples for stable isotope analyses on *in situ* moisture;
- laboratory method to extract *in situ* moisture from rock core for isotopic analyses; and
- laboratory methods to analyze water samples for environmental isotopes.

Water samples collected from seeps and any perched zones would also be analyzed for the stable isotope pairs and environmental radioactive isotopes presented in Table 12.5-VI. The samples will be collected with a method to prevent aeration and will be immediately sealed in an air tight glass bottle.

Sample collection and laboratory tests will be performed using either the following LANL ER SOPs or conventional laboratory methods:

- field methodology to collect and preserve groundwater samples from seeps, springs, and monitoring wells for environmental isotope analyses.

12.5.1.8 Straddle Packer Tests in Open Boreholes

An inflatable straddle packer assembly will be used to determine *in situ* permeabilities for discrete depth intervals in the open borehole of each drill hole. The testing method will be vacuum extraction. The testing interval will be every 20 ft for the first 100 ft and every 40 ft thereafter. The discrete intervals selected for testing will be based on the results of geologic description of core, the interpretation of the suite of borehole geophysical logs, and the results from the moisture content tests on core samples. The above information will be used to select discrete stratigraphic intervals for testing that would represent the hydrostratigraphic units presented in Table 12.5-II for the Bandelier Formation.

Pore gas samples would be collected during performance of the straddle packer tests to determine *in situ* permeabilities. The data are needed to characterize the vapor transport pathway. The collected gas samples will be analyzed for the following:

- volatile organic contaminants,
- carbon dioxide,
- methane,
- carbon-12/carbon-13,
- relative humidity, and
- SF_6 (a gas introduced during drilling to trace contamination of *in situ* pore gas by drilling air).

Sample collection and laboratory tests will be performed using either the following LANL ER Program SOPs or conventional field and laboratory procedures:

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

12.5.2 Subsequent Investigation

Hydrogeological property characterization data to 750 ft OU-wide and to 300 ft in liquid MDA boreholes will be assessed. If a perched zone is encountered at the same elevation in drill holes LADP-3 and -4, then drill holes on the mesa top (i.e., LADP-1, -2, and -5) may be deepened

beyond the 300-ft depth to determine whether perched water is continuous beneath the mesa. As shown in Table 12.5-VII, it is assumed that these holes will be deepened to 750 ft. Analytical requirements are assumed to be the same as in the initial investigation as shown in Tables 12.5-VII and 12.5-VIII. Additionally, if needed, one 300-ft drill hole will be added at each liquid MDA.

Data from the eight characterization holes will also be used to update the OU conceptual model. In conjunction with initial characterization data from SWMUs with deep liquid releases (particularly MDA T, other liquid MDAs, and the acid waste sumps), the need for deeper subsurface characterization data will be evaluated.

12.6 Transient Groundwater Emergence Sampling Plan

Lateral groundwater flow, which is controlled by stratigraphic permeability barriers within the Bandelier Tuff, may daylight in canyon walls or emerge in canyon bottoms, providing a potentially important present or future transport path for contaminant migration. Transient groundwater emergence sites will be identified by repeated field inspection during spring and summer months when spring flow on the Pajarito Plateau is greatest. The bedrock and geomorphic characteristics will be determined at any such sites of groundwater emergence, and the water will be sampled and analyzed for volatile, organic, and inorganic contaminants (Table 12.5-VI). In addition, geomorphic features such as amphitheater-shaped alcoves will be examined to identify potential sites of significant groundwater emergence during periods of wet climatic conditions. One such known site, DP Spring, will be investigated as detailed below. Analytical tables provide for five samples of seasonal surface water encountered (Table 12.6-I). Water will be analyzed for water quality parameters detailed in Table 12.5-VI.

12.6.1 Initial Investigation

12.6.1.1 DP Spring

Tracer Experiment, DP Spring. DP Spring is a recently discovered spring in lower DP Canyon, located east of the main technical area at TA-21 (Fig. 12.5-1). The spring issues from the north side of the canyon wall at the contact between the Tshirege member of the Bandelier Tuff and the overlying colluvium which is composed primarily of tuff debris. The shape of the colluvium body suggests it is filling in a paleocanyon cut into the tuff before the present canyon was formed. DP Spring flows from 2 to 20 L/min depending on season, and the spring water cascades down a

vertical drop of about 10 m from the spring orifice to the present canyon floor. Vegetation growing around the spring indicates it has existed for at least 10 years.

Three tritium measurements made on the spring in 1990 show that it contains 1295 to 2590 pCi/L. Because tritium in rain water in the Los Alamos area is 65 to 130 pCi/L, this spring contains anomalous tritium, presumably from a source upstream of the spring. One possible source is the sewage effluent from TA-21. The effluent, which was dumped into a small branch canyon of DP Canyon upstream of DP Spring, contained as much as 8740 pCi/L in 1991.

In order to find a direct hydraulic linkage between the sewage outfall effluent and the spring, a simple tracer test using fluorescein dye will be conducted. Fluorescein is an organic dye commonly used in tracer tests because it is nontoxic, biodegradable after several months, and easy to detect in diluted water using a spectrophotometer, or fluorometer (Dash et al. 1983). Detection limits with equipment presently available in the EES-1 chemistry laboratory are 50 ppb.

Our procedure will be to pour about 4 L of concentrated fluorescein distilled water solution into the small pond in the side canyon directly beneath the sewage outfall. This "pour" will be done in mid-June, near the end of the dry season. Samples of DP Spring water will then be collected on a twice daily basis (morning and night), on a 7-day-per-week schedule to get real-time data on the travel time and concentration maxima of fluorescein from the pond to DP Spring. If no fluorescein is observed within three months, samples will no longer be collected. Subsequent investigations will test other recharge sources for this spring.

Routine Monitoring. Any surface water seasonally present in DP Canyon will be sampled. Additionally, DP Spring will be sampled monthly for the first year. The water will be analyzed for radionuclides, VOAs, semivolatiles, and metals as detailed in Table 12.6-I.

12.6.1.2 Perched Water Zones Encountered in Borehole Drilling

Any perched water zones encountered while drilling will be sampled. In the initial investigation detailed in Sec. 12.5.1, perched water may be encountered in boreholes LADP-3 and -4, to be drilled in Los Alamos and DP Canyons, respectively. If so, this water will be sampled for the constituents given in Table 12.5-IV, including stable isotopes. This is indicated as water quality parameters in Table 12.6-II for two perched water samples. Subsequent quarterly samples for the duration of the RFI will be analyzed for a reduced analytical suite, depending on initial results. If no contaminants are found in the initial sample, quarterly samples will be analyzed for a water quality screening suite. However, for planning purposes, it is assumed a full analytical suite is analyzed for the first year.

Activities related to the installation and development of monitoring wells and piezometers and the routine measurement of water levels will be performed in accordance with either LANL ER Program SOPs or conventional field procedures as follows:

- Well Installation
- Well Development
- Piezometer Installation
- Piezometer Development
- Water Level Measurements

Activities related to the collection, preservation, transport, and analyses of water samples shall be performed in accordance with either LANL ER Program SOPs or conventional field procedures:

- Purging of Wells for Representative Sampling of Groundwater
- Field Analytical Measurements of Groundwater
- Sampling for Volatile Organics
- Field Methodology for Sampling Springs and Seep
- General Instructions SOP as guidance for Groundwater Sampling

12.6.2 Subsequent Investigations

12.6.2.1 Perched Zone Drill Holes in DP Canyon

Two geological and hydrologic characterization holes would be located in the eastern part of DP Canyon to characterize possible perched water (not a shallow alluvial aquifer that may be present) beneath DP Canyon and to investigate the source of tritium contamination found in DP Spring . Locations of the perched zone drill holes (designated as LAUZ-1 and LAUZ-2) are shown in Fig. 12.5-1. LAUZ-1 is downstream of MDAs T, A, and U in the main drainage of DP Canyon. LAUZ-2 is located in a tributary drainage to DP Canyon downstream of the outfall of the sewage treatment plant at the east end of the site. The estimated stratigraphy of these holes is given in Table 12.6-III.

The two holes would be drilled to the first perched zone encountered (again, not including any shallow alluvial aquifer that may be present) or to a total depth of approximately 200 ft (60 m). The exact depth for the drill holes would be determined from geologic and hydrologic information at drill holes LADP-3 and -4. The core from these holes will be sampled every 5 ft for constituents detailed in Table 12.6-

IV. If perched water is encountered, it will be sampled for the constituents given in Table 12.5-VI and indicated as water quality parameters in Table 12.6-V for two perched water samples. It is assumed this water will be sampled quarterly for three and a half years.

If perched water is not encountered at the LAUZ drill holes, then the decision to complete the drill holes with a screened monitor well will be determined by evaluation of the results from geologic description of core, geophysical logs that have been collected in the open boreholes, and from moisture content measurements on core. If the evaluation of the above data indicates that perched water may be present seasonally at a certain depth interval, then a monitor well will be constructed in the potential perched zone. If a zone for seasonal perched water is not identified, then the drill hole will be abandoned and sealed from total depth to land surface with cement grout.

12.6.2.2 DP Spring

After the initial year, DP Spring will be monitored quarterly for the duration of the RFI. Additional investigations will be closely coordinated with the Canyons' Task. For planning purposes, it is assumed that the spring will continue to be monitored quarterly for the duration of the RFI (Table 12.6-VI).

12.6.2.3 Perched Water Sampling

Any perched water zones encountered in the initial investigation will be sampled quarterly for the duration of the RFI (an additional four years) (Table 12.6-VI).

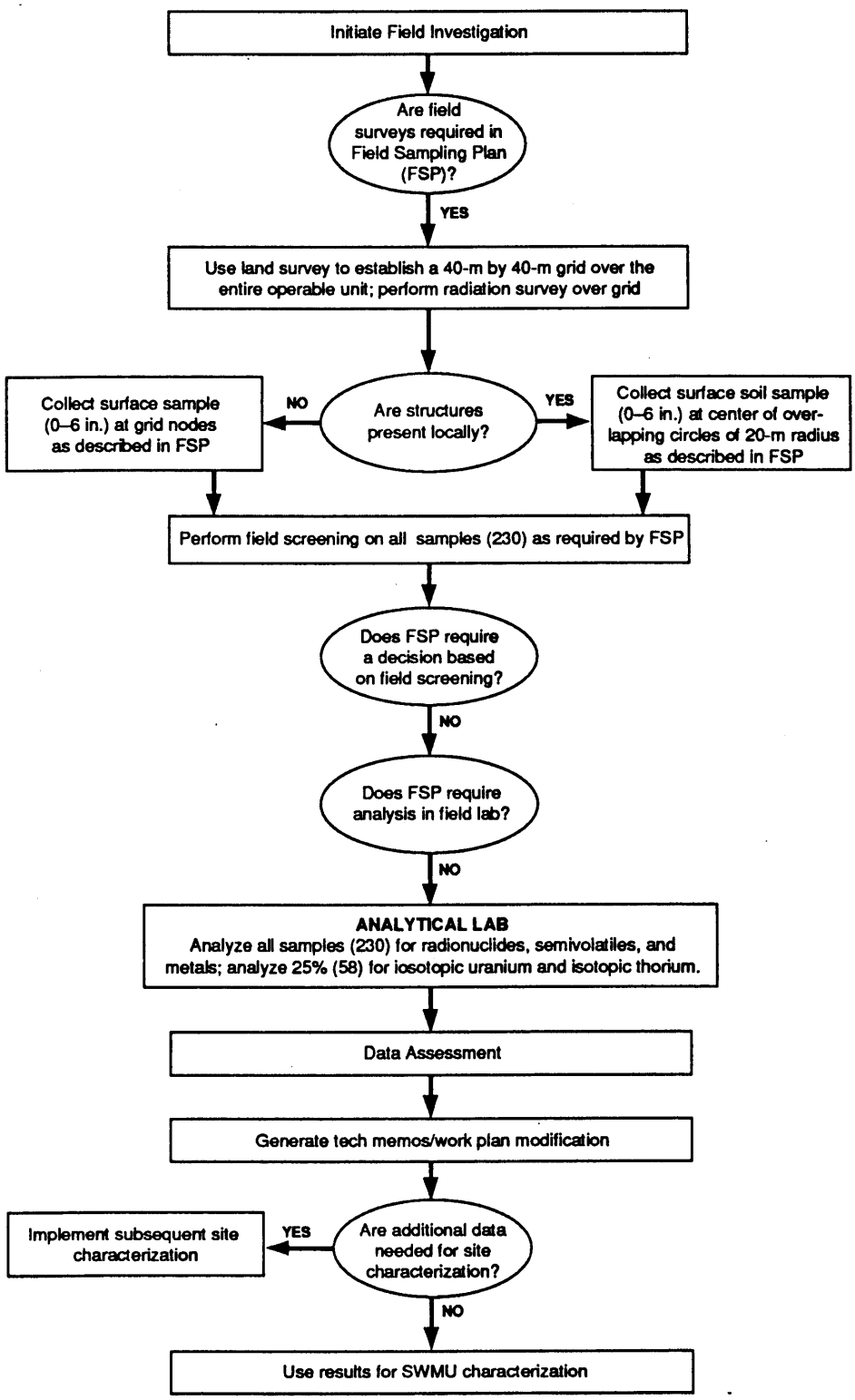

Fig. 12.1-1 Logic flow for field investigations for surface soil characterization of the entire operable unit.

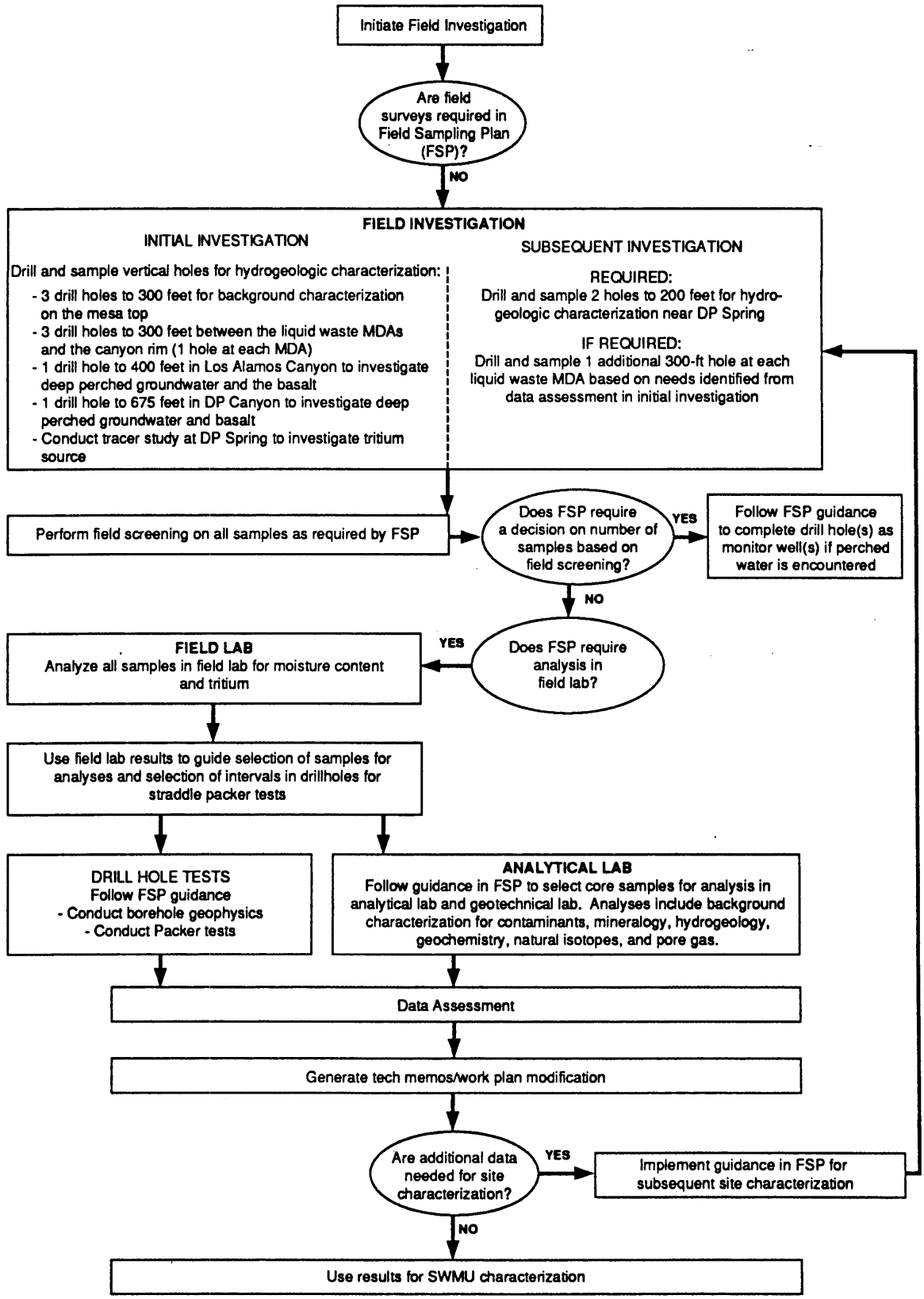

Fig. 12.1-2 Logic flow for hydrogeologic characterization investigations at TA-21.

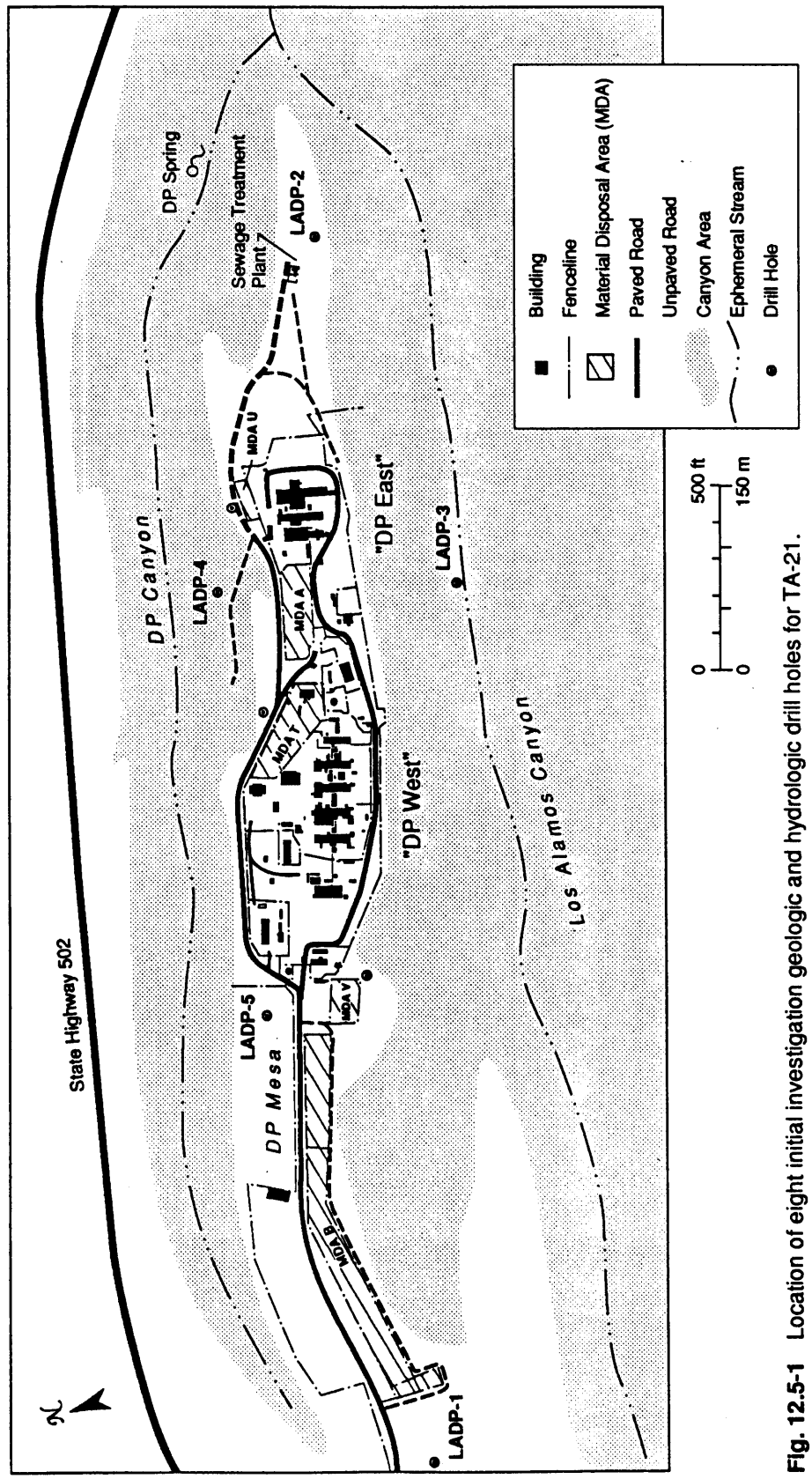

Fig. 12.5-1 Location of eight initial investigation geologic and hydrologic drill holes for TA-21.

TABLE 12.1-I SUMMARY OF INITIAL INVESTIGATIONS BY SECTION FOR CHAPTER 12.

Section	Description	Survey Areas			Surface	Near Surface Soil Samples		Water Samples
		Land	Radiological	Geophysical	Soil Samples	No. of Locations	No. of Samples	
12-4	Mesa Top Soil	1	2		230			
12-5	Mesa Top Boreholes							25
12-6	Water Sampling							
Total		1	2		230			25

Section	Description	Boreholes									Q A
		Shallow			Vertical			Angled			
		Number	Total Footage	No. of Samples	Number	Total Footage	No. of Samples	Number	Total Footage	No. of Samples	
12-4	Mesa Top Soil										37
12-5	Mesa Top Boreholes				8	2875	593				40
12-6	Water Sampling										37
Total					8	2875	593				114

TABLE 12-1-II SUMMARY OF SAMPLE AND ANALYSIS FOR INITIAL INVESTIGATIONS BY SECTION FOR CHAPTER 12

	12.4	12.5	12.6							Total
Field Sample Screening										
Gross Gamma	230	575								805
Gross Alpha	230	575								805
Tritium Vapor										
Organic Vapor		575								575
Combustable Gas/Oxygen		575								575
Lithological Logging		575								575
Field Laboratory Measurements										
Gross Alpha										
Gamma Spectrometry										
Tritium		575								575
Volatile Organics										
PCB										
Soil Moisture		575								575
Laboratory Analysis										
Gamma Spectrometry	255	53								308
Tritium	255	53	38							346
Total Uranium	255	53	26							334
Isotopic Plutonium	255	53	26							334
Isotopic Uranium	69									69
Strontium 90	255	53	26							334
VOA (SW 8240)		83	62							145
Semivolatiles (SW 8270)	267	58	50							375
Metals (SW 6010)	267	58	50							375
PCB (SW 8080)										
Isotopic Thorium	69	53								122
Water Quality Parameters			26							26
Gross Alpha/Beta			26							26

TABLE 12.1-III SUMMARY OF SUBSEQUENT INVESTIGATIONS BY SECTION FOR CHAPTER 12.

Section	Description	Survey Areas			Surface	Near Surface Soil Samples		Water Samples
		Land	Radiological	Geophysical	Soil Samples	No. of Locations	No. of Samples	
12-5	Mesa Top Boreholes							
12-6	Water Sampling							80
	Total							80

Section	Description	Boreholes									Q A
		Shallow			Vertical			Angled			
		Number	Total Footage	No. of Samples	Number	Total Footage	No. of Samples	Number	Total Footage	No. of Samples	
12-5	Mesa Top Boreholes				3	1350	270				
12-6	Water Sampling				2	400	80				74
	Total				5	1750	350				74

TABLE 12-1-IV SUMMARY OF SAMPLE AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS BY SECTION FOR CHAPTER 12

	12.5	12.6	Total
Field Sample Screening			
Gross Gamma	270	80	350
Gross Alpha	270	80	350
Tritium Vapor			
Organic Vapor	270	80	350
Combustable Gas/Oxygen	270	80	350
Lithological Logging	270	80	350
Field Laboratory Measurements			
Gross Alpha			
Gamma Spectrometry			
Tritium	270		270
Volatile Organics			
PCB			
Soil Moisture	270	80	350
Laboratory Analysis			
Gamma Spectrometry		92	92
Tritium		192	192
Total Uranium		176	176
Isotopic Plutonium		176	176
Isotopic Uranium			
Strontium 90		176	176
VOA (SW 8240)		234	234
Semivolatiles (SW 8270)		214	214
Metals (SW 6010)		214	214
PCB (SW 8080)			
Isotopic Thorium			
Water Quality Parameters		84	84
Gross Alpha/Beta		84	84

12-1-V SUMMARY OF INITIAL INVESTIGATIONS GEOHYDROLOGICAL ANALYSES FOR CHAPTER 12.

From Table:

	12.5-IV	Total
Hydrogeological and Geochemical		
Gravimetric Water Content	615	615
Bulk Density	575	575
Dry Density	575	575
Porosity	575	575
Porosity (He injection)	144	144
Saturated Hydraulic Conductivity	144	144
Air Water Relative Permeability	144	144
Moisture Characteristic Curve	144	144
Clay Mineral Content	184	184
Zeolite Mineralogy	184	184
Sulfate Mineral Content	184	184
Carbonate Mineral Content	184	184
Fe and Mn Content	184	184
Total Organic Compound	184	184
Cation Exchange Capacity	184	184
Slurry Ph	184	184
Environmental Isotopes		
Chloride-35/Chloride-37	90	90
Carbon-12/Carbon-13	90	90
Strontium-86/Strontium -87	90	90
Hydrogen/Deuterium	90	90
Oxygen-16/Oxygen-18	90	90
Tritium	90	90
Carbon-14	90	90
Chloride-36	90	90
Straddle Packer Tests		
In Situ Permeability	90	90
VOA's - Pore Gas	90	90
CO2 - Pore Gas	90	90
CH4 - Pore Gas	90	90
C-12/C-13 - Pore Gas	90	90
Relative Humidity - Pore Gas	90	90
SF6	90	90

12-1-VI SUMMARY OF SUBSEQUENT INVESTIGATIONS GEOHYDROLOGICAL ANALYSES FOR CHAPTER 12.

From Table: 12.5-VIII

										Total
Hydrogeological and Geochemical										
Gravimetric Water Content							285			285
Bulk Density							270			270
Dry Density							270			270
Porosity							270			270
Porosity (He injection)							69			69
Saturated Hydraulic Conductivity							69			69
Air Water Relative Permeability							69			69
Moisture Characteristic Curve							69			69
Clay Mineral Content							84			84
Zeolite Mineralogy							84			84
Sulfate Mineral Content							84			84
Carbonate Mineral Content							84			84
Fe and Mn Content							84			84
Total Organic Compound							84			84
Cation Exchange Capacity							84			84
Slurry Ph										
Environmental Isotopes										
Chloride-35/Chloride-37							36			36
Carbon-12/Carbon-13							36			36
Strontium-86/Strontium -87							36			36
Hydrogen/Deuterium							36			36
Oxygen-16/Oxygen-18							36			36
Tritium							36			36
Carbon-14							36			36
Chloride-36							36			36
Straddle Packer Tests										
In Situ Permeability							36			36
VOA's - Pore Gas							36			36
CO2 - Pore Gas							36			36
CH4 - Pore Gas							36			36
C-12/C-13 - Pore Gas							36			36
Relative Humidity - Pore Gas							36			36
SF6							36			36

Table 12.4-I

MESA TOP SURFACE SOIL SAMPLES.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
Mesa Top Surface Sampling				X	X		X																										
Surface Soil Sample	1	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X			
	2	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X			
	3	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X			
	4	0.0 - 6.0 in						X	X													X	X	X	X	X	X		X	X	X		
	5	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X			
Field Duplicate																						X	X	X	X		X		X	X			
	6	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X			
	7	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X			
	8	0.0 - 6.0 in						X	X													X	X	X	X	X	X		X	X	X		
	9	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X			
	10	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X			
Rinsate Blank																						X	X	X	X		X		X	X			
Field Blank																													X	X			
	11	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X			
	12	0.0 - 6.0 in						X	X													X	X	X	X	X	X		X	X		X	
	13	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X			
	14	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X			
	15	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X			
	16	0.0 - 6.0 in						X	X													X	X	X	X	X	X		X	X		X	
	17	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X			
	18	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X			
	19	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X			
	20	0.0 - 6.0 in						X	X													X	X	X	X	X	X		X	X		X	
	21	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X			

Table 12.4-1

MESA TOP SURFACE SOIL SAMPLES.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
	22	0.0 - 6.0 in						X	X													X	X	X	X		X	X	X	X			
	23	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X			
	24	0.0 - 6.0 in						X	X													X	X	X	X		X	X	X	X			
	25	0.0 - 6.0 in						X	X													X	X	X	X		X	X	X	X			
Field Duplicate																																	
	26	0.0 - 6.0 in						X	X													X	X	X	X		X	X	X	X			
	27	0.0 - 6.0 in						X	X													X	X	X	X		X	X	X	X			
	28	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X			
	29	0.0 - 6.0 in						X	X													X	X	X	X		X	X	X	X			
	30	0.0 - 6.0 in						X	X													X	X	X	X		X	X	X	X			
Rinsate Blank																																	
Field Blank																																	
	31	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X			
	32	0.0 - 6.0 in						X	X													X	X	X	X		X	X	X	X			
	33	0.0 - 6.0 in						X	X													X	X	X	X		X	X	X	X			
	34	0.0 - 6.0 in						X	X													X	X	X	X		X	X	X	X			
	35	0.0 - 6.0 in						X	X													X	X	X	X		X	X	X	X			
	36	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X			
	37	0.0 - 6.0 in						X	X													X	X	X	X		X	X	X	X			
	38	0.0 - 6.0 in						X	X													X	X	X	X		X	X	X	X			
	39	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X			
	40	0.0 - 6.0 in						X	X													X	X	X	X		X	X	X	X			
	41	0.0 - 6.0 in						X	X													X	X	X	X		X	X	X	X			
	42	0.0 - 6.0 in						X	X													X	X	X	X		X	X	X	X			
	43	0.0 - 6.0 in						X	X													X	X	X	X		X	X	X	X			
	44	0.0 - 6.0 in						X	X													X	X	X	X		X	X	X	X			

Table 12.4–I

MESA TOP SURFACE SOIL SAMPLES.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis																			
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta							
Field Duplicate																						X	X	X	X	X	X		X	X		X							
	45	0.0 – 6.0 in						X	X													X	X	X	X		X		X	X									
	46	0.0 – 6.0 in						X	X													X	X	X	X		X		X	X									
	47	0.0 – 6.0 in						X	X													X	X	X	X		X		X	X									
	48	0.0 – 6.0 in						X	X													X	X	X	X	X	X		X	X		X							
Rinsate Blank																						X	X	X	X	X	X		X	X		X							
Field Blank																													X	X									
	49	0.0 – 6.0 in						X	X													X	X	X	X		X		X	X									
	50	0.0 – 6.0 in						X	X													X	X	X	X		X		X	X									
	51	0.0 – 6.0 in						X	X													X	X	X	X		X		X	X									
	52	0.0 – 6.0 in						X	X													X	X	X	X	X	X		X	X		X							
	53	0.0 – 6.0 in						X	X													X	X	X	X		X		X	X									
	54	0.0 – 6.0 in						X	X													X	X	X	X		X		X	X									
	55	0.0 – 6.0 in						X	X													X	X	X	X		X		X	X									
	56	0.0 – 6.0 in						X	X													X	X	X	X	X	X		X	X		X							
	57	0.0 – 6.0 in						X	X													X	X	X	X		X		X	X									
	58	0.0 – 6.0 in						X	X													X	X	X	X		X		X	X									
	59	0.0 – 6.0 in						X	X													X	X	X	X		X		X	X									
	60	0.0 – 6.0 in						X	X													X	X	X	X	X	X		X	X		X							
	61	0.0 – 6.0 in						X	X													X	X	X	X		X		X	X									
	62	0.0 – 6.0 in						X	X													X	X	X	X		X		X	X									
	63	0.0 – 6.0 in						X	X													X	X	X	X		X		X	X									
	64	0.0 – 6.0 in						X	X													X	X	X	X	X	X		X	X		X							
Field Duplicate																						X	X	X	X	X	X		X	X		X							
	65	0.0 – 6.0 in						X	X													X	X	X	X		X		X	X									
	66	0.0 – 6.0 in						X	X													X	X	X	X		X		X	X									

Table 12.4-1

MESA TOP SURFACE SOIL SAMPLES.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analyses: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
	67	0.0 - 6.0 in																															
	68	0.0 - 6.0 in						X	X					X	X	X	X	X	X			X	X	X	X	X	X		X	X		X		
	69	0.0 - 6.0 in						X	X					X	X	X	X	X	X			X	X	X	X	X	X		X	X		X		
	70	0.0 - 6.0 in						X	X					X	X	X	X	X	X			X	X	X	X	X	X		X	X		X		
	71	0.0 - 6.0 in						X	X					X	X	X	X	X	X			X	X	X	X	X	X		X	X		X		
	72	0.0 - 6.0 in						X	X					X	X	X	X	X	X			X	X	X	X	X	X		X	X		X		
Rinsate Blank																																	
Field Blank	73	0.0 - 6.0 in						X	X					X	X	X	X	X	X			X	X	X	X	X	X		X	X		X		
	74	0.0 - 6.0 in						X	X					X	X	X	X	X	X			X	X	X	X	X	X		X	X		X		
	75	0.0 - 6.0 in						X	X					X	X	X	X	X	X			X	X	X	X	X	X		X	X		X		
	76	0.0 - 6.0 in						X	X					X	X	X	X	X	X			X	X	X	X	X	X		X	X		X		
	77	0.0 - 6.0 in						X	X					X	X	X	X	X	X			X	X	X	X	X	X		X	X		X		
	78	0.0 - 6.0 in						X	X					X	X	X	X	X	X			X	X	X	X	X	X		X	X		X		
	79	0.0 - 6.0 in						X	X					X	X	X	X	X	X			X	X	X	X	X	X		X	X		X		
	80	0.0 - 6.0 in						X	X					X	X	X	X	X	X			X	X	X	X	X	X		X	X		X		
Field Duplicate																																	
	81	0.0 - 6.0 in						X	X					X	X	X	X	X	X			X	X	X	X	X	X		X	X		X		
	82	0.0 - 6.0 in						X	X					X	X	X	X	X	X			X	X	X	X	X	X		X	X		X		
	83	0.0 - 6.0 in						X	X					X	X	X	X	X	X			X	X	X	X	X	X		X	X		X		
	84	0.0 - 6.0 in						X	X					X	X	X	X	X	X			X	X	X	X	X	X		X	X		X		
Rinsate Blank																																	
Field Blank																																	
	85	0.0 - 6.0 in						X	X					X	X	X	X	X	X			X	X	X	X	X	X		X	X		X		
	86	0.0 - 6.0 in						X	X					X	X	X	X	X	X			X	X	X	X	X	X		X	X		X		
	87	0.0 - 6.0 in						X	X					X	X	X	X	X	X			X	X	X	X	X	X		X	X		X		

Table 12.4-I

MESA TOP SURFACE SOIL SAMPLES.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Field Laboratory Measurements:	Field Laboratory Measurements:	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: Isotopic Thorium	Laboratory Analysis: Water Quality Parameters	Laboratory Analysis: Gross Alpha/Beta
	88	0.0 - 6.0 in						X	X													X	X	X	X	X	X		X	X		X		
	89	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	90	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	91	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	92	0.0 - 6.0 in						X	X													X	X	X	X	X	X		X	X		X		
	93	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	94	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	95	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
Field Duplicate																						X	X	X	X		X		X	X				
	96	0.0 - 6.0 in						X	X													X	X	X	X	X	X		X	X		X		
	97	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	98	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	99	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	100	0.0 - 6.0 in						X	X													X	X	X	X	X	X		X	X		X		
	101	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	102	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	103	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	104	0.0 - 6.0 in						X	X													X	X	X	X	X	X		X	X		X		
Rinsate Blank																						X	X	X	X	X	X		X	X		X		
Field Blank																													X	X				
	105	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	106	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	107	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	108	0.0 - 6.0 in						X	X													X	X	X	X	X	X		X	X		X		
	109	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	110	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				

Table 12.4-1

MESA TOP SURFACE SOIL SAMPLES.

Sample Identification	Sampling Location	Sample Type	Interval	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
	111		0.0 - 6.0 in																														
	112		0.0 - 6.0 in					X	X					X								X	X	X	X	X	X		X		X		
	113		0.0 - 6.0 in					X	X					X								X	X	X	X	X	X		X		X		
		Field Duplicate																															
	114		0.0 - 6.0 in																														
	115		0.0 - 6.0 in																														
	116		0.0 - 6.0 in																														
	117		0.0 - 6.0 in																														
	118		0.0 - 6.0 in																														
	119		0.0 - 6.0 in																														
	120		0.0 - 6.0 in																														
	121		0.0 - 6.0 in																														
	122		0.0 - 6.0 in																														
	123		0.0 - 6.0 in																														
	124		0.0 - 6.0 in																														
	125		0.0 - 6.0 in																														
		Rinsate Blank																															
		Field Blank																															
	126		0.0 - 6.0 in																														
	127		0.0 - 6.0 in																														
	128		0.0 - 6.0 in																														
	129		0.0 - 6.0 in																														
	130		0.0 - 6.0 in																														
	131		0.0 - 6.0 in																														
	132		0.0 - 6.0 in																														
	133		0.0 - 6.0 in																														

Table 12.4-I

MESA TOP SURFACE SOIL SAMPLES.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis															
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta			
Field Duplicate																						X	X	X	X		X		X	X						
	134	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X						
	135	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X						
	136	0.0 - 6.0 in						X	X													X	X	X	X	X	X		X	X		X				
	137	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X						
	138	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X						
	139	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X						
	140	0.0 - 6.0 in						X	X													X	X	X	X	X	X		X	X		X				
	141	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X						
	142	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X						
	143	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X						
	144	0.0 - 6.0 in						X	X													X	X	X	X	X	X		X	X		X				
Rinsate Blank																						X	X	X	X	X	X		X	X		X				
Field Blank																													X	X						
	145	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X						
	146	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X						
	147	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X						
	148	0.0 - 6.0 in						X	X													X	X	X	X	X	X		X	X		X				
	149	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X						
	150	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X						
	151	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X						
	152	0.0 - 6.0 in						X	X													X	X	X	X	X	X		X	X		X				
	153	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X						
	154	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X						
Field Duplicate																						X	X	X	X		X		X	X						
	155	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X						

Table 12.4-1

MESA TOP SURFACE SOIL SAMPLES.

Sample Identification	Sampling Location	Interval	Sample Type	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
	156	0.0 - 6.0 in																				X	X	X	X	X	X		X	X	X	X	
	157	0.0 - 6.0 in																				X	X	X	X	X	X		X	X	X	X	
	158	0.0 - 6.0 in																				X	X	X	X	X	X		X	X	X	X	
	159	0.0 - 6.0 in																				X	X	X	X	X	X		X	X	X	X	
	160	0.0 - 6.0 in																				X	X	X	X	X	X		X	X	X	X	
	161	0.0 - 6.0 in																				X	X	X	X	X	X		X	X	X	X	
	162	0.0 - 6.0 in																				X	X	X	X	X	X		X	X	X	X	
	163	0.0 - 6.0 in																				X	X	X	X	X	X		X	X	X	X	
	164	0.0 - 6.0 in																				X	X	X	X	X	X		X	X	X	X	
			Rinsate Blank																														
			Field Blank																														
	165	0.0 - 6.0 in							X	X												X	X	X	X	X	X		X	X	X	X	
	166	0.0 - 6.0 in							X	X												X	X	X	X	X	X		X	X	X	X	
	167	0.0 - 6.0 in							X	X												X	X	X	X	X	X		X	X	X	X	
	168	0.0 - 6.0 in							X	X												X	X	X	X	X	X		X	X	X	X	
	169	0.0 - 6.0 in							X	X												X	X	X	X	X	X		X	X	X	X	
	170	0.0 - 6.0 in							X	X												X	X	X	X	X	X		X	X	X	X	
	171	0.0 - 6.0 in							X	X												X	X	X	X	X	X		X	X	X	X	
	172	0.0 - 6.0 in							X	X												X	X	X	X	X	X		X	X	X	X	
	173	0.0 - 6.0 in							X	X												X	X	X	X	X	X		X	X	X	X	
	174	0.0 - 6.0 in							X	X												X	X	X	X	X	X		X	X	X	X	
			Field Duplicate																														
	175	0.0 - 6.0 in							X	X												X	X	X	X	X	X		X	X	X	X	
	176	0.0 - 6.0 in							X	X												X	X	X	X	X	X		X	X	X	X	
	177	0.0 - 6.0 in							X	X												X	X	X	X	X	X		X	X	X	X	
	178	0.0 - 6.0 in							X	X												X	X	X	X	X	X		X	X	X	X	

Table 12.4-I

MESA TOP SURFACE SOIL SAMPLES.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
	179	0.0 - 6.0 in						X	X													X	X	X		X		X	X	X				
	180	0.0 - 6.0 in						X	X													X	X	X	X	X		X	X	X	X			
	181	0.0 - 6.0 in						X	X													X	X	X		X		X	X	X				
	182	0.0 - 6.0 in						X	X													X	X	X	X	X		X	X	X	X			
	183	0.0 - 6.0 in						X	X													X	X	X		X		X	X	X				
	184	0.0 - 6.0 in						X	X													X	X	X	X	X		X	X	X	X			
Rinsate Blank																																		
Field Blank																																		
	185	0.0 - 6.0 in						X	X													X	X	X		X		X	X	X				
	186	0.0 - 6.0 in						X	X													X	X	X	X	X		X	X	X	X			
	187	0.0 - 6.0 in						X	X													X	X	X		X		X	X	X				
	188	0.0 - 6.0 in						X	X													X	X	X	X	X		X	X	X	X			
	189	0.0 - 6.0 in						X	X													X	X	X		X		X	X	X				
	190	0.0 - 6.0 in						X	X													X	X	X	X	X		X	X	X	X			
	191	0.0 - 6.0 in						X	X													X	X	X		X		X	X	X				
	192	0.0 - 6.0 in						X	X													X	X	X	X	X		X	X	X	X			
	193	0.0 - 6.0 in						X	X													X	X	X		X		X	X	X				
	194	0.0 - 6.0 in						X	X													X	X	X	X	X		X	X	X	X			
	195	0.0 - 6.0 in						X	X													X	X	X		X		X	X	X				
Field Duplicate																																		
	196	0.0 - 6.0 in						X	X													X	X	X	X	X		X	X	X	X			
	197	0.0 - 6.0 in						X	X													X	X	X		X		X	X	X				
	198	0.0 - 6.0 in						X	X													X	X	X	X	X		X	X	X	X			
	199	0.0 - 6.0 in						X	X													X	X	X		X		X	X	X				
	200	0.0 - 6.0 in						X	X													X	X	X	X	X		X	X	X	X			
	201	0.0 - 6.0 in						X	X													X	X	X		X		X	X	X				

Table 12.4-1

MESA TOP SURFACE SOIL SAMPLES.

Sample Identification	Sampling Location	Interval	Sample Type	Field Survey: Gross Gamma	Field Survey: Low-Energy Gamma	Field Survey: Electromagnetic	Field Survey: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Field Laboratory Measurements:	Field Laboratory Measurements:	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: Isotopic Thorium	Laboratory Analysis: Water Quality Parameters	Laboratory Analysis: Gross Alpha/Beta
	202	0.0 - 6.0 in						X	X						X	X						X	X	X	X				X	X			
	203	0.0 - 6.0 in						X	X						X	X						X	X	X	X				X	X			
	204	0.0 - 6.0 in						X	X						X	X						X	X	X	X				X	X			
			Rinsate Blank																															
			Field Blank																															
	205	0.0 - 6.0 in						X	X						X	X						X	X	X	X				X	X			
	206	0.0 - 6.0 in						X	X						X	X						X	X	X	X				X	X			
	207	0.0 - 6.0 in						X	X						X	X						X	X	X	X				X	X			
	208	0.0 - 6.0 in						X	X						X	X						X	X	X	X				X	X			
	209	0.0 - 6.0 in						X	X						X	X						X	X	X	X				X	X			
	210	0.0 - 6.0 in						X	X						X	X						X	X	X	X				X	X			
	211	0.0 - 6.0 in						X	X						X	X						X	X	X	X				X	X			
	212	0.0 - 6.0 in						X	X						X	X						X	X	X	X				X	X			
	213	0.0 - 6.0 in						X	X						X	X						X	X	X	X				X	X			
	214	0.0 - 6.0 in						X	X						X	X						X	X	X	X				X	X			
			Field Duplicate																															
	215	0.0 - 6.0 in						X	X						X	X						X	X	X	X				X	X			
	216	0.0 - 6.0 in						X	X						X	X						X	X	X	X				X	X			
	217	0.0 - 6.0 in						X	X						X	X						X	X	X	X				X	X			
	218	0.0 - 6.0 in						X	X						X	X						X	X	X	X				X	X			
	219	0.0 - 6.0 in						X	X						X	X						X	X	X	X				X	X			
	220	0.0 - 6.0 in						X	X						X	X						X	X	X	X				X	X			
	221	0.0 - 6.0 in						X	X						X	X						X	X	X	X				X	X			
	222	0.0 - 6.0 in						X	X						X	X						X	X	X	X				X	X			
	223	0.0 - 6.0 in						X	X						X	X						X	X	X	X				X	X			
	224	0.0 - 6.0 in						X	X						X	X						X	X	X	X				X	X			

Table 12.4-I

MESA TOP SURFACE SOIL SAMPLES.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis													
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta	
Rinsate Blank																						X	X	X	X	X	X		X	X		X			
Field Blank																													X	X					
	225	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X					
	226	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X					
	227	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X					
	228	0.0 - 6.0 in						X	X													X	X	X	X	X	X		X	X		X			
	229	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X					
	230	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X					
Field Duplicate																						X	X	X	X		X		X	X					

TABLE 12.5-I
ESTIMATED THICKNESS OF STRATIGRAPHIC UNITS PRESENT AT DRILL HOLE LOCATIONS

Drill Hole No.a	Estimated Surface Elevation (ft)	Estimated Thickness (ft) of Stratigraphic Units in the Bandelier Formation						Estimated Total Thickness of Bandelier Formation (ft)	Thickness of Puye Formation in the unsaturated zone (ft)
		Total Depth (ft)	Tshirege Member Bed	Cerro Tsankawi Pumice	Toledo Rhyolite	Otowi Member Bed	Guaje Pumice		
LADP-1	7240	1340	315-335	0-2	0-30	290-310	0-30	600	620
LADP-2	7090	1190	250-270	0-2	0-30	290-310	0-30	570	620
LADP-3	6730	830	0	0	0	260-280	0-30	270	620
LADP-4	7040	1140	115-135	0-2	0-30	290-310	0-30	425	620
LADP-5	7170	1270	260-290	0-2	0-30	290-310	0-30	575	620

[a]Drill hole locations are shown in Figure 12.5-1.

TABLE 12.5-II
HYDROSTRATIGRAPHIC UNITS WITHIN THE BANDELIER FORMATION

IGNIMBRITE FLOW UNITS (TUFF)

- Characterize the following lithologies within cooling units
    - Welded tuff/nonwelded tuff
        - zeolite zones
        - lithic-rich zones
        - dense, competent tuff
        - fractured, jointed tuff
            - open fractures, joints
            - nature of mineral coatings on open surfaces
            - clay-filled fractures, joints
- Characterize vertical stratigraphic contacts between discrete cooling units
    - Weathered tuff in contact zones
    - Thin surge deposits in contact zones
    - Thin pumice, ash-fall deposits in contact zones

BEDDED DEPOSITS

- Characterize the following lithologies
    - Fluvial sands, gravels, and cobbles
    - Lacustrine fine sand, silt, and clay
    - Inter-layered alluvial, ash flow, and ash-fall deposits
- Characterize vertical stratigraphic contacts between contrasting lithologies

PUMICE BEDS

- Characterize the following lithologies
    - zeolite zones
    - lithic-rich zones
    - inter-layered surge deposits
- Characterize vertical stratigraphic contacts between contrasting lithologies

Table 12.5-III

MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
Subsurface samples																																	
Vertical Borehole	LADP-3	0.0 - 5.0 ft						X	X							X			X														
		5.0 - 10.0 ft						X	X							X			X														
		10.0 - 15.0 ft						X	X							X			X														
		15.0 - 20.0 ft						X	X							X			X			E	E	E	E							E	
Trip Blank																						E	E	E	E		E	E	E	E	E	E	
		20.0 - 25.0 ft						X	X							X			X							E							
		25.0 - 30.0 ft						X	X							X			X														
		30.0 - 35.0 ft						X	X							X			X														
		35.0 - 40.0 ft						X	X							X			X														
		40.0 - 45.0 ft						X	X							X			X														
		45.0 - 50.0 ft						X	X							X			X														
		50.0 - 55.0 ft						X	X							X			X														
		55.0 - 60.0 ft						X	X							X			X														
		60.0 - 65.0 ft						X	X							X			X														
		65.0 - 70.0 ft						X	X							X			X														
		70.0 - 75.0 ft						X	X							X			X														
		75.0 - 80.0 ft						X	X							X			X			E	E	E	E							E	
Trip Blank																						E	E	E	E		E	E	E	E	E	E	
		80.0 - 85.0 ft						X	X							X			X														
		85.0 - 90.0 ft						X	X							X			X														
		90.0 - 95.0 ft						X	X							X			X														
		95.0 - 100.0 ft						X	X							X			X														
		100.0 - 105.0 ft						X	X							X			X														
		105.0 - 110.0 ft						X	X							X			X														

Table 12.5-III

MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
		110.0 – 115.0 ft						X	X		X	X	X			X			X															
		115.0 – 120.0 ft						X	X		X	X	X			X			X															
		120.0 – 125.0 ft						X	X		X	X	X			X			X															
		125.0 – 130.0 ft						X	X		X	X	X			X			X															
		130.0 – 135.0 ft						X	X		X	X	X			X			X															
		135.0 – 140.0 ft						X	X		X	X	X			X			X															
		140.0 – 145.0 ft						X	X		X	X	X			X			X															
		145.0 – 150.0 ft						X	X		X	X	X			X			X															
		150.0 – 155.0 ft						X	X		X	X	X			X			X															
		155.0 – 160.0 ft						X	X		X	X	X			X			X															
		160.0 – 165.0 ft						X	X		X	X	X			X			X															
		165.0 – 170.0 ft						X	X		X	X	X			X			X															
		170.0 – 175.0 ft						X	X		X	X	X			X			X															
		175.0 – 180.0 ft						X	X		X	X	X			X			X															
		180.0 – 185.0 ft						X	X		X	X	X			X			X															
		185.0 – 190.0 ft						X	X		X	X	X			X			X															
		190.0 – 195.0 ft						X	X		X	X	X			X			X			E	E								E			
		195.0 – 200.0 ft						X	X		X	X	X			X			X			E	E							E	E			
Trip Blank																																	
		200.0 – 205.0 ft						X	X		X	X	X			X			X			E	E							E	E			
		205.0 – 210.0 ft						X	X		X	X	X			X			X			E	E							E	E			
		210.0 – 215.0 ft						X	X		X	X	X			X			X			E	E							E	E			
		215.0 – 220.0 ft						X	X		X	X	X			X			X			E	E							E	E			
		220.0 – 225.0 ft						X	X		X	X	X			X			X			E	E							E	E			
		225.0 – 230.0 ft						X	X		X	X	X			X			X			E	E							E	E			
		230.0 – 235.0 ft						X	X		X	X	X			X			X			E	E							E	E			

Table 12.5-III

MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
		235.0 – 240.0 ft						X	X		X	X	X	X		X			X														
		240.0 – 245.0 ft						X	X		X	X	X	X		X			X														
		245.0 – 250.0 ft						X	X		X	X	X	X		X			X														
		250.0 – 255.0 ft						X	X		X	X	X	X		X			X														
		255.0 – 260.0 ft						X	X		X	X	X	X		X			X			E	E	E	E	E	E	E	E	E	E	E	E
Trip Blank																																
		260.0 – 265.0 ft						X	X		X	X	X	X		X			X														
		265.0 – 270.0 ft						X	X		X	X	X	X		X			X														
		270.0 – 275.0 ft						X	X		X	X	X	X		X			X														
		275.0 – 280.0 ft						X	X		X	X	X	X		X			X														
		280.0 – 285.0 ft						X	X		X	X	X	X		X			X														
		285.0 – 290.0 ft						X	X		X	X	X	X		X			X														
		290.0 – 295.0 ft						X	X		X	X	X	X		X			X														
		295.0 – 300.0 ft						X	X		X	X	X	X		X			X														
		300.0 – 305.0 ft						X	X		X	X	X	X		X			X														
		305.0 – 310.0 ft						X	X		X	X	X	X		X			X														
		310.0 – 315.0 ft						X	X		X	X	X	X		X			X														
		315.0 – 320.0 ft						X	X		X	X	X	X		X			X														
		320.0 – 325.0 ft						X	X		X	X	X	X		X			X														
		325.0 – 330.0 ft						X	X		X	X	X	X		X			X														
		330.0 – 335.0 ft						X	X		X	X	X	X		X			X														
		335.0 – 340.0 ft						X	X		X	X	X	X		X			X														
		340.0 – 345.0 ft						X	X		X	X	X	X		X			X														
		345.0 – 350.0 ft						X	X		X	X	X	X		X			X														
		350.0 – 355.0 ft						X	X		X	X	X	X		X			X														
		355.0 – 360.0 ft						X	X		X	X	X	X		X			X														

Table 12.5-III

MESA TOP CHARACTERIZATION BOREHOLES

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
Rinsate Blank																						E	E	E	E		E	E	E	E		E		
Field Duplicate																						E	E	E	E		E	E	E	E		E		
Field Blank																												E	E	E				
Trip Blank																												E						
		360.0 – 365.0 ft						X	X		X	X	X			X			X															
		365.0 – 370.0 ft						X	X		X	X	X			X			X															
		370.0 – 375.0 ft						X	X		X	X	X			X			X															
		375.0 – 380.0 ft						X	X		X	X	X			X			X															
		380.0 – 385.0 ft						X	X		X	X	X			X			X															
		385.0 – 390.0 ft						X	X		X	X	X			X			X															
		390.0 – 395.0 ft						X	X		X	X	X			X			X															
		395.0 – 400.0 ft						X	X		X	X	X			X			X															
Fracture Sampling Contingency																						C	C	C	C		C	C	C	C		C		
																						C	C	C	C		C	C	C	C		C		
																						C	C	C	C		C	C	C	C		C		

Table 12.5-III

MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
Subsurface samples																																	
Vertical Borehole	LADP-4	0.0 - 5.0 ft						X	X		X	X	X			X			X														
		5.0 - 10.0 ft						X	X		X	X	X			X			X														
		10.0 - 15.0 ft						X	X		X	X	X			X			X														
		15.0 - 20.0 ft						X	X		X	X	X			X			X														
		20.0 - 25.0 ft						X	X		X	X	X			X			X														
		25.0 - 30.0 ft						X	X		X	X	X			X			X														
		30.0 - 35.0 ft						X	X		X	X	X			X			X														
		35.0 - 40.0 ft						X	X		X	X	X			X			X														
		40.0 - 45.0 ft						X	X		X	X	X			X			X														
		45.0 - 50.0 ft						X	X		X	X	X			X			X														
		50.0 - 55.0 ft						X	X		X	X	X			X			X														
		55.0 - 60.0 ft						X	X		X	X	X			X			X														
		60.0 - 65.0 ft						X	X		X	X	X			X			X														
		65.0 - 70.0 ft						X	X		X	X	X			X			X														
		70.0 - 75.0 ft						X	X		X	X	X			X			X														
		75.0 - 80.0 ft						X	X		X	X	X			X			X														
		80.0 - 85.0 ft						X	X		X	X	X			X			X														
		85.0 - 90.0 ft						X	X		X	X	X			X			X														
		90.0 - 95.0 ft						X	X		X	X	X			X			X														
		95.0 - 100.0 ft						X	X		X	X	X			X			X														
		100.0 - 105.0 ft						X	X		X	X	X			X			X														
		105.0 - 110.0 ft						X	X		X	X	X			X			X														
		110.0 - 115.0 ft						X	X		X	X	X			X			X														
Trip Blank																						E	E	E	E	E	E	E	E	E	E		

Table 12.5–III

MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis														
				Gross Gamma	Low–Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta	
		115.0 – 120.0 ft						X	X		X	X	X			X			X																
		120.0 – 125.0 ft						X	X		X	X	X			X			X																
		125.0 – 130.0 ft						X	X		X	X	X			X			X																
		130.0 – 135.0 ft						X	X		X	X	X			X			X																
		135.0 – 140.0 ft						X	X		X	X	X			X			X																
		140.0 – 145.0 ft						X	X		X	X	X			X			X																
		145.0 – 150.0 ft						X	X		X	X	X			X			X																
		150.0 – 155.0 ft						X	X		X	X	X			X			X																
		155.0 – 160.0 ft						X	X		X	X	X			X			X																
		160.0 – 165.0 ft						X	X		X	X	X			X			X																
		165.0 – 170.0 ft						X	X		X	X	X			X			X																
		170.0 – 175.0 ft						X	X		X	X	X			X			X																
		175.0 – 180.0 ft						X	X		X	X	X			X			X																
		180.0 – 185.0 ft						X	X		X	X	X			X			X																
		185.0 – 190.0 ft						X	X		X	X	X			X			X																
		190.0 – 195.0 ft						X	X		X	X	X			X			X																
		195.0 – 200.0 ft						X	X		X	X	X			X			X			E	E	E	E		E	E	E	E		E			
Trip Blank																											E								
		200.0 – 205.0 ft						X	X		X	X	X			X			X																
		205.0 – 210.0 ft						X	X		X	X	X			X			X																
		210.0 – 215.0 ft						X	X		X	X	X			X			X																
		215.0 – 220.0 ft						X	X		X	X	X			X			X																
		220.0 – 225.0 ft						X	X		X	X	X			X			X																
		225.0 – 230.0 ft						X	X		X	X	X			X			X																
		230.0 – 235.0 ft						X	X		X	X	X			X			X																
		235.0 – 240.0 ft						X	X		X	X	X			X			X																

Table 12.5-III

MESA TOP CHARACTERIZATION BOREHOLES

	Sample Identification	Interval	Sampling Location	Sample Type
Field Surveys: Gross Gamma				
Field Surveys: Low-Energy Gamma				
Field Surveys: Electromagnetic				
Field Surveys: Land Survey				
Field Screening: Gross Gamma	X	240.0 – 245.0 ft		
Field Screening: Gross Alpha	X	245.0 – 250.0 ft		
Field Screening:		250.0 – 255.0 ft		
Field Screening: Organic Vapor	X	255.0 – 260.0 ft		
Field Screening: Combustible Gas/Oxygen	X	260.0 – 265.0 ft		
Field Screening: Lithological Logging	X	265.0 – 270.0 ft		
Laboratory Measurements: Gross Alpha	X	270.0 – 275.0 ft		
Laboratory Measurements: Gamma Spectrometry	X	275.0 – 280.0 ft		
Laboratory Measurements: Tritium	X	280.0 – 285.0 ft		
Laboratory Measurements: Volatile Organics	X	285.0 – 290.0 ft		
Laboratory Measurements: PCB	X	290.0 – 295.0 ft		
Laboratory Measurements: Soil Moisture	X	295.0 – 300.0 ft		
Laboratory Measurements:	X	300.0 – 305.0 ft		
Laboratory Measurements:	X	305.0 – 310.0 ft		
Laboratory Analysis: Gamma Spectrometry	X	310.0 – 315.0 ft		
Laboratory Analysis: Tritium	X	315.0 – 320.0 ft		
Laboratory Analysis: Total Uranium	X	320.0 – 325.0 ft		
Laboratory Analysis: Isotopic Plutonium	X	325.0 – 330.0 ft		
Laboratory Analysis: Isotopic Uranium	X	330.0 – 335.0 ft		
Laboratory Analysis: Strontium 90	X	335.0 – 340.0 ft		
Laboratory Analysis: VOA (SW 8240)	X	340.0 – 345.0 ft		
Laboratory Analysis: Semivolatiles (SW 8270)	X	345.0 – 350.0 ft		
Laboratory Analysis: Metals (SW 6010)	X	350.0 – 355.0 ft		
Laboratory Analysis: PCB (SW 8080)	X	355.0 – 360.0 ft		
Laboratory Analysis: Isotopic Thorium	X	360.0 – 365.0 ft		
Laboratory Analysis: Water Quality Parameters			Trip Blank	E
Laboratory Analysis: Gross Alpha/Beta				E
				E
				E
				E
				E
				E
				E
				E
				E
				E
				E
				E

Table 12.5-III

MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta	Laboratory Analysis
		365.0 – 370.0 ft		X				X	X		X	X	X			X			X															
		370.0 – 375.0 ft		X				X	X		X	X	X			X			X															
		375.0 – 380.0 ft		X				X	X		X	X	X			X			X															
		380.0 – 385.0 ft		X				X	X		X	X	X			X			X															
		385.0 – 390.0 ft		X				X	X		X	X	X			X			X															
		390.0 – 395.0 ft		X				X	X		X	X	X			X			X															
		395.0 – 400.0 ft		X				X	X		X	X	X			X			X															
		400.0 – 405.0 ft		X				X	X		X	X	X			X			X															
		405.0 – 410.0 ft		X				X	X		X	X	X			X			X															
		410.0 – 415.0 ft		X				X	X		X	X	X			X			X															
		415.0 – 420.0 ft		X				X	X		X	X	X			X			X															
		420.0 – 425.0 ft		X				X	X		X	X	X			X			X															
		425.0 – 430.0 ft		X				X	X		X	X	X			X			X															
		430.0 – 435.0 ft		X				X	X		X	X	X			X			X															
		435.0 – 440.0 ft		X				X	X		X	X	X			X			X															
		440.0 – 445.0 ft		X				X	X		X	X	X			X			X															
		445.0 – 450.0 ft		X				X	X		X	X	X			X			X															
		450.0 – 455.0 ft		X				X	X		X	X	X			X			X															
		455.0 – 460.0 ft		X				X	X		X	X	X			X			X															
		460.0 – 465.0 ft		X				X	X		X	X	X			X			X															
		465.0 – 470.0 ft		X				X	X		X	X	X			X			X															
		470.0 – 475.0 ft		X				X	X		X	X	X			X			X															
		475.0 – 480.0 ft		X				X	X		X	X	X			X			X															
		480.0 – 485.0 ft		X				X	X		X	X	X			X			X															
		485.0 – 490.0 ft		X				X	X		X	X	X			X			X															
		490.0 – 495.0 ft		X				X	X		X	X	X			X			X															

Table 12.5-III

MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: ontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: ivolatiles (SW 8270)	Laboratory Analysis: tals (SW 6010)	Laboratory Analysis: CB (SW 8080)	Laboratory Analysis: topic Thorium	Laboratory Analysis: Water Quality Parameters	Laboratory Analysis: Gross Alpha/Beta
		495.0 - 500.0 ft						X	X		X	X	X			X			X												
Trip Blank																				m	m	m	m		m	m	m		m		
		500.0 - 505.0 ft						X	X		X	X	X	X	X	X	X	X	X												
		505.0 - 510.0 ft						X	X		X	X	X	X	X	X	X	X	X												
		510.0 - 515.0 ft						X	X		X	X	X	X	X	X	X	X	X												
		515.0 - 520.0 ft						X	X		X	X	X	X	X	X	X	X	X												
		520.0 - 525.0 ft						X	X		X	X	X	X	X	X	X	X	X												
		525.0 - 530.0 ft						X	X		X	X	X	X	X	X	X	X	X												
		530.0 - 535.0 ft						X	X		X	X	X	X	X	X	X	X	X												
		535.0 - 540.0 ft						X	X		X	X	X	X	X	X	X	X	X												
		540.0 - 545.0 ft						X	X		X	X	X	X	X	X	X	X	X												
		545.0 - 550.0 ft						X	X		X	X	X	X	X	X	X	X	X												
		550.0 - 555.0 ft						X	X		X	X	X	X	X	X	X	X	X												
		555.0 - 560.0 ft						X	X		X	X	X	X	X	X	X	X	X												
		560.0 - 565.0 ft						X	X		X	X	X	X	X	X	X	X	X												
		565.0 - 570.0 ft						X	X		X	X	X	X	X	X	X	X	X												
		570.0 - 575.0 ft						X	X		X	X	X	X	X	X	X	X	X												
		575.0 - 580.0 ft						X	X		X	X	X	X	X	X	X	X	X												
		580.0 - 585.0 ft						X	X		X	X	X	X	X	X	X	X	X												
		585.0 - 590.0 ft						X	X		X	X	X	X	X	X	X	X	X												
		590.0 - 595.0 ft						X	X		X	X	X	X	X	X	X	X	X												
		595.0 - 600.0 ft						X	X		X	X	X	X	X	X	X	X	X												
		600.0 - 605.0 ft						X	X		X	X	X	X	X	X	X	X	X												
		605.0 - 610.0 ft						X	X		X	X	X	X	X	X	X	X	X												
		610.0 - 615.0 ft						X	X		X	X	X	X	X	X	X	X	X												
		615.0 - 620.0 ft						X	X		X	X	X	X	X	X	X	X	X												

Table 12.5-III

MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
		620.0 – 625.0 ft						X	X		X	X	X			X			X			E	E	E							E	C		
		625.0 – 630.0 ft						X	X		X	X	X			X			X			E	E	E				E	E	E	E	C	C	C
		630.0 – 635.0 ft						X	X		X	X	X			X			X			E	E	E	E	E	E	E	E	E	E	C	C	C
		635.0 – 640.0 ft						X	X		X	X	X			X			X			E	E	E	E	E	E	E	E	E	E	C	C	C
		640.0 – 645.0 ft						X	X		X	X	X			X			X			E	E	E	E	E	E	E	E	E	E	C	C	C
		645.0 – 650.0 ft						X	X		X	X	X			X			X			E	E	E	E	E	E	E	E	E	E	C	C	C
		650.0 – 655.0 ft						X	X		X	X	X			X			X			E	E	E	E	E	E	E	E	E	E	C	C	C
		655.0 – 660.0 ft						X	X		X	X	X			X			X			E	E	E	E	E	E	E	E	E	E	C	C	C
		660.0 – 665.0 ft						X	X		X	X	X			X			X			E	E	E	E	E	E	E	E	E	E	C	C	C
		665.0 – 670.0 ft						X	X		X	X	X			X			X			E	E	E	E	E	E	E	E	E	E	C	C	C
		670.0 – 675.0 ft						X	X		X	X	X			X			X			E	E	E	E	E	E	E	E	E	E	C	C	C
Rinsate Blank																																		
Field Blank																																		
Field Duplicate																																		
Trip Blank																																		
Fracture Sampling Contingency																																		

Table 12.5–III

MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
Subsurface samples																																	
Vertical Borehole	LADP-1	0.0 – 5.0 ft						X	X		X	X	X						X														
		5.0 – 10.0 ft						X	X		X	X	X						X														
		10.0 – 15.0 ft						X	X		X	X	X						X														
		15.0 – 20.0 ft						X	X		X	X	X						X			E	E	E	E		E	E	E	E	E	E	E
Trip Blank																						E					E						
		20.0 – 25.0 ft						X	X		X	X	X					X																
		25.0 – 30.0 ft						X	X		X	X	X					X																
		30.0 – 35.0 ft						X	X		X	X	X					X																
		35.0 – 40.0 ft						X	X		X	X	X					X																
		40.0 – 45.0 ft						X	X		X	X	X					X																
		45.0 – 50.0 ft						X	X		X	X	X					X																
		50.0 – 55.0 ft						X	X		X	X	X					X																
		55.0 – 60.0 ft						X	X		X	X	X					X																
		60.0 – 65.0 ft						X	X		X	X	X					X																
		65.0 – 70.0 ft						X	X		X	X	X					X																
		70.0 – 75.0 ft						X	X		X	X	X					X																
		75.0 – 80.0 ft						X	X		X	X	X					X																
		80.0 – 85.0 ft						X	X		X	X	X					X																
		85.0 – 90.0 ft						X	X		X	X	X					X																
		90.0 – 95.0 ft						X	X		X	X	X					X																
		95.0 – 100.0 ft						X	X		X	X	X					X																
		100.0 – 105.0 ft						X	X		X	X	X					X					E	E	E	E		E	E	E	E	E	E	E
Trip Blank		105.0 – 110.0 ft																					E					E						

Table 12.5-III

MESA TOP CHARACTERIZATION BOREHOLES

Sample Identification	Sampling Location	Sample Type	Interval	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
			110.0 – 115.0 ft					X	X		X	X	X			X			X														
			115.0 – 120.0 ft					X	X		X	X	X			X			X														
			120.0 – 125.0 ft					X	X		X	X	X			X			X														
			125.0 – 130.0 ft					X	X		X	X	X			X			X														
			130.0 – 135.0 ft					X	X		X	X	X			X			X														
			135.0 – 140.0 ft					X	X		X	X	X			X			X														
			140.0 – 145.0 ft					X	X		X	X	X			X			X														
			145.0 – 150.0 ft					X	X		X	X	X			X			X														
			150.0 – 155.0 ft					X	X		X	X	X			X			X														
			155.0 – 160.0 ft					X	X		X	X	X			X			X														
			160.0 – 165.0 ft					X	X		X	X	X			X			X														
			165.0 – 170.0 ft					X	X		X	X	X			X			X														
			170.0 – 175.0 ft					X	X		X	X	X			X			X														
			175.0 – 180.0 ft					X	X		X	X	X			X			X														
			180.0 – 185.0 ft					X	X		X	X	X			X			X														
			185.0 – 190.0 ft					X	X		X	X	X			X			X														
			190.0 – 195.0 ft					X	X		X	X	X			X			X														
			195.0 – 200.0 ft					X	X		X	X	X			X			X				E	E	E	E	E	E	E	E	E	E	E	E
			Trip Blank																			E						E					
			200.0 – 205.0 ft					X	X		X	X	X			X			X														
			205.0 – 210.0 ft					X	X		X	X	X			X			X														
			210.0 – 215.0 ft					X	X		X	X	X			X			X														
			215.0 – 220.0 ft					X	X		X	X	X			X			X														
			220.0 – 225.0 ft					X	X		X	X	X			X			X														
			225.0 – 230.0 ft					X	X		X	X	X			X			X														
			230.0 – 235.0 ft					X	X		X	X	X			X			X														

Table 12.5-III

MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
		235.0 - 240.0 ft																															
		240.0 - 245.0 ft						X	X		X	X	X			X																	
		245.0 - 250.0 ft						X	X		X	X	X			X																	
		250.0 - 255.0 ft						X	X		X	X	X			X																	
		255.0 - 260.0 ft						X	X		X	X	X			X						E	E	E	E		E	E	E	E	E	E	
Trip Blank																					E						E					
		260.0 - 265.0 ft						X	X		X	X	X			X						E	E	E	E		E	E	E	E	E	E	
		265.0 - 270.0 ft						X	X		X	X	X			X																	
		270.0 - 275.0 ft						X	X		X	X	X			X																	
		275.0 - 280.0 ft						X	X		X	X	X			X																	
		280.0 - 285.0 ft						X	X		X	X	X			X																	
		285.0 - 290.0 ft						X	X		X	X	X			X																	
		290.0 - 295.0 ft						X	X		X	X	X			X																	
		295.0 - 300.0 ft						X	X		X	X	X			X						E	E	E	E		E	E	E	E	E	E	
Rinsate Blank																					E						E					
Field Blank																					E						E					
Field Duplicate																					E	E	E	E		E	E	E	E	E	E	
Trip Blank																					E						E					
Fracture Sampling Contingency																					C	C	C	C		C	C	C	C	C	C	
																					C	C	C	C		C	C	C	C	C	C	
																					C	C	C	C		C	C	C	C	C	C	
																					C	C	C	C		C	C	C	C	C	C	
Vertical Borehole	LADP-2	0.0 - 5.0 ft						X	X		X	X	X			X				X		C	C	C	C		C	C	C	C	C	C	
		5.0 - 10.0 ft						X	X		X	X	X			X				X													
		10.0 - 15.0 ft						X	X		X	X	X			X				X													
		15.0 - 20.0 ft						X	X		X	X	X			X				X		E						E					

Table 12.5-III

MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture				Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
Trip Blank																												E						
		20.0 – 25.0 ft		X	X	X	X	X	X		X	X	X			X			X				E	E	E	E	E		E	E	E	E	
		25.0 – 30.0 ft		X	X	X	X	X	X		X	X	X			X			X				E	E	E	E	E		E	E	E	E	
		30.0 – 35.0 ft		X	X	X	X	X	X		X	X	X			X			X				E	E	E	E	E		E	E	E	E	
		35.0 – 40.0 ft		X	X	X	X	X	X		X	X	X			X			X				E	E	E	E	E		E	E	E	E	
		40.0 – 45.0 ft		X	X	X	X	X	X		X	X	X			X			X				E	E	E	E	E		E	E	E	E	
		45.0 – 50.0 ft		X	X	X	X	X	X		X	X	X			X			X				E	E	E	E	E		E	E	E	E	
		50.0 – 55.0 ft		X	X	X	X	X	X		X	X	X			X			X				E	E	E	E	E		E	E	E	E	
		55.0 – 60.0 ft		X	X	X	X	X	X		X	X	X			X			X				E	E	E	E	E		E	E	E	E	
		60.0 – 65.0 ft		X	X	X	X	X	X		X	X	X			X			X				E	E	E	E	E		E	E	E	E	
		65.0 – 70.0 ft		X	X	X	X	X	X		X	X	X			X			X				E	E	E	E	E		E	E	E	E	
		70.0 – 75.0 ft		X	X	X	X	X	X		X	X	X			X			X				E	E	E	E	E		E	E	E	E	
		75.0 – 80.0 ft		X	X	X	X	X	X		X	X	X			X			X				E	E	E	E	E		E	E	E	E	
		80.0 – 85.0 ft		X	X	X	X	X	X		X	X	X			X			X				E	E	E	E	E		E	E	E	E	
		85.0 – 90.0 ft		X	X	X	X	X	X		X	X	X			X			X				E	E	E	E	E		E	E	E	E	
		90.0 – 95.0 ft		X	X	X	X	X	X		X	X	X			X			X				E	E	E	E	E		E	E	E	E	
		95.0 – 100.0 ft		X	X	X	X	X	X		X	X	X			X			X				E	E	E	E	E		E	E	E	E	
		100.0 – 105.0 ft		X	X	X	X	X	X		X	X	X			X			X				E	E	E	E	E		E	E	E	E	
Trip Blank																												E						
		105.0 – 110.0 ft		X	X	X	X	X	X		X	X	X			X			X															
		110.0 – 115.0 ft		X	X	X	X	X	X		X	X	X			X			X															
		115.0 – 120.0 ft		X	X	X	X	X	X		X	X	X			X			X															
		120.0 – 125.0 ft		X	X	X	X	X	X		X	X	X			X			X															
		125.0 – 130.0 ft		X	X	X	X	X	X		X	X	X			X			X															
		130.0 – 135.0 ft		X	X	X	X	X	X		X	X	X			X			X															
		135.0 – 140.0 ft		X	X	X	X	X	X		X	X	X			X			X															

Table 12.5-III

MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
		140.0 - 145.0 ft						X	X		X	X	X			X			X														
		145.0 - 150.0 ft						X	X		X	X	X						X														
		150.0 - 155.0 ft						X	X		X	X	X						X														
		155.0 - 160.0 ft						X	X		X	X	X						X														
		160.0 - 165.0 ft						X	X		X	X	X						X														
		165.0 - 170.0 ft						X	X		X	X	X						X														
		170.0 - 175.0 ft						X	X		X	X	X						X														
		175.0 - 180.0 ft						X	X		X	X	X						X														
		180.0 - 185.0 ft						X	X		X	X	X						X														
		185.0 - 190.0 ft						X	X		X	X	X						X														
		190.0 - 195.0 ft						X	X		X	X	X						X														
		195.0 - 200.0 ft						X	X		X	X	X						X				E										
Trip Blank																							E										
		200.0 - 205.0 ft						X	X		X	X	X			X			X														
		205.0 - 210.0 ft						X	X		X	X	X			X			X														
		210.0 - 215.0 ft						X	X		X	X	X			X			X														
		215.0 - 220.0 ft						X	X		X	X	X			X			X														
		220.0 - 225.0 ft						X	X		X	X	X			X			X														
		225.0 - 230.0 ft						X	X		X	X	X			X			X														
		230.0 - 235.0 ft						X	X		X	X	X			X			X														
		235.0 - 240.0 ft						X	X		X	X	X			X			X														
		240.0 - 245.0 ft						X	X		X	X	X			X			X														
		245.0 - 250.0 ft						X	X		X	X	X			X			X														
		250.0 - 255.0 ft						X	X		X	X	X			X			X														
		255.0 - 260.0 ft						X	X		X	X	X			X			X				E										
Trip Blank																						E										

Table 12.5-III

MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
		260.0 – 265.0 ft						X	X		X	X	X			X			X															
		265.0 – 270.0 ft						X	X		X	X	X			X			X															
		270.0 – 275.0 ft						X	X		X	X	X			X			X															
		275.0 – 280.0 ft						X	X		X	X	X			X			X															
		280.0 – 285.0 ft						X	X		X	X	X			X			X															
		285.0 – 290.0 ft						X	X		X	X	X			X			X															
		290.0 – 295.0 ft						X	X		X	X	X			X			X															
		295.0 – 300.0 ft						X	X		X	X	X			X			X			E	E	E	E		E	E	E	E		E		
Rinsate Blank																						E	E	E	E		E	E	E	E		E		
Field Blank																												E	E	E				
Field Duplicate																						E	E	E	E		E	E	E	E		E		
Trip Blank																												E						
Fracture Sampling Contingency																						C	C	C	C		C	C	C	C		C		
																						C	C	C	C		C	C	C	C		C		
																						C	C	C	C		C	C	C	C		C		
																						C	C	C	C		C	C	C	C		C		
Vertical Borehole	LADP-5	0.0 – 5.0 ft						X	X		X	X	X			X			X															
		5.0 – 10.0 ft						X	X		X	X	X			X			X															
		10.0 – 15.0 ft						X	X		X	X	X			X			X															
		15.0 – 20.0 ft						X	X		X	X	X			X			X			E	E	E	E		E	E	E	E		E		
Trip Blank																												E						
		20.0 – 25.0 ft						X	X		X	X	X			X			X															
		25.0 – 30.0 ft						X	X		X	X	X			X			X															
		30.0 – 35.0 ft						X	X		X	X	X			X			X															
		35.0 – 40.0 ft						X	X		X	X	X			X			X															
		40.0 – 45.0 ft						X	X		X	X	X			X			X															

Table 12.5–III

MESA TOP CHARACTERIZATION BOREHOLES

Sample Identification	Interval	Sampling Location	Sample Type	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
	45.0 – 50.0 ft							X	X		X	X	X			X			X														
	50.0 – 55.0 ft							X	X		X	X	X			X			X														
	55.0 – 60.0 ft							X	X		X	X	X			X			X														
	60.0 – 65.0 ft							X	X		X	X	X			X			X														
	65.0 – 70.0 ft							X	X		X	X	X			X			X														
	70.0 – 75.0 ft							X	X		X	X	X			X			X														
	75.0 – 80.0 ft							X	X		X	X	X			X			X														
	80.0 – 85.0 ft							X	X		X	X	X			X			X														
	85.0 – 90.0 ft							X	X		X	X	X			X			X														
	90.0 – 95.0 ft							X	X		X	X	X			X			X														
	95.0 – 100.0 ft							X	X		X	X	X			X			X														
	100.0 – 105.0 ft							X	X		X	X	X			X			X														
	105.0 – 110.0 ft							X	X		X	X	X			X			X														
	110.0 – 115.0 ft							X	X		X	X	X			X			X														
	115.0 – 120.0 ft							X	X		X	X	X			X			X														
	120.0 – 125.0 ft							X	X		X	X	X			X			X														
	125.0 – 130.0 ft							X	X		X	X	X			X			X														
	130.0 – 135.0 ft							X	X		X	X	X			X			X														
	135.0 – 140.0 ft							X	X		X	X	X			X			X														
	140.0 – 145.0 ft							X	X		X	X	X			X			X														
	145.0 – 150.0 ft							X	X		X	X	X			X			X														
	150.0 – 155.0 ft							X	X		X	X	X			X			X														
	155.0 – 160.0 ft							X	X		X	X	X			X			X														
	160.0 – 165.0 ft							X	X		X	X	X			X			X														
	165.0 – 170.0 ft							X	X		X	X	X			X			X														
Trip Blank																						E	E	E	E	E	E	E	E	E	E	E	E

Table 12.5–III

MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis													
				Gross Gamma	Low–Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta	
		170.0 – 175.0 ft						X	X		X	X	X			X			X															
		175.0 – 180.0 ft						X	X		X	X	X			X			X															
		180.0 – 185.0 ft						X	X		X	X	X			X			X															
		185.0 – 190.0 ft						X	X		X	X	X			X			X															
		190.0 – 195.0 ft						X	X		X	X	X			X			X															
		195.0 – 200.0 ft						X	X		X	X	X			X			X			E	E	E	E		E	E	E	E		E			
Trip Blank																											E							
		200.0 – 205.0 ft						X	X		X	X	X			X			X															
		205.0 – 210.0 ft						X	X		X	X	X			X			X															
		210.0 – 215.0 ft						X	X		X	X	X			X			X															
		215.0 – 220.0 ft						X	X		X	X	X			X			X															
		220.0 – 225.0 ft						X	X		X	X	X			X			X															
		225.0 – 230.0 ft						X	X		X	X	X			X			X															
		230.0 – 235.0 ft						X	X		X	X	X			X			X															
		235.0 – 240.0 ft						X	X		X	X	X			X			X															
		240.0 – 245.0 ft						X	X		X	X	X			X			X															
		245.0 – 250.0 ft						X	X		X	X	X			X			X															
		250.0 – 255.0 ft						X	X		X	X	X			X			X															
		255.0 – 260.0 ft						X	X		X	X	X			X			X			E	E	E	E		E	E	E	E		E			
Trip Blank																											E							
		260.0 – 265.0 ft						X	X		X	X	X			X			X															
		265.0 – 270.0 ft						X	X		X	X	X			X			X															
		270.0 – 275.0 ft						X	X		X	X	X			X			X															
		275.0 – 280.0 ft						X	X		X	X	X			X			X															
		280.0 – 285.0 ft						X	X		X	X	X			X			X															
		285.0 – 290.0 ft						X	X		X	X	X			X			X															

Table 12.5-III

MESA TOP CHARACTERIZATION BOREHOLES

		Sample Identification	Interval	Sampling Location	Sample Type
Field Surveys	Gross Gamma		290.0 - 295.0 ft		
	Low-Energy Gamma		295.0 - 300.0 ft		
	Electromagnetic				Rinsate Blank
	Land Survey				Field Blank
Field Screening	Gross Gamma				Field Duplicate
	Gross Alpha				Trip Blank
					Fracture Sampling Contingency
	Organic Vapor				
	Combustible Gas/Oxygen				
	Lithological Logging				
Field Laboratory Measurements	Gross Alpha				
	Gamma Spectrometry				
	Tritium				
	Volatile Organics				
	PCB				
	Soil Moisture				
Laboratory Analysis	Gamma Spectrometry				
	Tritium				
	Total Uranium				
	Isotopic Plutonium				
	Isotopic Uranium				
	Strontium 90				
	VOA (SW 8240)				
	Semivolatiles (SW 8270)				
	Metals (SW 6010)				
	PCB (SW 8080)				
	Isotopic Thorium				
	Water Quality Parameters				
	Gross Alpha/Beta				

Table 12.5-III

MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening					Field Laboratory Measurements						Laboratory Analysis												
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
Subsurface samples																																
Vertical Borehole	MDA T	0.0 – 5.0 ft						X	X		X	X	X			X			X												
		5.0 – 10.0 ft						X	X		X	X	X			X			X												
		10.0 – 15.0 ft						X	X		X	X	X			X			X												
		15.0 – 20.0 ft						X	X		X	X	X			X			X												
		20.0 – 25.0 ft						X	X		X	X	X			X			X												
		25.0 – 30.0 ft						X	X		X	X	X			X			X												
		30.0 – 35.0 ft						X	X		X	X	X			X			X												
		35.0 – 40.0 ft						X	X		X	X	X			X			X												
		40.0 – 45.0 ft						X	X		X	X	X			X			X												
		45.0 – 50.0 ft						X	X		X	X	X			X			X												
		50.0 – 55.0 ft						X	X		X	X	X			X			X												
		55.0 – 60.0 ft						X	X		X	X	X			X			X												
		60.0 – 65.0 ft						X	X		X	X	X			X			X												
		65.0 – 70.0 ft						X	X		X	X	X			X			X												
		70.0 – 75.0 ft						X	X		X	X	X			X			X												
		75.0 – 80.0 ft						X	X		X	X	X			X			X												
		80.0 – 85.0 ft						X	X		X	X	X			X			X												
		85.0 – 90.0 ft						X	X		X	X	X			X			X												
		90.0 – 95.0 ft						X	X		X	X	X			X			X												
		95.0 – 100.0 ft						X	X		X	X	X			X			X												
		100.0 – 105.0 ft						X	X		X	X	X			X			X												
		105.0 – 110.0 ft						X	X		X	X	X			X			X												
		110.0 – 115.0 ft						X	X		X	X	X			X			X												
		115.0 – 120.0 ft						X	X		X	X	X			X			X												

Table 12.5-III

MESA TOP CHARACTERIZATION BOREHOLES

Sample Identification	Sampling Location	Interval	Sample Type	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
		120.0 – 125.0 ft						X	X		X	X	X			X			X												
		125.0 – 130.0 ft						X	X		X	X	X			X			X												
		130.0 – 135.0 ft						X	X		X	X	X			X			X												
		135.0 – 140.0 ft						X	X		X	X	X			X			X												
		140.0 – 145.0 ft						X	X		X	X	X			X			X												
		145.0 – 150.0 ft						X	X		X	X	X			X			X												
		150.0 – 155.0 ft						X	X		X	X	X			X			X												
		155.0 – 160.0 ft						X	X		X	X	X			X			X												
		160.0 – 165.0 ft						X	X		X	X	X			X			X												
		165.0 – 170.0 ft						X	X		X	X	X			X			X												
		170.0 – 175.0 ft						X	X		X	X	X			X			X												
		175.0 – 180.0 ft						X	X		X	X	X			X			X												
		180.0 – 185.0 ft						X	X		X	X	X			X			X												
		185.0 – 190.0 ft						X	X		X	X	X			X			X												
		190.0 – 195.0 ft						X	X		X	X	X			X			X												
		195.0 – 200.0 ft						X	X		X	X	X			X			X												
		200.0 – 205.0 ft						X	X		X	X	X			X			X												
		205.0 – 210.0 ft						X	X		X	X	X			X			X												
		210.0 – 215.0 ft						X	X		X	X	X			X			X												
		215.0 – 220.0 ft						X	X		X	X	X			X			X												
		220.0 – 225.0 ft						X	X		X	X	X			X			X												
		225.0 – 230.0 ft						X	X		X	X	X			X			X												
		230.0 – 235.0 ft						X	X		X	X	X			X			X												
		235.0 – 240.0 ft						X	X		X	X	X			X			X												
		240.0 – 245.0 ft						X	X		X	X	X			X			X												
		245.0 – 250.0 ft						X	X		X	X	X			X			X												

Table 12.5-III

MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements							Laboratory Analysis												
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging		Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
		250.0 – 255.0 ft						X	X		X	X	X				X			X													
		255.0 – 260.0 ft						X	X		X	X	X				X			X													
		260.0 – 265.0 ft						X	X		X	X	X				X			X													
		265.0 – 270.0 ft						X	X		X	X	X				X			X													
		270.0 – 275.0 ft						X	X		X	X	X				X			X													
		275.0 – 280.0 ft						X	X		X	X	X				X			X													
		280.0 – 285.0 ft						X	X		X	X	X				X			X													
		285.0 – 290.0 ft						X	X		X	X	X				X			X													
		290.0 – 295.0 ft						X	X		X	X	X				X			X													
		295.0 – 300.0 ft						X	X		X	X	X				X			X													
Vertical Borehole	MDA U	0.0 – 5.0 ft						X	X		X	X	X				X			X													
		5.0 – 10.0 ft						X	X		X	X	X				X			X													
		10.0 – 15.0 ft						X	X		X	X	X				X			X													
		15.0 – 20.0 ft						X	X		X	X	X				X			X													
		20.0 – 25.0 ft						X	X		X	X	X				X			X													
		25.0 – 30.0 ft						X	X		X	X	X				X			X													
		30.0 – 35.0 ft						X	X		X	X	X				X			X													
		35.0 – 40.0 ft						X	X		X	X	X				X			X													
		40.0 – 45.0 ft						X	X		X	X	X				X			X													
		45.0 – 50.0 ft						X	X		X	X	X				X			X													
		50.0 – 55.0 ft						X	X		X	X	X				X			X													
		55.0 – 60.0 ft						X	X		X	X	X				X			X													
		60.0 – 65.0 ft						X	X		X	X	X				X			X													
		65.0 – 70.0 ft						X	X		X	X	X				X			X													
		70.0 – 75.0 ft						X	X		X	X	X				X			X													
		75.0 – 80.0 ft						X	X		X	X	X				X			X													

Table 12.5-III

MESA TOP CHARACTERIZATION BOREHOLES

	Sample Identification	Sampling Location	Sample Type	Interval
Field Surveys				
Gross Gamma				
Low-Energy Gamma				
Electromagnetic				
Land Survey				
Field Screening				
Gross Gamma				80.0 – 85.0 ft
Gross Alpha				85.0 – 90.0 ft
				90.0 – 95.0 ft
Organic Vapor				95.0 – 100.0 ft
Combustible Gas/Oxygen				100.0 – 105.0 ft
Lithological Logging				105.0 – 110.0 ft
Field Laboratory Measurements				110.0 – 115.0 ft
Gross Alpha				115.0 – 120.0 ft
Gamma Spectrometry				120.0 – 125.0 ft
Tritium				125.0 – 130.0 ft
Volatile Organics				130.0 – 135.0 ft
PCB				135.0 – 140.0 ft
Soil Moisture				140.0 – 145.0 ft
				145.0 – 150.0 ft
				150.0 – 155.0 ft
Laboratory Analysis				155.0 – 160.0 ft
Gamma Spectrometry				160.0 – 165.0 ft
Tritium				165.0 – 170.0 ft
Total Uranium				170.0 – 175.0 ft
Isotopic Plutonium				175.0 – 180.0 ft
Isotopic Uranium				180.0 – 185.0 ft
Strontium 90				185.0 – 190.0 ft
VOA (SW 8240)				190.0 – 195.0 ft
Semivolatiles (SW 8270)				195.0 – 200.0 ft
Metals (SW 6010)				200.0 – 205.0 ft
PCB (SW 8080)				205.0 – 210.0 ft
Isotopic Thorium				
Water Quality Parameters				
Gross Alpha/Beta				

Table 12.5-III

MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements							Laboratory Analysis											
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
		210.0 – 215.0 ft						X	X		X	X	X			X			X												
		215.0 – 220.0 ft						X	X		X	X	X			X			X												
		220.0 – 225.0 ft						X	X		X	X	X			X			X												
		225.0 – 230.0 ft						X	X		X	X	X			X			X												
		230.0 – 235.0 ft						X	X		X	X	X			X			X												
		235.0 – 240.0 ft						X	X		X	X	X			X			X												
		240.0 – 245.0 ft						X	X		X	X	X			X			X												
		245.0 – 250.0 ft						X	X		X	X	X			X			X												
		250.0 – 255.0 ft						X	X		X	X	X			X			X												
		255.0 – 260.0 ft						X	X		X	X	X			X			X												
		260.0 – 265.0 ft						X	X		X	X	X			X			X												
		265.0 – 270.0 ft						X	X		X	X	X			X			X												
		270.0 – 275.0 ft						X	X		X	X	X			X			X												
		275.0 – 280.0 ft						X	X		X	X	X			X			X												
		280.0 – 285.0 ft						X	X		X	X	X			X			X												
		285.0 – 290.0 ft						X	X		X	X	X			X			X												
		290.0 – 295.0 ft						X	X		X	X	X			X			X												
		295.0 – 300.0 ft						X	X		X	X	X			X			X												
Vertical Borehole	MDA V	0.0 – 5.0 ft						X	X		X	X	X			X			X												
		5.0 – 10.0 ft						X	X		X	X	X			X			X												
		10.0 – 15.0 ft						X	X		X	X	X			X			X												
		15.0 – 20.0 ft						X	X		X	X	X			X			X												
		20.0 – 25.0 ft						X	X		X	X	X			X			X												
		25.0 – 30.0 ft						X	X		X	X	X			X			X												
		30.0 – 35.0 ft						X	X		X	X	X			X			X												
		35.0 – 40.0 ft						X	X		X	X	X			X			X												

Table 12.5-III

MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys	Field Screening	Field Laboratory Measurements	Laboratory Analysis
		40.0 - 45.0 ft					
		45.0 - 50.0 ft					
		50.0 - 55.0 ft					
		55.0 - 60.0 ft					
		60.0 - 65.0 ft					
		65.0 - 70.0 ft					
		70.0 - 75.0 ft					
		75.0 - 80.0 ft					
		80.0 - 85.0 ft					
		85.0 - 90.0 ft					
		90.0 - 95.0 ft					
		95.0 - 100.0 ft					
		100.0 - 105.0 ft					
		105.0 - 110.0 ft					
		110.0 - 115.0 ft					
		115.0 - 120.0 ft					
		120.0 - 125.0 ft					
		125.0 - 130.0 ft					
		130.0 - 135.0 ft					
		135.0 - 140.0 ft					
		140.0 - 145.0 ft					
		145.0 - 150.0 ft					
		150.0 - 155.0 ft					
		155.0 - 160.0 ft					
		160.0 - 165.0 ft					
		165.0 - 170.0 ft					

Field Surveys	Gross Gamma
	Low-Energy Gamma
	Electromagnetic
	Land Survey
Field Screening	Gross Gamma
	Gross Alpha
	Organic Vapor
	Combustible Gas/Oxygen
	Lithological Logging
Field Laboratory Measurements	Gross Alpha
	Gamma Spectrometry
	Tritium
	Volatile Organics
	PCB
	Soil Moisture
Laboratory Analysis	Gamma Spectrometry
	Tritium
	Total Uranium
	Isotopic Plutonium
	Isotopic Uranium
	Strontium 90
	VOA (SW 8240)
	Semivolatiles (SW 8270)
	Metals (SW 6010)
	PCB (SW 8080)
	Isotopic Thorium
	Water Quality Parameters
	Gross Alpha/Beta

Table 12.5–IV

INITIAL GEOPHYSICAL INVESTIGATIONS

FOR MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical: Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (He Injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Environmental Isotopes: Chloride–36/Chloride–37	Carbon–12/Carbon–13	Strontium–86/Strontium–87	Hydrogen/Deuterium	Oxygen–18/Oxygen–16	Tritium	Carbon–14	Chloride–36	Open Hole Tests: Straddle Packer Tests: In Situ Permeability	VOA's – Pore Gas	CO2 – Pore Gas	CH4 – Pore Gas	C–12/C–13 – Pore Gas	Relative Humidity – Pore Gas	SF6	Open Hole Tests: Geophysics: Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM–39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium–252)	Side Scan Video
		190.0 – 195.0 ft		X	X	X	X																																				
		195.0 – 200.0 ft		X	X	X	X																																					
		200.0 – 205.0 ft		X	X	X	X																																					
		205.0 – 210.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																								
		210.0 – 215.0 ft		X	X	X	X																																					
		215.0 – 220.0 ft		X	X	X	X																																					
		220.0 – 225.0 ft		X	X	X	X																																					
		225.0 – 230.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X									
		230.0 – 235.0 ft		X	X	X	X																																					
		235.0 – 240.0 ft		X	X	X	X																																					
		240.0 – 245.0 ft		X	X	X	X																																					
		245.0 – 250.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																								
		250.0 – 255.0 ft		X	X	X	X																																					
		255.0 – 260.0 ft		X	X	X	X																																					
		260.0 – 265.0 ft		X	X	X	X																																					
		265.0 – 270.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X									
		270.0 – 275.0 ft		X	X	X	X																																					
		275.0 – 280.0 ft		X	X	X	X																																					
		280.0 – 285.0 ft		X	X	X	X																																					
		285.0 – 290.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																								
		290.0 – 295.0 ft		X	X	X	X																																					
		295.0 – 300.0 ft		X	X	X	X																																					
		300.0 – 305.0 ft		X	X	X	X																																					
		305.0 – 310.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																								
		310.0 – 315.0 ft		X	X	X	X																																					
		315.0 – 320.0 ft		X	X	X	X																																					
		320.0 – 325.0 ft		X	X	X	X																																					
		325.0 – 330.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X									
		330.0 – 335.0 ft		X	X	X	X																																					
		335.0 – 340.0 ft		X	X	X	X																																					
		340.0 – 345.0 ft		X	X	X	X																																					
		345.0 – 350.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																								
		350.0 – 355.0 ft		X	X	X	X																																					
		355.0 – 360.0 ft		X	X	X	X																																					
		360.0 – 365.0 ft		X	X	X	X																																					
		365.0 – 370.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X									

Table 12.5-IV

INITIAL GEOPHYSICAL INVESTIGATIONS
FOR MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical												Environmental Isotope								Open Hole Tests: Straddle Packer Tests							Open Hole Tests: Geophysics										
				Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (He injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph		Chloride-35/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium -87	Hydrogen/Deuterium	Oxygen-16/Oxygen-18	Tritium	Carbon-14	Chloride-36		In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6		Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
		370.0 - 375.0 ft		X	X	X	X																																		
		375.0 - 380.0 ft		X	X	X	X																																		
		380.0 - 385.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
		385.0 - 390.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
		390.0 - 395.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
		395.0 - 400.0 ft		X	X	X	X																																		
Fracture Contingency Sample				C	C	C	C					C	C	C	C	C	C	C	C																						
Vertical Borehole	LADP-4			C	C	C	C					C	C	C	C	C	C	C	C																						
Continuous Downhold		0.0 - 5.0 ft		X	X	X	X																													X	X	X	X	X	X	X	X	X
		5.0 - 10.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X		X	X	X	X	X	X	X								
		10.0 - 15.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X		X	X	X	X	X	X	X								
		15.0 - 20.0 ft		X	X	X	X																																		
		20.0 - 25.0 ft		X	X	X	X																																		
		25.0 - 30.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X		X	X	X	X	X	X	X								
		30.0 - 35.0 ft		X	X	X	X																																		
		35.0 - 40.0 ft		X	X	X	X																																		
		40.0 - 45.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X		X	X	X	X	X	X	X								
		45.0 - 50.0 ft		X	X	X	X																																		
		50.0 - 55.0 ft		X	X	X	X																																		
		55.0 - 60.0 ft		X	X	X	X																																		
		60.0 - 65.0 ft		X	X	X	X																																		
		65.0 - 70.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X		X	X	X	X	X	X	X								
		70.0 - 75.0 ft		X	X	X	X																																		
		75.0 - 80.0 ft		X	X	X	X																																		
		80.0 - 85.0 ft		X	X	X	X																																		
		85.0 - 90.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X		X	X	X	X	X	X	X								
		90.0 - 95.0 ft		X	X	X	X																																		
		95.0 - 100.0 ft		X	X	X	X																																		
		100.0 - 105.0 ft		X	X	X	X																																		
		105.0 - 110.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X		X	X	X	X	X	X	X								

Table 12.5-IV

INITIAL GEOPHYSICAL INVESTIGATIONS
FOR MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical: Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (Hg Injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Environmental Isotopes: Chloride-36/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-18/Oxygen-16	Tritium	Carbon-14	Chloride-36	Open Hole Tests: Straddle Packer Tests: In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6	Open Hole Tests: Geophysics: Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
		110.0 – 115.0 ft		X	X	X	X																																			
		115.0 – 120.0 ft		X	X	X	X																																			
		120.0 – 125.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
		125.0 – 130.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
		130.0 – 135.0 ft		X	X	X	X																																			
		135.0 – 140.0 ft		X	X	X	X																																			
		140.0 – 145.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
		145.0 – 150.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		150.0 – 155.0 ft		X	X	X	X																																		
		155.0 – 160.0 ft		X	X	X	X																																			
		160.0 – 165.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
		165.0 – 170.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
		170.0 – 175.0 ft		X	X	X	X																																			
		175.0 – 180.0 ft		X	X	X	X																																			
		180.0 – 185.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
		185.0 – 190.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
		190.0 – 195.0 ft		X	X	X	X																																			
		195.0 – 200.0 ft		X	X	X	X																																			
		200.0 – 205.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
		205.0 – 210.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
		210.0 – 215.0 ft		X	X	X	X																																			
		215.0 – 220.0 ft		X	X	X	X																																			
		220.0 – 225.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
		225.0 – 230.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
		230.0 – 235.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
		235.0 – 240.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
		240.0 – 245.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
		245.0 – 250.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
		250.0 – 255.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
		255.0 – 260.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
		260.0 – 265.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		265.0 – 270.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
		270.0 – 275.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
		275.0 – 280.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						
		280.0 – 285.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																						

Table 12.5–IV

INITIAL GEOPHYSICAL INVESTIGATIONS
FOR MESA TOP CHARACTERIZATION BOREHOLES

Sample Identification	Sampling Interval	Sampling Location	Sample Type	Hydrogeological and Geochemical												Environmental Isotopes								Open Hole Tests: Straddle Packer Tests							Open Hole Tests: Geophysics										
	285.0 – 290.0 ft			X	X	X	X	X	X	X	X	X	X	X	X																									
	290.0 – 295.0 ft			X	X	X	X	X	X	X	X	X	X	X	X																									
	295.0 – 300.0 ft			X	X	X	X	X	X	X	X	X	X	X	X																									
	300.0 – 305.0 ft			X	X	X	X	X	X	X	X	X	X	X	X																									
	305.0 – 310.0 ft			X	X	X	X	X	X	X	X	X	X	X	X																									
	310.0 – 315.0 ft			X	X	X	X	X	X	X	X	X	X	X	X																									
	315.0 – 320.0 ft			X	X	X	X	X	X	X	X	X	X	X	X																									
	320.0 – 325.0 ft			X	X	X	X	X	X	X	X	X	X	X	X																									
	325.0 – 330.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	330.0 – 335.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	335.0 – 340.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	340.0 – 345.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	345.0 – 350.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	350.0 – 355.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	355.0 – 360.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	360.0 – 365.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	365.0 – 370.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	370.0 – 375.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	375.0 – 380.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	380.0 – 385.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	385.0 – 390.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	390.0 – 395.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	395.0 – 400.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	400.0 – 405.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	405.0 – 410.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	410.0 – 415.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	415.0 – 420.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	420.0 – 425.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	425.0 – 430.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	430.0 – 435.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	435.0 – 440.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	440.0 – 445.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	445.0 – 450.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	450.0 – 455.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	455.0 – 460.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 12.5-IV

INITIAL GEOPHYSICAL INVESTIGATIONS
FOR MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Groundwater Water Content	Bulk Density	Dry Density	Porosity	Porosity (Hg Injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Chloride-35/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-18/Oxygen-16	Tritium	Carbon-14	Chloride-36	In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6	Thermal Neutron (Moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
		460.0 - 465.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		465.0 - 470.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		470.0 - 475.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		475.0 - 480.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		480.0 - 485.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		485.0 - 490.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		490.0 - 495.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		495.0 - 500.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		500.0 - 505.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		505.0 - 510.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		510.0 - 515.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		515.0 - 520.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		520.0 - 525.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		525.0 - 530.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		530.0 - 535.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		535.0 - 540.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		540.0 - 545.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		545.0 - 550.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		550.0 - 555.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		555.0 - 560.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		560.0 - 565.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		565.0 - 570.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		570.0 - 575.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		575.0 - 580.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		580.0 - 585.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		585.0 - 590.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		590.0 - 595.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		595.0 - 600.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		600.0 - 605.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		605.0 - 610.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		610.0 - 615.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		615.0 - 620.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		620.0 - 625.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		625.0 - 630.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		630.0 - 635.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											

Table 12.5-IV

INITIAL GEOPHYSICAL INVESTIGATIONS
FOR MESA TOP CHARACTERIZATION BOREHOLES

	Sample Identification	Interval	Sampling Location	Sample Type
Hydrogeological and Geochemical				
Gravimetric Water Content	X	635.0 - 640.0 ft		
Bulk Density	X	640.0 - 645.0 ft		
Dry Density	X	645.0 - 650.0 ft		
Porosity	X	650.0 - 655.0 ft		
Porosity (He injection)	X	655.0 - 660.0 ft		
Saturated Hydraulic Conductivity	X	660.0 - 665.0 ft		
Air Water Relative Permeability	X	665.0 - 670.0 ft		
Moisture Characteristic Curve	X	670.0 - 675.0 ft		
Clay Mineralogy	X	Fracture Contingency Sample		
Zeolite Mineralogy	X			
Matrix Mineralogy	X			
Carbonate Mineralogy	X			
Fe and Mn Mineralogy	X			
Total Organic Compound	X			
Cation Exchange Capacity	X			
Slurry Ph	X			
Environmental Isotopes				
Chloride-35/Chloride-37	X			
Carbon-12/Carbon-13	X			
Strontium-86/Strontium -87	X			
Hydrogen/Deuterium	X			
Oxygen-16/Oxygen-18	X			
Tritium	X			
Carbon-14	X			
Chloride-36	X			
Open Hole Tests: Straddle Packer Tests				
In Situ Permeability	X			
VOA's - Pore Gas	X			
CO2 - Pore Gas	X			
CH4 - Pore Gas	X			
C-12/C-13 - Pore Gas	X			
Relative Humidity - Pore Gas	X			
SF6	X			
Open Hole Tests: Geophysics				
Thermal Neutron (moisture)				
Gamma Gamma (density)				
Caliper				
Axial Borehole Video				
EM Induction (Geonics EM-39)				
Magnetic Susceptibility				
Natural Gamma				
Spectral Gamma (U, Th, K)				
Prompt Fission Neutron				
Geochemical (Californium-252)				
Side Scan Video				

Table 12.5–IV

INITIAL GEOPHYSICAL INVESTIGATIONS

FOR MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical																								Environmental Isotopes									Open Hole Tests: Straddle Packer Tests									Open Hole Tests: Geophysics										
				Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (He injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph		Chloride-35/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-18/Oxygen-16	Tritium	Carbon-14	Chloride-36		In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6		Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
Vertical Borehole	LADP-1																																																				
Continuous Downhole																																																					
		0.0 – 5.0 ft		X	X	X	X																																														
		5.0 – 10.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X																		
		10.0 – 15.0 ft		X	X	X	X																																														
		15.0 – 20.0 ft		X	X	X	X																																														
		20.0 – 25.0 ft		X	X	X	X																																														
		25.0 – 30.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X																		
		30.0 – 35.0 ft		X	X	X	X																																														
		35.0 – 40.0 ft		X	X	X	X																																														
		40.0 – 45.0 ft		X	X	X	X																																														
		45.0 – 50.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X																		
		50.0 – 55.0 ft		X	X	X	X																																														
		55.0 – 60.0 ft		X	X	X	X																																														
		60.0 – 65.0 ft		X	X	X	X																																														
		65.0 – 70.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X																		
		70.0 – 75.0 ft		X	X	X	X																																														
		75.0 – 80.0 ft		X	X	X	X																																														
		80.0 – 85.0 ft		X	X	X	X																																														
		85.0 – 90.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X																		
		90.0 – 95.0 ft		X	X	X	X																																														
		95.0 – 100.0 ft		X	X	X	X																																														
		100.0 – 105.0 ft		X	X	X	X																																														
		105.0 – 110.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X																		
		110.0 – 115.0 ft		X	X	X	X																																														
		115.0 – 120.0 ft		X	X	X	X																																														
		120.0 – 125.0 ft		X	X	X	X																																														
		125.0 – 130.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																																		
		130.0 – 135.0 ft		X	X	X	X																																														
		135.0 – 140.0 ft		X	X	X	X																																														
		140.0 – 145.0 ft		X	X	X	X																																														
		145.0 – 150.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X																		
		150.0 – 155.0 ft		X	X	X	X																																														
		155.0 – 160.0 ft		X	X	X	X																																														
		160.0 – 165.0 ft		X	X	X	X																																														
		165.0 – 170.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																																		
		170.0 – 175.0 ft		X	X	X	X																																														
		175.0 – 180.0 ft		X	X	X	X																																														
		180.0 – 185.0 ft		X	X	X	X																																														
		185.0 – 190.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X																		

Table 12.5–IV

INITIAL GEOPHYSICAL INVESTIGATIONS
FOR MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical: Gravimetric Water Content	Built Density	Dry Density	Porosity	Porosity (He injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Environmental Isotopes: Chloride–36/Chloride–37	Carbon–12/Carbon–13	Strontium–86/Strontium –87	Hydrogen/Deuterium	Oxygen–16/Oxygen–18	Tritium	Carbon–14	Chloride–36	Open Hole Tests: Straddle Packer Tests: In Situ Permeability	VOA's – Pore Gas	CO2 – Pore Gas	CH4 – Pore Gas	C–12/C–13 – Pore Gas	Relative Humidity – Pore Gas	SF6	Open Hole Tests: Geophysics: Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM–39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium–252)	Side Scan Video
		190.0 – 195.0 ft		X	X	X	X																																			
		195.0 – 200.0 ft		X	X	X	X																																			
		200.0 – 205.0 ft		X	X	X	X																																			
		205.0 – 210.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																							
		210.0 – 215.0 ft		X	X	X	X																																			
		215.0 – 220.0 ft		X	X	X	X																																			
		220.0 – 225.0 ft		X	X	X	X																																			
		225.0 – 230.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																							
		230.0 – 235.0 ft		X	X	X	X																																			
		235.0 – 240.0 ft		X	X	X	X																																			
		240.0 – 245.0 ft		X	X	X	X																																			
		245.0 – 250.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																							
		250.0 – 255.0 ft		X	X	X	X																																			
		255.0 – 260.0 ft		X	X	X	X																																			
		260.0 – 265.0 ft		X	X	X	X																																			
		265.0 – 270.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		270.0 – 275.0 ft		X	X	X	X																																			
		275.0 – 280.0 ft		X	X	X	X																																			
		280.0 – 285.0 ft		X	X	X	X																																			
		285.0 – 290.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																							
		290.0 – 295.0 ft		X	X	X	X																																			
		295.0 – 300.0 ft		X	X	X	X																																			
Fracture Contingency Sample				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C																							
Vertical Borehole	LADP–2			C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C																							
Continuous Downhole		0.0 – 5.0 ft		X	X	X	X																																			
		5.0 – 10.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		10.0 – 15.0 ft		X	X	X	X																																			
		15.0 – 20.0 ft		X	X	X	X																																			
		20.0 – 25.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																							
		25.0 – 30.0 ft		X	X	X	X																																			
		30.0 – 35.0 ft		X	X	X	X																																			

Table 12.5–IV

INITIAL GEOPHYSICAL INVESTIGATIONS

FOR MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical: Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Particle Size Distribution	Bulk Permeability	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Environmental Isotopes: Chloride-36/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-18/Oxygen-18	Tritium	Carbon-14	Chloride-36	Open Hole Tests: Straddle Packer Tests: In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6	Open Hole Tests: Geophysics: Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
		35.0 – 40.0 ft		X	X	X	X	X																																			
		40.0 – 45.0 ft		X	X	X	X	X																																			
		45.0 – 50.0 ft		X	X	X	X	X																																			
		50.0 – 55.0 ft		X	X	X	X	X																																			
		55.0 – 60.0 ft		X	X	X	X	X																																			
		60.0 – 65.0 ft		X	X	X	X	X																																			
		65.0 – 70.0 ft		X	X	X	X	X																																			
		70.0 – 75.0 ft		X	X	X	X	X																																			
		75.0 – 80.0 ft		X	X	X	X	X																																			
		80.0 – 85.0 ft		X	X	X	X	X																																			
		85.0 – 90.0 ft		X	X	X	X	X																																			
		90.0 – 95.0 ft		X	X	X	X	X																																			
		95.0 – 100.0 ft		X	X	X	X	X																																			
		100.0 – 105.0 ft																																									
		105.0 – 110.0 ft		X	X	X	X	X																																			
		110.0 – 115.0 ft		X	X	X	X	X																																			
		115.0 – 120.0 ft		X	X	X	X	X																																			
		120.0 – 125.0 ft		X	X	X	X	X																																			
		125.0 – 130.0 ft		X	X	X	X	X																																			
		130.0 – 135.0 ft		X	X	X	X	X																																			
		135.0 – 140.0 ft		X	X	X	X	X																																			
		140.0 – 145.0 ft		X	X	X	X	X																																			
		145.0 – 150.0 ft		X	X	X	X	X																																			
		150.0 – 155.0 ft		X	X	X	X	X																																			
		155.0 – 160.0 ft		X	X	X	X	X																																			
		160.0 – 165.0 ft		X	X	X	X	X																																			
		165.0 – 170.0 ft		X	X	X	X	X																																			
		170.0 – 175.0 ft		X	X	X	X	X																																			
		175.0 – 180.0 ft		X	X	X	X	X																																			
		180.0 – 185.0 ft		X	X	X	X	X																																			
		185.0 – 190.0 ft		X	X	X	X	X																																			
		190.0 – 195.0 ft		X	X	X	X	X																																			
		195.0 – 200.0 ft		X	X	X	X	X																																			
		200.0 – 205.0 ft		X	X	X	X	X																																			
		205.0 – 210.0 ft		X	X	X	X	X																																			

Table 12.5-IV

INITIAL GEOPHYSICAL INVESTIGATIONS
FOR MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical												Environmental Isotopes							Open Hole Tests: Straddle Packer Tests						Open Hole Tests: Geophysics									
		210.0 - 215.0 ft		X	Gravimetric Water Content																																
		215.0 - 220.0 ft		X	Bulk Density																																
		220.0 - 225.0 ft		X	Dry Density																																
		225.0 - 230.0 ft		X	Porosity																																
		230.0 - 235.0 ft		X	Porosity (He injection)																																
		235.0 - 240.0 ft		X	Saturated Hydraulic Conductivity																																
		240.0 - 245.0 ft		X	Air Water Relative Permeability																																
		245.0 - 250.0 ft		X	Moisture Characteristic Curve																																
		250.0 - 255.0 ft		X	Clay Mineralogy																																
		255.0 - 260.0 ft		X	Zeolite Mineralogy																																
		260.0 - 265.0 ft		X	Matrix Mineralogy																																
		265.0 - 270.0 ft		X	Carbonate Mineralogy																																
		270.0 - 275.0 ft		X	Fe and Mn Mineralogy																																
		275.0 - 280.0 ft		X	Total Organic Compound																																
		280.0 - 285.0 ft		X	Cation Exchange Capacity																																
		285.0 - 290.0 ft		X	Slurry Ph																																
		290.0 - 295.0 ft		X																																
		295.0 - 300.0 ft		X	Chloride-35/Chloride-37																																
Fracture Contingency Sample				C	Carbon-12/Carbon-13																																
				C	Strontium-86/Strontium -87																																
				C	Hydrogen/Deuterium																																
				C	Oxygen-18/Oxygen-18																																
				C	Tritium																																
				C	Carbon-14																																
				C	Chloride-36																																
	LADP-5			C																																
Vertical Borehole				C	In Situ Permeability																																
				C	VOA's - Pore Gas																																
				C	CO2 - Pore Gas																																
				C	CH4 - Pore Gas																																
				C	C-12/C-13 - Pore Gas																																
				C	Relative Humidity - Pore Gas																																
				C	SF6																																
Continuous Downhole		0.0 - 5.0 ft		X																																
		5.0 - 10.0 ft		X	Thermal Neutron (moisture)																																
		10.0 - 15.0 ft		X	Gamma Gamma (density)																																
		15.0 - 20.0 ft		X	Caliper																																
		20.0 - 25.0 ft		X	Axial Borehole Video																																
		25.0 - 30.0 ft		X	EM Induction (Geonics EM-39)																																
		30.0 - 35.0 ft		X	Magnetic Susceptibility																																
		35.0 - 40.0 ft		X	Natural Gamma																																
		40.0 - 45.0 ft		X	Spectral Gamma (U, Th, K)																																
		45.0 - 50.0 ft		X	Prompt Fission Neutron																																
					Geochemical (Californium-252)																																
					Side Scan Video																																

Table 12.5-IV

INITIAL GEOPHYSICAL INVESTIGATIONS
FOR MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical: Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (He injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Environmental Isotopes: Chloride-36/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-18/Oxygen-18	Tritium	Carbon-14	Chloride-36	Open Hole Tests: Straddle Packer Tests: In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF-6		Open Hole Tests: Geophysics: Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
		50.0 – 55.0 ft		X	X	X	X																																					
		55.0 – 60.0 ft		X	X	X	X																																					
		60.0 – 65.0 ft		X	X	X	X																																					
		65.0 – 70.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		70.0 – 75.0 ft		X	X	X	X																																					
		75.0 – 80.0 ft		X	X	X	X																																					
		80.0 – 85.0 ft		X	X	X	X																																					
		85.0 – 90.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		90.0 – 95.0 ft		X	X	X	X																																					
		95.0 – 100.0 ft		X	X	X	X																																					
		100.0 – 105.0 ft		X	X	X	X																																					
		105.0 – 110.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		110.0 – 115.0 ft		X	X	X	X																																					
		115.0 – 120.0 ft		X	X	X	X																																					
		120.0 – 125.0 ft		X	X	X	X																																					
		125.0 – 130.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		130.0 – 135.0 ft		X	X	X	X																																					
		135.0 – 140.0 ft		X	X	X	X																																					
		140.0 – 145.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		145.0 – 150.0 ft		X	X	X	X																																					
		150.0 – 155.0 ft		X	X	X	X																																					
		155.0 – 160.0 ft		X	X	X	X																																					
		160.0 – 165.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		165.0 – 170.0 ft		X	X	X	X																																					
		170.0 – 175.0 ft		X	X	X	X																																					
		175.0 – 180.0 ft		X	X	X	X																																					
		180.0 – 185.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		185.0 – 190.0 ft		X	X	X	X																																					
		190.0 – 195.0 ft		X	X	X	X																																					
		195.0 – 200.0 ft		X	X	X	X																																					
		200.0 – 205.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		205.0 – 210.0 ft		X	X	X	X																																					
		210.0 – 215.0 ft		X	X	X	X																																					
		215.0 – 220.0 ft		X	X	X	X																																					
		220.0 – 225.0 ft		X	X	X	X																																					

Table 12.5-IV

INITIAL GEOPHYSICAL INVESTIGATIONS
FOR MESA TOP CHARACTERIZATION BOREHOLES

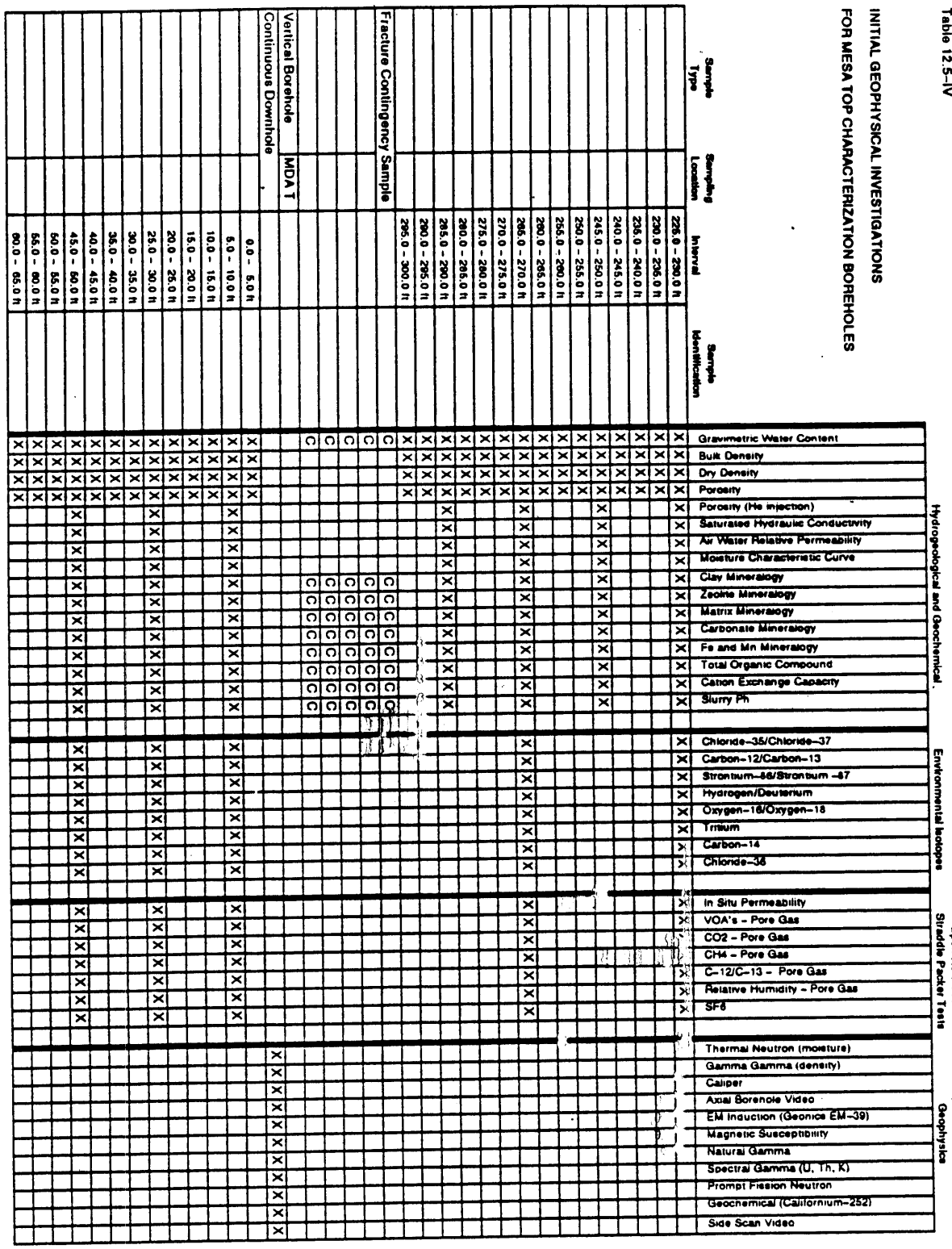

Table 12.5-IV

INITIAL GEOPHYSICAL INVESTIGATIONS
FOR MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (fire injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph		Chloride-35/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-16/Oxygen-18	Tritium	Carbon-14	Chloride-36		In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6		Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
		65.0 – 70.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		70.0 – 75.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		75.0 – 80.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		80.0 – 85.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		85.0 – 90.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		90.0 – 95.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		95.0 – 100.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		100.0 – 105.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		105.0 – 110.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		110.0 – 115.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		115.0 – 120.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		120.0 – 125.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		125.0 – 130.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		130.0 – 135.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		135.0 – 140.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		140.0 – 145.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		145.0 – 150.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		150.0 – 155.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		155.0 – 160.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		160.0 – 165.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		165.0 – 170.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		170.0 – 175.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		175.0 – 180.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		180.0 – 185.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		185.0 – 190.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		190.0 – 195.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		195.0 – 200.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		200.0 – 205.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		205.0 – 210.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		210.0 – 215.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		215.0 – 220.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		220.0 – 225.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		225.0 – 230.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		230.0 – 235.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											
		235.0 – 240.0 ft		X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X	X	X	X	X	X											

Table 12.5-IV

INITIAL GEOPHYSICAL INVESTIGATIONS
FOR MESA TOP CHARACTERIZATION BOREHOLES

				Hydrogeological and Geochemical																Environmental Isotopes								Open Hole Tests: Straddle Packer Tests							Open Hole Tests: Geophysics										
Sample Type	Sampling Location	Interval	Sample Identification	Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (He injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Chloride-36/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-16/Oxygen-18	Tritium	Carbon-14	Chloride-36	In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6	Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
		240.0 - 245.0 ft		X	X	X	X																																						
		245.0 - 250.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																										
		250.0 - 255.0 ft		X	X	X	X																																						
		255.0 - 260.0 ft		X	X	X	X																																						
		260.0 - 265.0 ft		X	X	X	X																																						
		265.0 - 270.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		270.0 - 275.0 ft		X	X	X	X																																						
		275.0 - 280.0 ft		X	X	X	X																																						
		280.0 - 285.0 ft		X	X	X	X																																						
		285.0 - 290.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																										
		290.0 - 295.0 ft		X	X	X	X																																						
		295.0 - 300.0 ft		X	X	X	X																																						
Fracture Contingency Sample				C								C	C	C	C	C	C	C	C																										
				C								C	C	C	C	C	C	C	C																										
				C								C	C	C	C	C	C	C	C																										
				C								C	C	C	C	C	C	C	C																										
				C								C	C	C	C	C	C	C	C																										
Vertical Borehole	MDA U																																												
Continuous Downhole																																			X	X	X	X	X	X	X	X	X	X	X
		0.0 - 5.0 ft		X	X	X	X																																						
		5.0 - 10.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		10.0 - 15.0 ft		X	X	X	X																																						
		15.0 - 20.0 ft		X	X	X	X																																						
		20.0 - 25.0 ft		X	X	X	X																																						
		25.0 - 30.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		30.0 - 35.0 ft		X	X	X	X																																						
		35.0 - 40.0 ft		X	X	X	X																																						
		40.0 - 45.0 ft		X	X	X	X																																						
		45.0 - 50.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		50.0 - 55.0 ft		X	X	X	X																																						
		55.0 - 60.0 ft		X	X	X	X																																						
		60.0 - 65.0 ft		X	X	X	X																																						
		65.0 - 70.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		70.0 - 75.0 ft		X	X	X	X																																						
		75.0 - 80.0 ft		X	X	X	X																																						

Table 12.5-IV

INITIAL GEOPHYSICAL INVESTIGATIONS
FOR MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical: Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (He injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Environmental Isotopes: Chloride-36/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-18/Oxygen-16	Tritium	Carbon-14	Chloride-36	Open Hole Tests: Straddle Packer Tests: In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF-6	Open Hole Tests: Geophysics: Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Slide Scan Video
		80.0 – 85.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		85.0 – 90.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		90.0 – 95.0 ft		X	X	X	X																																					
		95.0 – 100.0 ft		X	X	X	X																																					
		100.0 – 105.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		105.0 – 110.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		110.0 – 116.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		115.0 – 120.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		120.0 – 125.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		125.0 – 130.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		130.0 – 135.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		135.0 – 140.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		140.0 – 145.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		145.0 – 150.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		150.0 – 155.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		155.0 – 160.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		160.0 – 165.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		165.0 – 170.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		170.0 – 176.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		175.0 – 180.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		180.0 – 185.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		185.0 – 190.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		190.0 – 195.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		195.0 – 200.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		200.0 – 205.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		205.0 – 210.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		210.0 – 215.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		215.0 – 220.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		220.0 – 225.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		225.0 – 230.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		230.0 – 235.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		235.0 – 240.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		240.0 – 245.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		245.0 – 250.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
		250.0 – 255.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										

Table 12.5-IV

INITIAL GEOPHYSICAL INVESTIGATIONS
FOR MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical												Environmental Isotopes								Open Hole Tests: Straddle Packer Tests							Open Hole Tests: Geophysics										
		255.0 – 260.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		260.0 – 265.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		265.0 – 270.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		270.0 – 275.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		275.0 – 280.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		280.0 – 285.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		285.0 – 290.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		290.0 – 295.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		295.0 – 300.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Fracture Contingency Sample				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Vertical Borehole	MDA V			C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Continuous Downhole		0.0 – 5.0 ft		X	X											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		5.0 – 10.0 ft		X	X											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		10.0 – 15.0 ft		X	X											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		15.0 – 20.0 ft		X	X											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		20.0 – 25.0 ft		X	X											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		25.0 – 30.0 ft		X	X											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		30.0 – 35.0 ft		X	X											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		35.0 – 40.0 ft		X	X											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		40.0 – 45.0 ft		X	X											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		45.0 – 50.0 ft		X	X											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		50.0 – 55.0 ft		X	X											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		55.0 – 60.0 ft		X	X											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		60.0 – 65.0 ft		X	X											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		65.0 – 70.0 ft		X	X											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		70.0 – 75.0 ft		X	X											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		75.0 – 80.0 ft		X	X											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		80.0 – 85.0 ft		X	X											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		85.0 – 90.0 ft		X	X											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		90.0 – 95.0 ft		X	X											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 12.5-IV

INITIAL GEOPHYSICAL INVESTIGATIONS

FOR MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical: Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (Hg Injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Environmental Isotopes: Chloride-36/Chloride-37	Carbon-13/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-18/Oxygen-18	Tritium	Carbon-14	Chloride-36	Open Hole Tests: Straddle Packer Tests: In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6	Open Hole Tests: Geophysics: Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
		95.0 – 100.0 ft		X	X	X	X																																			
		100.0 – 105.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		105.0 – 110.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		110.0 – 115.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		115.0 – 120.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		120.0 – 126.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		125.0 – 130.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		130.0 – 135.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		135.0 – 140.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		140.0 – 145.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		145.0 – 150.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		150.0 – 155.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		155.0 – 160.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		160.0 – 165.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		165.0 – 170.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		170.0 – 175.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		175.0 – 180.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		180.0 – 185.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		185.0 – 190.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		190.0 – 195.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		195.0 – 200.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		200.0 – 205.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		205.0 – 210.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		210.0 – 215.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		215.0 – 220.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		220.0 – 225.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		225.0 – 230.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		230.0 – 235.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		235.0 – 240.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		240.0 – 245.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		245.0 – 250.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		250.0 – 255.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		255.0 – 260.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		260.0 – 265.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		265.0 – 270.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 12.5-IV

INITIAL GEOPHYSICAL INVESTIGATIONS
FOR MESA TOP CHARACTERIZATION BOREHOLES

	Sample Type	Sampling Location	Interval	Sample Identification
			270.0 - 275.0 ft	
			275.0 - 280.0 ft	
			280.0 - 285.0 ft	
			285.0 - 290.0 ft	
			290.0 - 295.0 ft	
			295.0 - 300.0 ft	
			Fracture Contingency Sample	
Hydrogeological and Geochemical				
Gravimetric Water Content	X	X	X	X
Bulk Density	X	X	X	X
Dry Density	X	X	X	X
Porosity	X	X	X	X
Porosity (He injection)	X	X	X	
Saturated Hydraulic Conductivity	X	X	X	
Air Water Relative Permeability	X	X	X	
Moisture Characteristic Curve	X	X	X	
Clay Mineralogy	X	X	X	C
Zeolite Mineralogy	X	X	X	C
Matrix Mineralogy	X	X	X	C
Carbonate Mineralogy	X	X	X	C
Fe and Mn Mineralogy	X	X	X	C
Total Organic Compound	X	X	X	C
Cation Exchange Capacity	X	X	X	C
Slurry Ph	X	X	X	C
Environmental Isotopes				
Chloride-35/Chloride-37				
Carbon-12/Carbon-13				
Strontium-86/Strontium -87				
Hydrogen/Deuterium				
Oxygen-16/Oxygen-18				
Tritium				
Carbon-14				
Chloride-36				
Open Hole Tests: Straddle Packer Tests				
In Situ Permeability				
VOA's - Pore Gas				
CO2 - Pore Gas				
CH4 - Pore Gas				
C-12/C-13 - Pore Gas				
Relative Humidity - Pore Gas				
SF6				
Open Hole Tests: Geophysics				
Thermal Neutron (moisture)				
Gamma Gamma (density)				
Caliper				
Axial Borehole Video				
EM Induction (Geonics EM-39)				
Magnetic Susceptibility				
Natural Gamma				
Spectral Gamma (U, Th, K)				
Prompt Fission Neutron				
Geochemical (Californium-252)				
Side Scan Video				

TABLE 12.5-V
SUITE OF GEOPHYSICAL LOGS

	Characterization	
Open Hole	Hydrogeological	Contamination
Thermal Neutron (Moisture)	% moisture, perched zones	
Gamma Gamma (Density)	bulk density of rocks	
Caliper	fracture	
Axial Borehole Video	fracture orientation	
Sidescan Borehole Video	fracture orientation	
EM Induction (Geonics EM-39)	stratigraphic correlation, perched zones	
Magnetic Susceptibility (Romulus)	stratigraphic correlation	
Natural gamma	stratigraphic correlation	radioactive contamination
Spectral Gamma (U, TH, K)	stratigraphic correlation	radioactive contamination
Prompt Fission Neutron	-Fissionable Isotopes	radioactive contamination
Geochemical (Californium-252)	- 8 to 10 elements that undergo neutron activation and elastic scattering	chemical contamination
Cased Hole		
Thermal Neutron (Moisture)	% moisture, perched zones	
Gamma Gamma (Density)	% moisture, perched zones	
EM Induction (PVC Casing)	perched zones	
Temperature Gradient (Requires fluid-stemming casing)	vapor phase transport	

TABLE 12.5-VI
ANALYTICAL SUITE FOR GROUNDWATER SAMPLES COLLECTED FROM SEEPS, PERCHED ZONES, AND ROCK PORES IN UNSATURATED ZONE

Major Anions	Minor and Trace Constituents
Carbonate	Aluminum
Chloride	Antimony
Sulfate	Arsenic
Fluoride	Barium
Nitrate	Beryllium
Nitrite	Boron
Nitrate and Nitrite	Bromide
Phosphate	Cadmium
	Chromium
	Cobalt
Major Cations	Copper
Ammonium	Cyanide
Calcium	Iron
Magnesium	Lead
Potassium	Manganese
Sodium	Mercury
Silica	Molybdenum
	Nickel
Radionuclides	Selenium
Gross alpha	Silver
Gross beta	Sulfide (as H2S)
Radium-226	Strontium
Thorium-230	Thallium
	Uranium
Other Parameters	Vanadium
Total Organic Carbon	Zinc
Total suspended solids (<10 micron)	
	Environmental Isotopes
	Chloride-35/Chloride-37
Field Measured Parameters	Carbon-12/Carbon-13
Temperature	Strontium-86/Strontium-87
pH	Hydrogen/Deuterium
Eh	Oxygen-16/Oxygen-18
Specific Conductance	Tritium
Alkalinity	Carbon-14
Dissolved Oxygen	Chloride-36

Table 12.5-VII

SUBSEQUENT INVESTIGATIONS, EXTENTION OF MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements							Laboratory Analysis												
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivol (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
Subsurface samples																																	
Vertical Borehole	LADP-1	300.0 – 305.0 ft						X	X		X	X	X			X			X														
		305.0 – 310.0 ft						X	X		X	X	X			X			X														
		310.0 – 315.0 ft						X	X		X	X	X			X			X														
		315.0 – 320.0 ft						X	X		X	X	X			X			X														
		320.0 – 325.0 ft						X	X		X	X	X			X			X														
		325.0 – 330.0 ft						X	X		X	X	X			X			X														
		330.0 – 335.0 ft						X	X		X	X	X			X			X														
		335.0 – 340.0 ft						X	X		X	X	X			X			X														
		340.0 – 345.0 ft						X	X		X	X	X			X			X														
		345.0 – 350.0 ft						X	X		X	X	X			X			X														
		350.0 – 355.0 ft						X	X		X	X	X			X			X														
		355.0 – 360.0 ft						X	X		X	X	X			X			X														
		360.0 – 365.0 ft						X	X		X	X	X			X			X														
		365.0 – 370.0 ft						X	X		X	X	X			X			X														
		370.0 – 375.0 ft						X	X		X	X	X			X			X														
		375.0 – 380.0 ft						X	X		X	X	X			X			X														
		380.0 – 385.0 ft						X	X		X	X	X			X			X														
		385.0 – 390.0 ft						X	X		X	X	X			X			X														
		390.0 – 395.0 ft						X	X		X	X	X			X			X														
		395.0 – 400.0 ft						X	X		X	X	X			X			X														
		400.0 – 405.0 ft						X	X		X	X	X			X			X														
		405.0 – 410.0 ft						X	X		X	X	X			X			X														
		410.0 – 415.0 ft						X	X		X	X	X			X			X														
		415.0 – 420.0 ft						X	X		X	X	X			X			X														

Table 12.5-VII

SUBSEQUENT INVESTIGATIONS, EXTENTION OF MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
		420.0 - 425.0 ft						X	X		X	X	X			X			X															
		425.0 - 430.0 ft						X	X		X	X	X			X			X															
		430.0 - 435.0 ft						X	X		X	X	X			X			X															
		435.0 - 440.0 ft						X	X		X	X	X			X			X															
		440.0 - 445.0 ft						X	X		X	X	X			X			X															
		445.0 - 450.0 ft						X	X		X	X	X			X			X															
		450.0 - 455.0 ft						X	X		X	X	X			X			X															
		455.0 - 460.0 ft						X	X		X	X	X			X			X															
		460.0 - 465.0 ft						X	X		X	X	X			X			X															
		465.0 - 470.0 ft						X	X		X	X	X			X			X															
		470.0 - 475.0 ft						X	X		X	X	X			X			X															
		475.0 - 480.0 ft						X	X		X	X	X			X			X															
		480.0 - 485.0 ft						X	X		X	X	X			X			X															
		485.0 - 490.0 ft						X	X		X	X	X			X			X															
		490.0 - 495.0 ft						X	X		X	X	X			X			X															
		495.0 - 500.0 ft						X	X		X	X	X			X			X															
		500.0 - 505.0 ft						X	X		X	X	X			X			X															
		505.0 - 510.0 ft						X	X		X	X	X			X			X															
		510.0 - 515.0 ft						X	X		X	X	X			X			X															
		515.0 - 520.0 ft						X	X		X	X	X			X			X															
		520.0 - 525.0 ft						X	X		X	X	X			X			X															
		525.0 - 530.0 ft						X	X		X	X	X			X			X															
		530.0 - 535.0 ft						X	X		X	X	X			X			X															
		535.0 - 540.0 ft						X	X		X	X	X			X			X															
		540.0 - 545.0 ft						X	X		X	X	X			X			X															
		545.0 - 550.0 ft						X	X		X	X	X			X			X															

Table 12.5-VII

SUBSEQUENT INVESTIGATIONS, EXTENTION OF MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture					Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
		550.0 – 555.0 ft						X	X		X	X	X			X			X																
		555.0 – 560.0 ft						X	X		X	X	X			X			X																
		560.0 – 565.0 ft						X	X		X	X	X			X			X																
		565.0 – 570.0 ft						X	X		X	X	X			X			X																
		570.0 – 575.0 ft						X	X		X	X	X			X			X																
		575.0 – 580.0 ft						X	X		X	X	X			X			X																
		580.0 – 585.0 ft						X	X		X	X	X			X			X																
		585.0 – 590.0 ft						X	X		X	X	X			X			X																
		590.0 – 595.0 ft						X	X		X	X	X			X			X																
		595.0 – 600.0 ft						X	X		X	X	X			X			X																
		600.0 – 605.0 ft						X	X		X	X	X			X			X																
		605.0 – 610.0 ft						X	X		X	X	X			X			X																
		610.0 – 615.0 ft						X	X		X	X	X			X			X																
		615.0 – 620.0 ft						X	X		X	X	X			X			X																
		620.0 – 625.0 ft						X	X		X	X	X			X			X																
		625.0 – 630.0 ft						X	X		X	X	X			X			X																
		630.0 – 635.0 ft						X	X		X	X	X			X			X																
		635.0 – 640.0 ft						X	X		X	X	X			X			X																
		640.0 – 645.0 ft						X	X		X	X	X			X			X																
		645.0 – 650.0 ft						X	X		X	X	X			X			X																
		650.0 – 655.0 ft						X	X		X	X	X			X			X																
		655.0 – 660.0 ft						X	X		X	X	X			X			X																
		660.0 – 665.0 ft						X	X		X	X	X			X			X																
		665.0 – 670.0 ft						X	X		X	X	X			X			X																
		670.0 – 675.0 ft						X	X		X	X	X			X			X																
		675.0 – 680.0 ft						X	X		X	X	X			X			X																

Table 12.5-VII

SUBSEQUENT INVESTIGATIONS, EXTENTION OF MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
		680.0 – 685.0 ft						X	X		X	X	X																					
		685.0 – 690.0 ft						X	X		X	X	X																					
		690.0 – 695.0 ft						X	X		X	X	X																					
		695.0 – 700.0 ft						X	X		X	X	X																					
		700.0 – 705.0 ft						X	X		X	X	X																					
		705.0 – 710.0 ft						X	X		X	X	X																					
		710.0 – 715.0 ft						X	X		X	X	X																					
		715.0 – 720.0 ft						X	X		X	X	X																					
		720.0 – 725.0 ft						X	X		X	X	X																					
		725.0 – 730.0 ft						X	X		X	X	X																					
		730.0 – 735.0 ft						X	X		X	X	X																					
		735.0 – 740.0 ft						X	X		X	X	X																					
		740.0 – 745.0 ft						X	X		X	X	X																					
		745.0 – 750.0 ft						X	X		X	X	X																					
Vertical Borehole	LADP-2	300.0 – 305.0 ft						X	X		X	X	X																					
		305.0 – 310.0 ft						X	X		X	X	X																					
		310.0 – 315.0 ft						X	X		X	X	X																					
		315.0 – 320.0 ft						X	X		X	X	X																					
		320.0 – 325.0 ft						X	X		X	X	X																					
		325.0 – 330.0 ft						X	X		X	X	X																					
		330.0 – 335.0 ft						X	X		X	X	X																					
		335.0 – 340.0 ft						X	X		X	X	X																					
		340.0 – 345.0 ft						X	X		X	X	X																					
		345.0 – 350.0 ft						X	X		X	X	X																					
		350.0 – 355.0 ft						X	X		X	X	X																					
		355.0 – 360.0 ft						X	X		X	X	X																					

Table 12.5-VII

SUBSEQUENT INVESTIGATIONS, EXTENTION OF MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Field Laboratory Measurements:	Field Laboratory Measurements:	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: Isotopic Thorium	Laboratory Analysis: Water Quality Parameters	Laboratory Analysis: Gross Alpha/Beta
		360.0 - 365.0 ft						X	X		X	X	X			X			X															
		365.0 - 370.0 ft						X	X		X	X	X			X			X															
		370.0 - 375.0 ft						X	X		X	X	X			X			X															
		375.0 - 380.0 ft						X	X		X	X	X			X			X															
		380.0 - 385.0 ft						X	X		X	X	X			X			X															
		385.0 - 390.0 ft						X	X		X	X	X			X			X															
		390.0 - 395.0 ft						X	X		X	X	X			X			X															
		395.0 - 400.0 ft						X	X		X	X	X			X			X															
		400.0 - 405.0 ft						X	X		X	X	X			X			X															
		405.0 - 410.0 ft						X	X		X	X	X			X			X															
		410.0 - 415.0 ft						X	X		X	X	X			X			X															
		415.0 - 420.0 ft						X	X		X	X	X			X			X															
		420.0 - 425.0 ft						X	X		X	X	X			X			X															
		425.0 - 430.0 ft						X	X		X	X	X			X			X															
		430.0 - 435.0 ft						X	X		X	X	X			X			X															
		435.0 - 440.0 ft						X	X		X	X	X			X			X															
		440.0 - 445.0 ft						X	X		X	X	X			X			X															
		445.0 - 450.0 ft						X	X		X	X	X			X			X															
		450.0 - 455.0 ft						X	X		X	X	X			X			X															
		455.0 - 460.0 ft						X	X		X	X	X			X			X															
		460.0 - 465.0 ft						X	X		X	X	X			X			X															
		465.0 - 470.0 ft						X	X		X	X	X			X			X															
		470.0 - 475.0 ft						X	X		X	X	X			X			X															
		475.0 - 480.0 ft						X	X		X	X	X			X			X															
		480.0 - 485.0 ft						X	X		X	X	X			X			X															
		485.0 - 490.0 ft						X	X		X	X	X			X			X															

Table 12.5-VII

SUBSEQUENT INVESTIGATIONS, EXTENTION OF MESA TOP CHARACTERIZATION BOREHOLES

Sample Identification	Interval	Sampling Location	Sample Type	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
	490.0 - 495.0 ft							X	X		X	X	X			X			X														
	495.0 - 500.0 ft							X	X		X	X	X			X			X														
	500.0 - 505.0 ft							X	X		X	X	X			X			X														
	505.0 - 510.0 ft							X	X		X	X	X			X			X														
	510.0 - 515.0 ft							X	X		X	X	X			X			X														
	515.0 - 520.0 ft							X	X		X	X	X			X			X														
	520.0 - 525.0 ft							X	X		X	X	X			X			X														
	525.0 - 530.0 ft							X	X		X	X	X			X			X														
	530.0 - 535.0 ft							X	X		X	X	X			X			X														
	535.0 - 540.0 ft							X	X		X	X	X			X			X														
	540.0 - 545.0 ft							X	X		X	X	X			X			X														
	545.0 - 550.0 ft							X	X		X	X	X			X			X														
	550.0 - 555.0 ft							X	X		X	X	X			X			X														
	555.0 - 560.0 ft							X	X		X	X	X			X			X														
	560.0 - 565.0 ft							X	X		X	X	X			X			X														
	565.0 - 570.0 ft							X	X		X	X	X			X			X														
	570.0 - 575.0 ft							X	X		X	X	X			X			X														
	575.0 - 580.0 ft							X	X		X	X	X			X			X														
	580.0 - 585.0 ft							X	X		X	X	X			X			X														
	585.0 - 590.0 ft							X	X		X	X	X			X			X														
	590.0 - 595.0 ft							X	X		X	X	X			X			X														
	595.0 - 600.0 ft							X	X		X	X	X			X			X														
	600.0 - 605.0 ft							X	X		X	X	X			X			X														
	605.0 - 610.0 ft							X	X		X	X	X			X			X														
	610.0 - 615.0 ft							X	X		X	X	X			X			X														
	615.0 - 620.0 ft							X	X		X	X	X			X			X														

Table 12.5-VII

SUBSEQUENT INVESTIGATIONS, EXTENTION OF MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
		620.0 – 625.0 ft						X	X		X	X	X			X			X															
		625.0 – 630.0 ft						X	X		X	X	X			X			X															
		630.0 – 635.0 ft						X	X		X	X	X			X			X															
		635.0 – 640.0 ft						X	X		X	X	X			X			X															
		640.0 – 645.0 ft						X	X		X	X	X			X			X															
		645.0 – 650.0 ft						X	X		X	X	X			X			X															
		650.0 – 655.0 ft						X	X		X	X	X			X			X															
		655.0 – 660.0 ft						X	X		X	X	X			X			X															
		660.0 – 665.0 ft						X	X		X	X	X			X			X															
		665.0 – 670.0 ft						X	X		X	X	X			X			X															
		670.0 – 675.0 ft						X	X		X	X	X			X			X															
		675.0 – 680.0 ft						X	X		X	X	X			X			X															
		680.0 – 685.0 ft						X	X		X	X	X			X			X															
		685.0 – 690.0 ft						X	X		X	X	X			X			X															
		690.0 – 695.0 ft						X	X		X	X	X			X			X															
		695.0 – 700.0 ft						X	X		X	X	X			X			X															
		700.0 – 705.0 ft						X	X		X	X	X			X			X															
		705.0 – 710.0 ft						X	X		X	X	X			X			X															
		710.0 – 715.0 ft						X	X		X	X	X			X			X															
		715.0 – 720.0 ft						X	X		X	X	X			X			X															
		720.0 – 725.0 ft						X	X		X	X	X			X			X															
		725.0 – 730.0 ft						X	X		X	X	X			X			X															
		730.0 – 735.0 ft						X	X		X	X	X			X			X															
		735.0 – 740.0 ft						X	X		X	X	X			X			X															
		740.0 – 745.0 ft						X	X		X	X	X			X			X															
		745.0 – 750.0 ft						X	X		X	X	X			X			X															

Table 12.5-VII

SUBSEQUENT INVESTIGATIONS, EXTENTION OF MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys	Field Screening	Field Laboratory Measurements	Laboratory Analysis
Vertical Borehole	LADP-5	300.0 – 305.0 ft		Gross Gamma	Gross Gamma	Gross Alpha	Gamma Spectrometry
		305.0 – 310.0 ft		Low-Energy Gamma	Gross Alpha	Gamma Spectrometry	Tritium
		310.0 – 315.0 ft		Electromagnetic		Tritium	Total Uranium
		315.0 – 320.0 ft		Land Survey	Organic Vapor	Volatile Organics	Isotopic Plutonium
		320.0 – 325.0 ft			Combustible Gas/Oxygen	PCB	Isotopic Uranium
		325.0 – 330.0 ft			Lithological Logging	Soil Moisture	Strontium 90
		330.0 – 335.0 ft					VOA (SW 8240)
		335.0 – 340.0 ft					Semivolatiles (SW 8270)
		340.0 – 345.0 ft					Metals (SW 6010)
		345.0 – 350.0 ft					PCB (SW 8080)
		350.0 – 355.0 ft					Isotopic Thorium
		355.0 – 360.0 ft					Water Quality Parameters
		360.0 – 365.0 ft					Gross Alpha/Beta
		365.0 – 370.0 ft					
		370.0 – 375.0 ft					
		375.0 – 380.0 ft					
		380.0 – 385.0 ft					
		385.0 – 390.0 ft					
		390.0 – 395.0 ft					
		395.0 – 400.0 ft					
		400.0 – 405.0 ft					
		405.0 – 410.0 ft					
		410.0 – 415.0 ft					
		415.0 – 420.0 ft					
		420.0 – 425.0 ft					
		425.0 – 430.0 ft					

Table 12.5-VII

SUBSEQUENT INVESTIGATIONS, EXTENTION OF MESA TOP CHARACTERIZATION BOREHOLES

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
		430.0 - 435.0 ft						X	X		X	X	X			X			X															
		435.0 - 440.0 ft						X	X		X	X	X			X			X															
		440.0 - 445.0 ft						X	X		X	X	X			X			X															
		445.0 - 450.0 ft						X	X		X	X	X			X			X															
		450.0 - 455.0 ft						X	X		X	X	X			X			X															
		455.0 - 460.0 ft						X	X		X	X	X			X			X															
		460.0 - 465.0 ft						X	X		X	X	X			X			X															
		465.0 - 470.0 ft						X	X		X	X	X			X			X															
		470.0 - 475.0 ft						X	X		X	X	X			X			X															
		475.0 - 480.0 ft						X	X		X	X	X			X			X															
		480.0 - 485.0 ft						X	X		X	X	X			X			X															
		485.0 - 490.0 ft						X	X		X	X	X			X			X															
		490.0 - 495.0 ft						X	X		X	X	X			X			X															
		495.0 - 500.0 ft						X	X		X	X	X			X			X															
		500.0 - 505.0 ft						X	X		X	X	X			X			X															
		505.0 - 510.0 ft						X	X		X	X	X			X			X															
		510.0 - 515.0 ft						X	X		X	X	X			X			X															
		515.0 - 520.0 ft						X	X		X	X	X			X			X															
		520.0 - 525.0 ft						X	X		X	X	X			X			X															
		525.0 - 530.0 ft						X	X		X	X	X			X			X															
		530.0 - 535.0 ft						X	X		X	X	X			X			X															
		535.0 - 540.0 ft						X	X		X	X	X			X			X															
		540.0 - 545.0 ft						X	X		X	X	X			X			X															
		545.0 - 550.0 ft						X	X		X	X	X			X			X															
		550.0 - 555.0 ft						X	X		X	X	X			X			X															
		555.0 - 560.0 ft						X	X		X	X	X			X			X															

Table 12.5–VII

SUBSEQUENT INVESTIGATIONS, EXTENTION OF MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analytes: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
		590.0 – 595.0 ft						X	X		X	X	X			X			X														
		595.0 – 570.0 ft						X	X		X	X	X			X			X														
		570.0 – 575.0 ft						X	X		X	X	X			X			X														
		575.0 – 580.0 ft						X	X		X	X	X			X			X														
		580.0 – 585.0 ft						X	X		X	X	X			X			X														
		585.0 – 590.0 ft						X	X		X	X	X			X			X														
		590.0 – 595.0 ft						X	X		X	X	X			X			X														
		595.0 – 600.0 ft						X	X		X	X	X			X			X														
		600.0 – 605.0 ft						X	X		X	X	X			X			X														
		605.0 – 610.0 ft						X	X		X	X	X			X			X														
		610.0 – 615.0 ft						X	X		X	X	X			X			X														
		615.0 – 620.0 ft						X	X		X	X	X			X			X														
		620.0 – 625.0 ft						X	X		X	X	X			X			X														
		625.0 – 630.0 ft						X	X		X	X	X			X			X														
		630.0 – 635.0 ft						X	X		X	X	X			X			X														
		635.0 – 640.0 ft						X	X		X	X	X			X			X														
		[illegible]						X	X		X	X	X			X			X														
		645.0 – 650.0 ft						X	X		X	X	X			X			X														
		650.0 – 655.0 ft						X	X		X	X	X			X			X														
		655.0 – 660.0 ft						X	X		X	X	X			X			X														
		660.0 – 665.0 ft						X	X		X	X	X			X			X														
		665.0 – 670.0 ft						X	X		X	X	X			X			X														
		670.0 – 675.0 ft						X	X		X	X	X			X			X														
		675.0 – 680.0 ft						X	X		X	X	X			X			X														
		680.0 – 685.0 ft						X	X		X	X	X			X			X														
		685.0 – 690.0 ft						X	X		X	X	X			X			X														

Table 12.5–VII

SUBSEQUENT INVESTIGATIONS, EXTENTION OF MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low–Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture						Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
		690.0 – 695.0 ft						X	X		X	X	X			X			X																
		695.0 – 700.0 ft						X	X		X	X	X			X			X																
		700.0 – 705.0 ft						X	X		X	X	X			X			X																
		705.0 – 710.0 ft						X	X		X	X	X			X			X																
		710.0 – 715.0 ft						X	X		X	X	X			X			X																
		715.0 – 720.0 ft						X	X		X	X	X			X			X																
		720.0 – 725.0 ft						X	X		X	X	X			X			X																
		725.0 – 730.0 ft						X	X		X	X	X			X			X																
		730.0 – 735.0 ft						X	X		X	X	X			X			X																
		735.0 – 740.0 ft						X	X		X	X	X			X			X																
		740.0 – 745.0 ft						X	X		X	X	X			X			X																
		745.0 – 750.0 ft						X			X	X	X			X																			

Table 12.5-VIII

SUBSEQUENT GEOPHYSICAL INVESTIGATIONS

FOR MESA TOP CHARACTERIZATION BOREHOLES

				Hydrogeological and Geochemical																Environmental Isotopes								Open Hole Tests: Straddle Packer Tests							Open Hole Tests: Geophysics										
Sample Type	Sampling Location	Interval	Sample Identification	Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (He injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Chloride-35/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-16/Oxygen-18	Tritium	Carbon-14	Chloride-36	In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6	Thermal Ne[illegible]tron (moisture)	Gamma Ga[illegible]ma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
Vertical Borehole	LADP-1																																												
Continuous Downhole																																			X	X	X	X	X	X	X	X	X	X	X
		300.0 - 305.0 ft		X	X	X	X																																						
		305.0 - 310.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		310.0 - 315.0 ft		X	X	X	X																																						
		315.0 - 320.0 ft		X	X	X	X																																						
		320.0 - 325.0 ft		X	X	X	X																																						
		325.0 - 330.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																										
		330.0 - 335.0 ft		X	X	X	X																																						
		335.0 - 340.0 ft		X	X	X	X																																						
		340.0 - 345.0 ft		X	X	X	X																																						
		345.0 - 350.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		350.0 - 355.0 ft		X	X	X	X																																						
		355.0 - 360.0 ft		X	X	X	X																																						
		360.0 - 365.0 ft		X	X	X	X																																						
		365.0 - 370.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																										
		370.0 - 375.0 ft		X	X	X	X																																						
		375.0 - 380.0 ft		X	X	X	X																																						
		380.0 - 385.0 ft		X	X	X	X																																						
		385.0 - 390.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		390.0 - 395.0 ft		X	X	X	X																																						
		395.0 - 400.0 ft		X	X	X	X																																						
		400.0 - 405.0 ft		X	X	X	X																																						
		405.0 - 410.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		410.0 - 415.0 ft		X	X	X	X																																						
		415.0 - 420.0 ft		X	X	X	X																																						
		420.0 - 425.0 ft		X	X	X	X																																						
		425.0 - 430.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																										
		430.0 - 435.0 ft		X	X	X	X																																						
		435.0 - 440.0 ft		X	X	X	X																																						
		440.0 - 445.0 ft		X	X	X	X																																						
		445.0 - 450.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		450.0 - 455.0 ft		X	X	X	X																																						
		455.0 - 460.0 ft		X	X	X	X																																						
		460.0 - 465.0 ft		X	X	X	X																																						
		465.0 - 470.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																										
		470.0 - 475.0 ft		X	X	X	X																																						
		475.0 - 480.0 ft		X	X	X	X																																						
		480.0 - 485.0 ft		X	X	X	X																																						
		485.0 - 490.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											

Table 12.5-VIII

SUBSEQUENT GEOPHYSICAL INVESTIGATIONS
FOR MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical: Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (Hg injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Environmental Isotopes: Chloride-36/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-18/Oxygen-16	Tritium	Carbon-14	Chloride-36	Open Hole Tests: Straddle Packer Tests: In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6		Open Hole Tests: Geophysics: Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
		490.0 – 495.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		495.0 – 500.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		500.0 – 505.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		505.0 – 510.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		510.0 – 515.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		515.0 – 520.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		520.0 – 525.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		525.0 – 530.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		530.0 – 535.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		535.0 – 540.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		540.0 – 545.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		545.0 – 550.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		550.0 – 555.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		555.0 – 560.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		560.0 – 565.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		565.0 – 570.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		570.0 – 575.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		575.0 – 580.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		580.0 – 585.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		585.0 – 590.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		590.0 – 595.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		595.0 – 600.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		600.0 – 605.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		605.0 – 610.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		610.0 – 615.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		615.0 – 620.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		620.0 – 625.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		625.0 – 630.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		630.0 – 635.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		635.0 – 640.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		640.0 – 645.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		645.0 – 650.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		650.0 – 655.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		655.0 – 660.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		660.0 – 665.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
		665.0 – 670.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									

Table 12.5-VIII

SUBSEQUENT GEOPHYSICAL INVESTIGATIONS
FOR MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical																Environmental Isotopes								Open Hole Tests: Straddle Packer Tests							Open Hole Tests: Geophysics										
				Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (He injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Chloride-36/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-16/Oxygen-18	Tritium	Carbon-14	Chloride-36	In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6	Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
		670.0 - 675.0 ft		X	X	X	X																																						
		675.0 - 680.0 ft		X	X	X	X																																						
		680.0 - 685.0 ft		X	X	X	X																																						
		685.0 - 690.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		690.0 - 695.0 ft		X	X	X	X																																						
		695.0 - 700.0 ft		X	X	X	X																																						
		700.0 - 705.0 ft		X	X	X	X																																						
		705.0 - 710.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																										
		710.0 - 715.0 ft		X	X	X	X																																						
		715.0 - 720.0 ft		X	X	X	X																																						
		720.0 - 725.0 ft		X	X	X	X																																						
		725.0 - 730.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		730.0 - 735.0 ft		X	X	X	X																																						
		735.0 - 740.0 ft		X	X	X	X																																						
		740.0 - 745.0 ft		X	X	X	X																																						
		745.0 - 750.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																										
Fracture Contingency Sample				C								C	C	C	C	C	C	C	C																										
				C								C	C	C	C	C	C	C	C																										
				C								C	C	C	C	C	C	C	C																										
				C								C	C	C	C	C	C	C	C																										
				C								C	C	C	C	C	C	C	C																										
Vertical Borehole	LADP-2																																												
Continuous Downhole																																			X	X	X	X	X	X	X	X	X	X	X
		300.0 - 305.0 ft		X	X	X	X																																						
		305.0 - 310.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		310.0 - 315.0 ft		X	X	X	X																																						
		315.0 - 320.0 ft		X	X	X	X																																						
		320.0 - 325.0 ft		X	X	X	X																																						
		325.0 - 330.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																										
		330.0 - 335.0 ft		X	X	X	X																																						
		335.0 - 340.0 ft		X	X	X	X																																						
		340.0 - 345.0 ft		X	X	X	X																																						
		345.0 - 350.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X											
		350.0 - 355.0 ft		X	X	X	X																																						
		355.0 - 360.0 ft		X	X	X	X																																						

Table 12.5–VIII

SUBSEQUENT GEOPHYSICAL INVESTIGATIONS
FOR MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical: Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (Hg injection)	Saturated Hydraulic Conductivity	In Situ Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Silica Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Environmental Isotopes: Chloride-35/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-18/Oxygen-16	Tritium	Carbon-14	Chloride-36	Open Hole Tests: Straddle Packer Tests: In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6	Open Hole Tests: Geophysics: Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
		360.0 – 365.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		365.0 – 370.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		370.0 – 375.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		375.0 – 380.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		380.0 – 385.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		385.0 – 390.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		390.0 – 395.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		395.0 – 400.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		400.0 – 405.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		405.0 – 410.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		410.0 – 415.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		415.0 – 420.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		420.0 – 425.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		425.0 – 430.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		430.0 – 435.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		435.0 – 440.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		440.0 – 445.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		445.0 – 450.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		450.0 – 455.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		455.0 – 460.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		460.0 – 465.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		465.0 – 470.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		470.0 – 475.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		475.0 – 480.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		480.0 – 485.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		485.0 – 490.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		490.0 – 495.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		495.0 – 500.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		500.0 – 505.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		505.0 – 510.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		510.0 – 515.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		515.0 – 520.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		520.0 – 525.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		525.0 – 530.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		530.0 – 535.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 12.5-VIII

SUBSEQUENT GEOPHYSICAL INVESTIGATIONS
FOR MESA TOP CHARACTERIZATION BOREHOLES

Sample Identification	Sampling Interval	Sample Location	Sample Type	Hydrogeological and Geochemical: Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (He injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry pH	Environmental Isotopes: Chloride-36/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-16/Oxygen-18	Tritium	Carbon-14	Chloride-36	Open Hole Tests: Straddle Packer Tests: In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-13/C-12 - Pore Gas	Relative Humidity - Pore Gas	SF6	Open Hole Tests: Geophysics: Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
	535.0 - 540.0 ft			X	X	X	X																																				
	540.0 - 545.0 ft			X	X	X	X																																					
	545.0 - 550.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
	550.0 - 555.0 ft			X	X	X	X																																					
	555.0 - 560.0 ft			X	X	X	X																																					
	560.0 - 565.0 ft			X	X	X	X																																					
	565.0 - 570.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
	570.0 - 575.0 ft			X	X	X	X																																					
	575.0 - 580.0 ft			X	X	X	X																																					
	580.0 - 585.0 ft			X	X	X	X																																					
	585.0 - 590.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
	590.0 - 595.0 ft			X	X	X	X																																					
	595.0 - 600.0 ft			X	X	X	X																																					
	600.0 - 605.0 ft			X	X	X	X																																					
	605.0 - 610.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
	610.0 - 615.0 ft			X	X	X	X																																					
	615.0 - 620.0 ft			X	X	X	X																																					
	620.0 - 625.0 ft			X	X	X	X																																					
	625.0 - 630.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
	630.0 - 635.0 ft			X	X	X	X																																					
	635.0 - 640.0 ft			X	X	X	X																																					
	640.0 - 645.0 ft			X	X	X	X																																					
	645.0 - 650.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
	650.0 - 655.0 ft			X	X	X	X																																					
	655.0 - 660.0 ft			X	X	X	X																																					
	660.0 - 665.0 ft			X	X	X	X																																					
	665.0 - 670.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
	670.0 - 675.0 ft			X	X	X	X																																					
	675.0 - 680.0 ft			X	X	X	X																																					
	680.0 - 685.0 ft			X	X	X	X																																					
	685.0 - 690.0 ft			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X																									
	690.0 - 695.0 ft			X	X	X	X																																					
	695.0 - 700.0 ft			X	X	X	X																																					
	700.0 - 705.0 ft			X	X	X	X																																					
	705.0 - 710.0 ft			X	X	X	X																																					

Table 12.5–VIII

SUBSEQUENT GEOPHYSICAL INVESTIGATIONS

FOR MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (Hg injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Carbon	Cation Exchange Capacity	Slurry Ph	Chloride-36/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-18/Oxygen-16	Tritium	Carbon-14	Chloride-36	In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF-6	Thermal Properties (moisture)	Gamma Ray (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma (U, Th, K)	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
				Hydrogeological and Geochemical																Environmental Isotopes								Open Hole Tests: Straddle Packer Tests							Open Hole Tests: Geophysics										
		710.0 – 715.0 ft		X	X	X	X	X	X	X	X	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		715.0 – 720.0 ft		X	X	X	X	X	X	X	X	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		720.0 – 726.0 ft		X	X	X	X	X	X	X	X	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		725.0 – 730.0 ft		X	X	X	X	X	X	X	X	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		730.0 – 735.0 ft		X	X	X	X	X	X	X	X	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		735.0 – 740.0 ft		X	X	X	X	X	X	X	X	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		740.0 – 745.0 ft		X	X	X	X	X	X	X	X	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		745.0 – 750.0 ft		X	X	X	X	X	X	X	X	C	C	C	C	C	C	C	C	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Fracture Contingency	Sample			C																																							
					C																																						
						C																																				
							C																																			
								C																																		
									C																																	
Vertical Borehole	LADP-5																																									
Continuous Downhole		300.0 – 305.0 ft		X	X	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		305.0 – 310.0 ft		X	X	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		310.0 – 315.0 ft		X	X	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		315.0 – 320.0 ft		X	X	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		320.0 – 325.0 ft		X	X	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		325.0 – 330.0 ft		X	X	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		330.0 – 335.0 ft		X	X	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		335.0 – 340.0 ft		X	X	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		340.0 – 345.0 ft		X	X	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		345.0 – 350.0 ft		X	X	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		350.0 – 355.0 ft		X	X	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		355.0 – 360.0 ft		X	X	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		360.0 – 365.0 ft		X	X	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		365.0 – 370.0 ft		X	X	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		370.0 – 375.0 ft		X	X	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		375.0 – 380.0 ft		X	X	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		380.0 – 385.0 ft		X	X	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		385.0 – 390.0 ft		X	X	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		390.0 – 395.0 ft		X	X	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		395.0 – 400.0 ft		X	X	X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 12.5-VIII

SUBSEQUENT GEOPHYSICAL INVESTIGATIONS
FOR MESA TOP CHARACTERIZATION BOREHOLES

Sample Identification	Sampling Location	Sample Type	Interval	Hydrogeological and Geochemical											Environmental Isotopes								Open Hole Tests: Straddle Packer Tests							Open Hole Tests: Geophysics										
			400.0 - 405.0 ft	X	X	X	X	X																																
			405.0 - 410.0 ft	X	X	X	X	X																																
			410.0 - 415.0 ft	X	X	X	X	X																																
			415.0 - 420.0 ft	X	X	X	X	X																																
			420.0 - 425.0 ft	X	X	X	X	X																																
			425.0 - 430.0 ft	X	X	X	X	X																																
			430.0 - 435.0 ft	X	X	X	X	X																																
			435.0 - 440.0 ft	X	X	X	X	X																																
			440.0 - 445.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			445.0 - 450.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			450.0 - 455.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			455.0 - 460.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			460.0 - 465.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			465.0 - 470.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			470.0 - 475.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			475.0 - 480.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			480.0 - 485.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			485.0 - 490.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			490.0 - 495.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			495.0 - 500.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			500.0 - 505.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			505.0 - 510.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			510.0 - 515.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			515.0 - 520.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			520.0 - 525.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			525.0 - 530.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			530.0 - 535.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			535.0 - 540.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			540.0 - 545.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			545.0 - 550.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			550.0 - 555.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			555.0 - 560.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			560.0 - 565.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			565.0 - 570.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
			570.0 - 575.0 ft	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 12.5–VIII

SUBSEQUENT GEOPHYSICAL INVESTIGATIONS

FOR MESA TOP CHARACTERIZATION BOREHOLES

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical: Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (Hg injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Environmental Isotopes: Chloride-36/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-18/Oxygen-16	Tritium	Carbon-14	Chloride-36	Open Hole Tests: Straddle Packer Tests: In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6	Open Hole Tests: Geophysics: Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
		575.0 – 580.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		580.0 – 585.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		585.0 – 590.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		590.0 – 595.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		595.0 – 600.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		600.0 – 605.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		605.0 – 610.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		610.0 – 615.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		615.0 – 620.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		620.0 – 625.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		625.0 – 630.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		630.0 – 635.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		635.0 – 640.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		640.0 – 645.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		645.0 – 650.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		650.0 – 655.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		655.0 – 660.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		660.0 – 665.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		665.0 – 670.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		670.0 – 675.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		675.0 – 680.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		680.0 – 685.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		685.0 – 690.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		690.0 – 695.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		695.0 – 700.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		700.0 – 705.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		705.0 – 710.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		710.0 – 715.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		715.0 – 720.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		720.0 – 725.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		725.0 – 730.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		730.0 – 735.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		735.0 – 740.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		740.0 – 745.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		745.0 – 750.0 ft		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 12.5-VIII

SUBSEQUENT GEOPHYSICAL INVESTIGATIONS
FOR MESA TOP CHARACTERIZATION BOREHOLES

	Sample Identification	Sampling Interval	Sampling Location	Sample Type: Fracture Contingency Sample				
Hydrogeological and Geochemical	Gravimetric Water Content			C	C	C	C	C
	Bulk Density							
	Dry Density							
	Porosity							
	Porosity (He injection)							
	Saturated Hydraulic Conductivity							
	Air Water Relative Permeability							
	Moisture Characteristic Curve							
	Clay Mineralogy			C	C	C	C	C
	Zeolite Mineralogy			C	C	C	C	C
	Matrix Mineralogy			C	C	C	C	C
	Carbonate Mineralogy			C	C	C	C	C
	Fe and Mn Mineralogy			C	C	C	C	C
	Total Organic Compound			C	C	C	C	C
	Cation Exchange Capacity			C	C	C	C	C
	Slurry Ph			C	C	C	C	C
Environmental Isotopes	Chloride-35/Chloride-37							
	Carbon-12/Carbon-13							
	Strontium-86/Strontium -87							
	Hydrogen/Deuterium							
	Oxygen-16/Oxygen-18							
	Tritium							
	Carbon-14							
	Chloride-36							
Open Hole Tests: Straddle Packer Tests	In Situ Permeability							
	VOA's - Pore Gas							
	CO2 - Pore Gas							
	CH4 - Pore Gas							
	C-12/C-13 - Pore Gas							
	Relative Humidity - Pore Gas							
	SF6							
Open Hole Tests: Geophysics	Thermal Neutron (moisture)							
	Gamma Gamma (density)							
	Caliper							
	Axial Borehole Video							
	EM Induction (Geonics EM-39)							
	Magnetic Susceptibility							
	Natural Gamma							
	Spectral Gamma (U, Th, K)							
	Prompt Fission Neutron							
	Geochemical (Californium-252)							
	Side Scan Video							

Table 12.6-1

SPRINGS SAMPLING INITIAL INVESTIGATION

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
Surface Water																																	
Seasonal	1			X	X	X	X	X	X		X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X
	2			X	X	X	X	X	X		X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X
	3			X	X	X	X	X	X		X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X
	4			X	X	X	X	X	X		X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X
	5			X	X	X	X	X	X		X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X	X	X	X
DP Spring																																	
Monthly	1																																
Field Duplicate																																	
Reagent Blank																																	
Field Blank																																	
Trip Blank																																	
Monthly	2																																
Reagent Blank																																	
Field Blank																																	
Trip Blank																																	
Monthly	3																																
Reagent Blank																																	
Field Blank																																	
Trip Blank																																	
Monthly	4																																
Reagent Blank																																	
Field Blank																																	
Trip Blank																																	
Monthly	5																																

Table 12.6-I

SPRINGS SAMPLING INITIAL INVESTIGATION

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
Reagent Blank																																	
Field Blank																							X					X	X				
Trip Blank																												X	X				
Monthly	6																					X		X	X	X	X	X	X	X	X	X	X
Reagent Blank																												X	X				
Field Blank																												X	X				
Trip Blank																												X	X				
Monthly	7																					X		X	X	X	X	X	X	X	X	X	X
Reagent Blank																												X	X				
Field Blank																												X	X				
Trip Blank																												X	X				
Monthly	8																					X		X	X	X	X	X	X	X	X	X	X
Reagent Blank																												X	X				
Field Blank																												X	X				
Trip Blank																												X	X				
Monthly	9																					X		X	X	X	X	X	X	X	X	X	X
Reagent Blank																												X	X				
Field Blank																												X	X				
Trip Blank																												X	X				
Monthly	9																					X		X	X	X	X	X	X	X	X	X	X
Reagent Blank																												X	X				
Field Blank																												X	X				
Trip Blank																												X	X				
Monthly	8																					X		X	X	X	X	X	X	X	X	X	X
Reagent Blank																												X	X				
Field Blank																												X	X				
Trip Blank																												X	X				
Monthly	9																					X		X	X	X	X	X	X	X	X	X	X
Reagent Blank																												X	X				
Field Blank																												X	X				
Trip Blank																												X	X				
Monthly	11																					X		X	X	X	X	X	X	X	X	X	X
Reagent Blank																												X	X				
Field Blank																												X	X				

Table 12.6-1

SPRINGS SAMPLING INITIAL INVESTIGATION

	Sample Identification	Interval	Sampling Location	Sample Type	Trip Blank	Field Blank	Reagent Blank	Monthly	Trip Blank
Field Surveys	Gross Gamma								
	[illegible]-Energy Gamma								
	Electromagnetic								
	Land Survey								
Field Screening	Gross Gamma								
	Gross Alpha								
	Organic Vapor								
	Combustible Gas/Oxygen								
	Lithological Logging								
Laboratory Measurements	Gross Alpha								
	Gamma Spectrometry								
	Tritium								
	Volatile Organics								
	PCB								
	Soil Moisture								
Laboratory Analysis	Gamma Spectrometry								
	Tritium					X		X	
	Total Uranium							X	
	Isotopic Plutonium							X	
	Isotopic Uranium								
	Strontium 90							X	
	VOA (SW 8240)				X	X	X	X	X
	Semivolatiles (SW 8270)					X	X	X	
	Metals (SW 6010)					X	X	X	
	PCB (SW 8080)								
	Isotopic Thorium								
	Water Quality Parameters							X	
	Gross Alpha/Beta							X	

Table 12.6-II

PERCHED WATER SAMPLING INITIAL INVESTIGATIONS.

	Sample Type	Sampling Location	Interval	Sample Identification
Field Surveys				
Gross Gamma	LADP-3			
Low-Energy Gamma	Quarterly	1		
Electromagnetic		2		
Land Survey		3		
		4		
Field Screening				
Gross Gamma	LADP-4			
Gross Alpha	Quarterly	1		
		2		
Organic Vapor		3		
Combustible Gas/Oxygen		4		
Lithological Logging				
Field Laboratory Measurements				
Gross Alpha				
Gamma Spectrometry				
Tritium				
Volatile Organics				
PCB				
Soil Moisture				
Laboratory Analysis				
Gamma Spectrometry				
Tritium	X	X	X	X
Total Uranium	X	X	X	X
Isotopic Plutonium	X	X	X	X
Isotopic Uranium	X	X	X	X
Strontium 90				
VOA (SW 8240)	X	X	X	X
Semivolatiles (SW 8270)	X	X	X	X
Metals (SW 6010)	X	X	X	X
PCB (SW 8080)	X	X	X	X
Isotopic Thorium				
Water Quality Parameters	X	X	X	X
Gross Alpha/Beta	X	X	X	X

TABLE 12.6-III
ESTIMATED THICKNESS OF STRATIGRAPHIC UNITS PRESENT AT PERCHED WATER HOLE LOCATIONS

Drill Hole No.[a]	Estimated Surface Elevation (ft)	Total Depth (ft)	Estimated Thickness (ft) of Stratigraphic Units in the Bandelier Formation					Estimated Total Thickness of Bandelier Formation (ft)
			Tshirege Member	Tsankawi Pumice Bed	Cerro Toledo Rhyolite	Otowi Member	Guaje Pumice Bed	
LAUZ-1	7020	200	110-140	0-2	0-30	60	not penetrated	200
LAUZ-2	7030	200	110-140	0-2	0-30	60	not penetrated	200

[a]Drill hole locations are shown in Fig. 12.5-1.

Table 12.6-IV

SUBSURFACE SAMPLING IN DP CANYON, SUBSEQUENT INVESTIGATION.

Sample Type	Sampling Location	Interval	Sample Identification	Field Survey: Gross Gamma	Field Survey: Low-Energy Gamma	Field Survey: Electromagnetic	Field Survey: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Field Laboratory Measurements:	Field Laboratory Measurements:	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: Isotopic Thorium	Laboratory Analysis: Water Quality Parameters	Laboratory Analysis: Gross Alpha/Beta
LAUZ-1																																		
Vertical Borehole	1	0.0 – 5.0 ft						X	X		X	X	X		X				X			X												
		5.0 – 10.0 ft						X	X		X	X	X		X				X			X												
		10.0 – 15.0 ft						X	X		X	X	X		X				X			X												
		15.0 – 20.0 ft						X	X		X	X	X		X				X			X												
		20.0 – 25.0 ft						X	X		X	X	X		X				X			X												
Rinsate Blank																																		
Field Blank																																		
		25.0 – 30.0 ft						X	X		X	X	X		X				X			X												
		30.0 – 35.0 ft						X	X		X	X	X		X				X			X												
		35.0 – 40.0 ft						X	X		X	X	X		X				X			X												
		40.0 – 45.0 ft						X	X		X	X	X		X				X			X												
		45.0 – 50.0 ft						X	X		X	X	X		X				X			X												
		50.0 – 55.0 ft						X	X		X	X	X		X				X			X												
		55.0 – 60.0 ft						X	X		X	X	X		X				X			X												
Field Duplicate																																		
		60.0 – 65.0 ft						X	X		X	X	X		X				X			X												
		65.0 – 70.0 ft						X	X		X	X	X		X				X			X												
		70.0 – 75.0 ft						X	X		X	X	X		X				X			X												
		75.0 – 80.0 ft						X	X		X	X	X		X				X			X												
		80.0 – 85.0 ft						X	X		X	X	X		X				X			X												
		85.0 – 90.0 ft						X	X		X	X	X		X				X			X												
		90.0 – 95.0 ft						X	X		X	X	X		X				X			X												
		95.0 – 100.0 ft						X	X		X	X	X		X				X			X												
Trip Blank		100.0 – 105.0 ft																																

Table 12.6-iV

SUBSURFACE SAMPLING IN DP CANYON, SUBSEQUENT INVESTIGATION.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma; Low-Energy Gamma; Electromagnetic; Land Survey	Field Screening: Gross Gamma; Gross Alpha; Organic Vapor; Combustible Gas/Oxygen; Lithological Logging	Field Laboratory Measurements: Gross Alpha; Gamma Spectrometry; Tritium; Volatile Organics; PCB; Soil Moisture	Laboratory Analysis: Gamma Spectrometry; Tritium; Total Uranium; Isotopic Plutonium; Isotopic Uranium; Strontium 90; VOA (SW 8240); Semivolatiles (SW 8270); Metals (SW 6010); PCB (SW 8080); Isotopic Thorium; Water Quality Parameters; Gross Alpha/Beta
		105.0 – 110.0 ft			X X X X	X	X X X X X X X X X X X X X
		110.0 – 115.0 ft			X X X X	X	X X X X X X X X X X X X X
		115.0 – 120.0 ft			X X X X	X	X X X X X X X X X X X X X
Rinsate Blank							X X X X X X X X X X X X X
Field Blank							X X X X X X X X X X X X X
		120.0 – 125.0 ft			X X X X	X	X X X X X X X X X X X X X
		125.0 – 130.0 ft			X X X X	X	X X X X X X X X X X X X X
		130.0 – 135.0 ft			X X X X	X	X X X X X X X X X X X X X
		135.0 – 140.0 ft			X X X X	X	X X X X X X X X X X X X X
		140.0 – 145.0 ft			X X X X	X	X X X X X X X X X X X X X
		145.0 – 150.0 ft			X X X X	X	X X X X X X X X X X X X X
		150.0 – 155.0 ft			X X X X	X	X X X X X X X X X X X X X
Field Duplicate							X X X X X X X X X X X X X
		155.0 – 160.0 ft			X X X X	X	X X X X X X X X X X X X X
		160.0 – 165.0 ft			X X X X	X	X X X X X X X X X X X X X
		165.0 – 170.0 ft			X X X X	X	X X X X X X X X X X X X X
		170.0 – 175.0 ft			X X X X	X	X X X X X X X X X X X X X
		175.0 – 180.0 ft			X X X X	X	X X X X X X X X X X X X X
		180.0 – 185.0 ft			X X X X	X	X X X X X X X X X X X X X
		185.0 – 190.0 ft			X X X X	X	X X X X X X X X X X X X X
		190.0 – 195.0 ft			X X X X	X	X X X X X X X X X X X X X
		195.0 – 200.0 ft			X X X X	X	X X X X X X X X X X X X X
Field Duplicate							X X X X X X X X X X X X X
Rinsate Blank							X X X X X X X X X X X X X
Field Blank							X X X X X X X X X X X X X
Trip Blank							X X X X X X X X X X X X X

Table 12.6-IV

SUBSURFACE SAMPLING IN DP CANYON, SUBSEQUENT INVESTIGATION.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Laboratory Measurements: Gross Alpha	Laboratory Measurements: Gamma Spectrometry	Laboratory Measurements: Tritium	Laboratory Measurements: Volatile Organics	Laboratory Measurements: PCB	Laboratory Measurements: Soil Moisture	Laboratory Measurements:	Laboratory Measurements:	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: Isotopic Thorium	Laboratory Analysis: Water Quality Parameters	Laboratory Analysis: Gross Alpha/Beta
LAUZ-2																																		
Vertical Borehole	2	0.0 - 5.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X	X			
		5.0 - 10.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X	X			
		10.0 - 15.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X	X			
		15.0 - 20.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X	X			
		20.0 - 25.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X	X			
Rinsate Blank																																		
Field Blank		25.0 - 30.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X	X			
		30.0 - 35.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X	X			
		35.0 - 40.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X	X			
		40.0 - 45.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X	X			
		45.0 - 50.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X	X			
		50.0 - 55.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X	X			
		55.0 - 60.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X	X			
Field Duplicate		60.0 - 65.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X	X			
		65.0 - 70.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X	X			
		70.0 - 75.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X	X			
		75.0 - 80.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X	X			
		80.0 - 85.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X	X			
		85.0 - 90.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X	X			
		90.0 - 95.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X	X			
		95.0 - 100.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X	X			
Trip Blank		100.0 - 105.0 ft																																

Table 12.6-IV

SUBSURFACE SAMPLING IN DP CANYON, SUBSEQUENT INVESTIGATION.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture		Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
		105.0 – 110.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X				
		110.0 – 115.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X				
		115.0 – 120.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X				
Rinsate Blank																																
Field Blank																																
		120.0 – 125.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X				
		125.0 – 130.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X				
		130.0 – 135.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X				
		135.0 – 140.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X				
		140.0 – 145.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X				
		145.0 – 150.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X				
		150.0 – 155.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X				
Field Duplicate																																
		155.0 – 160.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X				
		160.0 – 165.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X				
		165.0 – 170.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X				
		170.0 – 175.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X				
		175.0 – 180.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X				
		180.0 – 185.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X				
		185.0 – 190.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X				
		190.0 – 195.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X				
		195.0 – 200.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X				
Field Duplicate																																
Rinsate Blank																																
Field Blank																																
Trip Blank																																

Table 12.6-V

PERCHED WATER SAMPLING SUBSEQUENT INVESTIGATIONS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
LADP-3 Year 2																																	
Quarterly	1																					X	X	X	X	X	X	X	X	X	X	X	X
	2																					X	X	X	X	X	X	X	X	X	X	X	X
	3																					X	X	X	X	X	X	X	X	X	X	X	X
	4																					X	X	X	X	X	X	X	X	X	X	X	X
LADP-4 Year 2																																	
Quarterly	1																					X	X	X	X	X	X	X	X	X	X	X	X
	2																					X	X	X	X	X	X	X	X	X	X	X	X
	3																					X	X	X	X	X	X	X	X	X	X	X	X
	4																					X	X	X	X	X	X	X	X	X	X	X	X
LAUZ-1 Year 2																																	
Quarterly	1																					X	X	X	X	X	X	X	X	X	X	X	X
	2																					X	X	X	X	X	X	X	X	X	X	X	X
	3																					X	X	X	X	X	X	X	X	X	X	X	X
	4																					X	X	X	X	X	X	X	X	X	X	X	X
LAUZ-2 Year 2																																	
Quarterly	1																					X	X	X	X	X	X	X	X	X	X	X	X
	2																					X	X	X	X	X	X	X	X	X	X	X	X
	3																					X	X	X	X	X	X	X	X	X	X	X	X
	4																					X	X	X	X	X	X	X	X	X	X	X	X
LADP-3 Year 3																																	
Quarterly	1																					X	X	X	X	X	X	X	X	X	X	X	X
	2																					X	X	X	X	X	X	X	X	X	X	X	X
	3																					X	X	X	X	X	X	X	X	X	X	X	X
	4																					X	X	X	X	X	X	X	X	X	X	X	X
LADP-4 Year 3																																	

Table 12.6-V

PERCHED WATER SAMPLING SUBSEQUENT INVESTIGATIONS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Laboratory Analysis: Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
Quarterly	1																																
	2																																
	3			X	X																												
	4			X	X																												
LAUZ-1 Year 3																																	
Quarterly	1			X	X			X	X													X	X	X			X	X	X			X	X
	2			X	X			X	X													X	X	X			X	X	X			X	X
	3			X	X			X	X													X	X	X			X	X	X			X	X
	4			X	X			X	X													X	X	X			X	X	X			X	X
LAUZ-2 Year 3																																	
Quarterly	1			X	X																	X	X	X			X	X	X			X	X
	2			X	X																	X	X	X			X	X	X			X	X
	3			X	X																	X	X	X			X	X	X			X	X
	4			X	X																	X	X	X			X	X	X			X	X
LADP-3 Year 4																																	
Quarterly	1			X	X																	X	X	X			X	X	X			X	X
	2			X	X																	X	X	X			X	X	X			X	X
	3			X	X																	X	X	X			X	X	X			X	X
	4			X	X																	X	X	X			X	X	X			X	X
LADP-4 Year 4																																	
Quarterly	1			X	X																	X	X	X			X	X	X			X	X
	2			X	X																	X	X	X			X	X	X			X	X
	3			X	X																	X	X	X			X	X	X			X	X
	4			X	X																	X	X	X			X	X	X			X	X
LAUZ-1 Year 4																																	
Quarterly	1			X	X																	X	X	X			X	X	X			X	X

Table 12.6-V

PERCHED WATER SAMPLING SUBSEQUENT INVESTIGATIONS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
	2																					X	X	X			X	X	X	X		X	X
	3																					X	X	X			X	X	X	X		X	X
LAUZ-2 Year 4 Quarterly	4																					X	X	X			X	X	X	X		X	X
	1																					X	X	X			X	X	X	X		X	X
	2																					X	X	X			X	X	X	X		X	X
	3																					X	X	X			X	X	X	X		X	X
	4																					X	X	X			X	X	X	X		X	X
	2																					X	X	X			X	X	X	X		X	X
	3																					X	X	X			X	X	X	X		X	X
LADP-3 Year 5 Quarterly	4																					X	X	X			X	X	X	X		X	X
	1																					X	X	X			X	X	X	X		X	X
	2																					X	X	X			X	X	X	X		X	X
	3																					X	X	X			X	X	X	X		X	X
	4																					X	X	X			X	X	X	X		X	X
	1																					X	X	X			X	X	X	X		X	X
	2																					X	X	X			X	X	X	X		X	X
LADP-4 Year 5 Quarterly	3																					X	X	X			X	X	X	X		X	X
	4																					X	X	X			X	X	X	X		X	X
	1																					X	X	X			X	X	X	X		X	X
	2																					X	X	X			X	X	X	X		X	X
LAUZ-1 Year 5 Quarterly	3																					X	X	X			X	X	X	X		X	X
	4																					X	X	X			X	X	X	X		X	X
	1																					X	X	X			X	X	X	X		X	X
	2																					X	X	X			X	X	X	X		X	X
LAUZ-2 Year 5 Quarterly	3																					X	X	X			X	X	X	X		X	X
	4																					X	X	X			X	X	X	X		X	X
	1																					X	X	X			X	X	X	X		X	X
	2																					X	X	X			X	X	X	X		X	X

Table 12.6-V

PERCHED WATER SAMPLING SUBSEQUENT INVESTIGATIONS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Strontium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
	3															X						X	X			X	X	X	X			X	X
	4															X						X	X			X	X	X	X			X	X

Table 12.6–VI

SPRINGS SAMPLING SUBSEQUENT INVESTIGATIONS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
DP Spring Year 2																																		
Quarterly	1																						X	X	X		X	X	X	X			X	X
Field Duplicate																							X	X	X		X	X	X	X			X	X
Reagent Blank																												X	X	X				
Field Blank																							X					X	X	X				
Trip Blank																												X						
	2																						X	X	X		X	X	X	X			X	X
Reagent Blank																												X	X	X				
Field Blank																							X					X	X	X				
Trip Blank																												X						
	3																						X	X	X		X	X	X	X			X	X
Reagent Blank																												X	X	X				
Field Blank																							X					X	X	X				
Trip Blank																												X						
	4																						X	X	X		X	X	X	X			X	X
Reagent Blank																												X	X	X				
Field Blank																							X					X	X	X				
Trip Blank																												X						
DP Spring Year 3																																		
Quarterly	1																						X	X	X		X	X	X	X			X	X
Field Duplicate																							X	X	X		X	X	X	X			X	X
Reagent Blank																												X	X	X				
Field Blank																							X					X	X	X				
Trip Blank																												X						
	2																						X	X	X		X	X	X	X			X	X

Table 12.6-VI

SPRINGS SAMPLING SUBSEQUENT INVESTIGATIONS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture				Gam. ra Spectrometry	Laboratory Analysis: Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
Reagent Blank																																		
Field Blank																							X	X				X	X	X				
Trip Blank																							X	X	X	X	X	X	X	X			X	X
	3																						X	X	X	X	X	X	X	X			X	X
Reagent Blank																							X	X				X	X	X				
Field Blank																							X	X				X	X	X				
Trip Blank																							X	X	X	X	X	X	X	X			X	X
	4																						X	X	X	X	X	X	X	X			X	X
Reagent Blank																							X	X				X	X	X				
Field Blank																							X	X				X	X	X				
Trip Blank																							X	X	X	X	X	X	X	X			X	X
DP Spring Year 4																							X	X	X	X	X	X	X	X			X	X
Quarterly	1																						X	X				X	X	X				
Field Duplicate																							X	X				X	X	X				
Reagent Blank																							X	X	X	X	X	X	X	X			X	X
Field Blank																							X	X				X	X	X				
Trip Blank																							X	X	X	X	X	X	X	X			X	X
	2																						X	X	X	X	X	X	X	X			X	X
Reagent Blank																							X	X				X	X	X				
Field Blank																							X	X				X	X	X				
Trip Blank																							X	X	X	X	X	X	X	X			X	X
	3																						X	X	X	X	X	X	X	X			X	X
Reagent Blank																							X	X				X	X	X				
Field Blank																							X	X				X	X	X				
Trip Blank																							X	X	X	X	X	X	X	X			X	X
	4																						X	X	X	X	X	X	X	X			X	X

Table 12.6-VI

SPRINGS SAMPLING SUBSEQUENT INVESTIGATIONS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Isotopic Thorium	Water Quality Parameters	Gross Alpha/Beta
Reagent Blank																																	
Field Blank																						X						X	X				
Trip Blank																												X					
DP Spring Year 5																																	
Quarterly	1																					X	X					X	X				
Field Duplicate																							X	X				X	X				
Reagent Blank																							X	X				X	X				
Field Blank																							X	X				X	X				
Trip Blank	2																						X	X				X	X				
Reagent Blank																																	
Field Blank																																	
Trip Blank																																	
	3																																
Reagent Blank																																	
Field Blank																																	
Trip Blank																																	
	4																																
Reagent Blank																																	
Field Blank																																	
Trip Blank																																	

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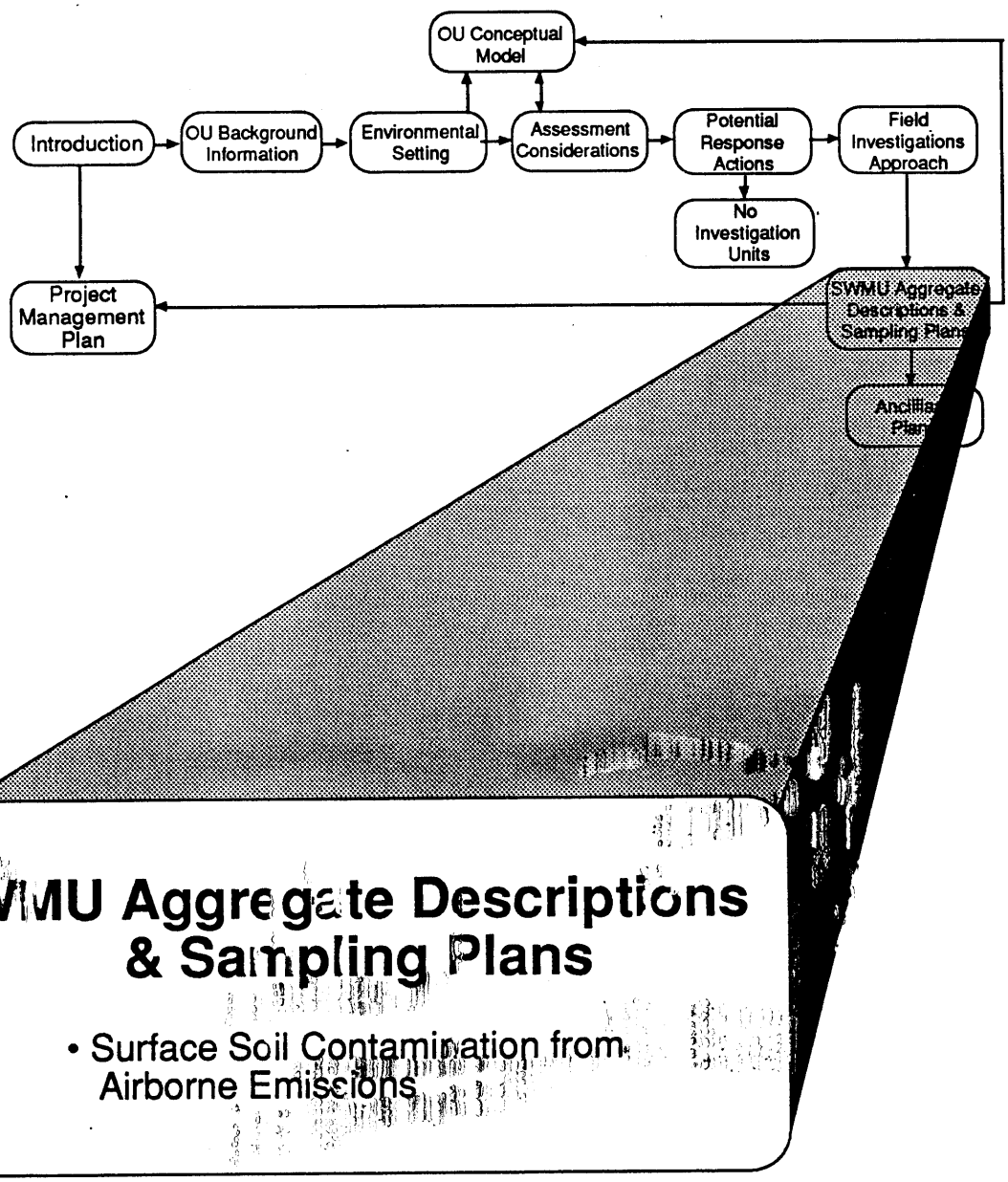
CHAPTER 13


OU Conceptual Model
Introduction
OU Background Information
Environmental Setting
Assessment Considerations
Potential Response Actions
Field Investigations Approach
No Investigation Units
Project Management Plan
SWMU Aggregate Descriptions & Sampling Plans
SWMU Aggregate Descriptions & Sampling Plans
• Surface Soil Contamination from Airborne Emissions

13 SURFACE SOIL CONTAMINATION FROM AIRBORNE EMISSIONS

13.1 Introduction

This chapter addresses general surface contamination of the TA-21 OU because of past airborne contaminant releases. The 18 SWMUs included are described in Sec. 13.2 below.

The surface soils of the OU are potentially contaminated from past airborne emissions from incinerators, stacks, and filter houses within the TA-21 area. The source term from all SWMUs together is addressed because surface contamination cannot be traced back to a specific stack. The objective of the investigation described in this chapter is to confirm the absence of localized areas of contamination resulting from stack emissions. The analysis will focus on radionuclides because historical data show that only radionuclide emissions have occurred.

Potential migration pathways at TA-21 SWMUs are discussed in Chapter 5. Surface soil is the identified contaminated media for all of the SWMUs in this chapter. In addition, subsurface soil is a contaminated medium for SWMUs 21-007, Salamanders, and 21-020(a) and (b), Decommissioned Filter Houses. The identified potential contaminant migration pathways for all of this chapter's SWMUs include atmospheric dispersion and surface run-off. Infiltration is identified as a pathway for the decommissioned filter houses. Exposure routes and potential receptors for each environmental transport pathway are identified in Chapter 6.

The criteria for potential response actions at TA-21 SWMUs are discussed in Chapter 10. Preliminary remedial alternatives that are identified for all this chapter's SWMUs are removal and disposal and removal and treatment. Depending on the results of the field investigation, the no-action alternative is identified as potentially appropriate for SWMU 21-008, Incinerator, and SWMU 21-019, Filter Houses/Exhaust Stacks.

The strategy for field investigations to characterize airborne emissions over the entire OU is presented in Fig. 13.1-1. The investigation will be performed in stages, and the results from the initial investigation will be used to determine requirements for subsequent sampling. In contrast to many sampling plans at TA-21, the subsequent investigation to characterize airborne emissions is a required activity.

The locations where samples from the deposition layer will be collected in the initial investigation are the same locations where surface soil samples will be collected for the OU-wide characterization of

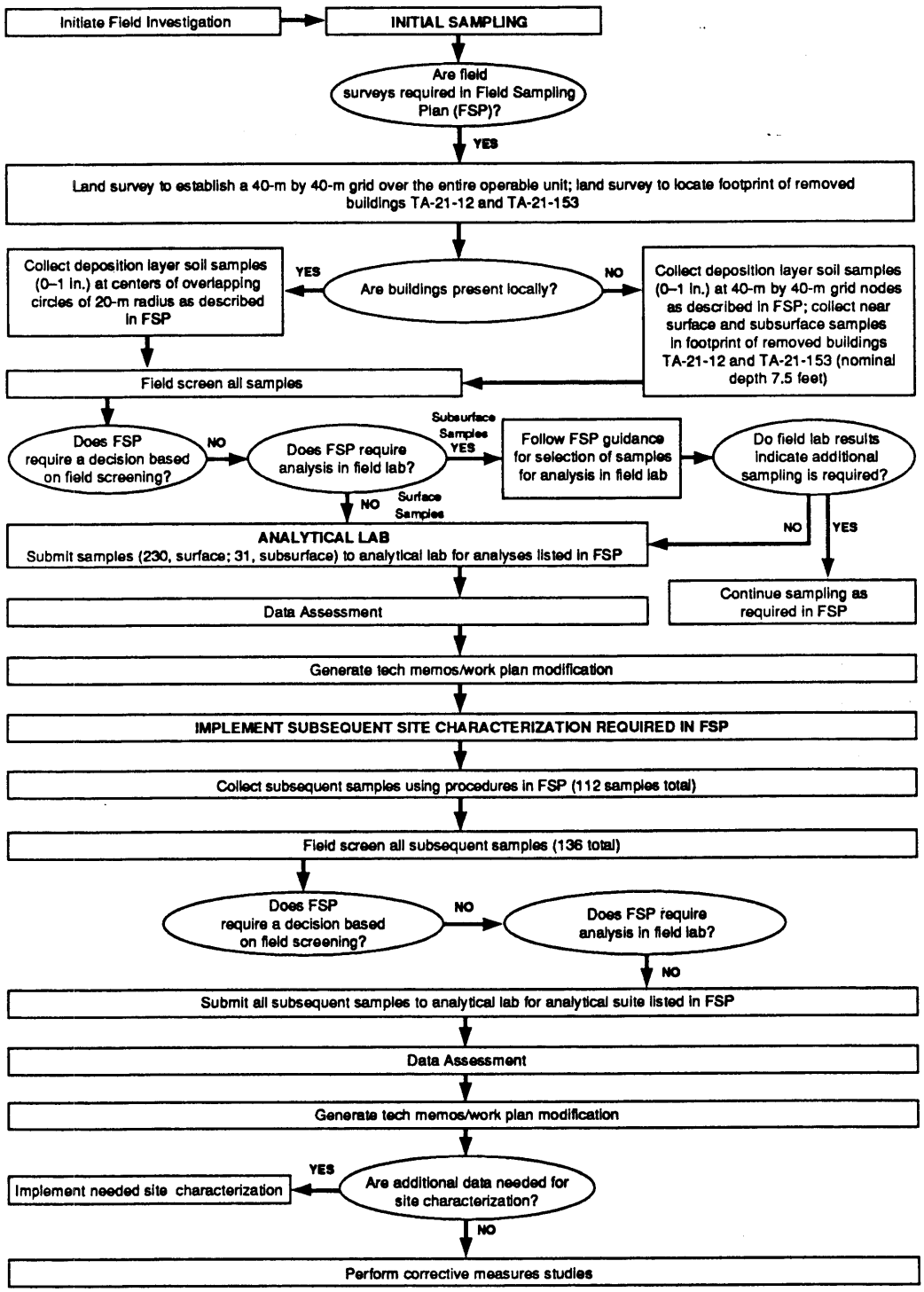


Fig. 13.1-1 Logic flow for field investigations to characterize deposition layer contamination from airborne emissions.

surface soils (see Chapter 12).

The objective of the initial phase of investigation is to locate contaminated areas greater than 3,000 m^2. The initial sampling will also investigate subsurface soil contamination in the "footprint" of the decommissioned filter houses (SWMU 21-020). The subsequent investigation will focus on characterizing the areal extent of contamination found in the initial sampling.

Measurements to be taken during the field investigations and laboratory analyses are summarized in Tables 13.1-I through 13.-IV. Methods for field measurements and laboratory analysis are

13.1-1 SUMMARY OF INITIAL INVESTIGATIONS BY SECTION FOR CHAPTER 13.

Section	Description	Survey Areas			Surface	Near Surface		
		Land	Radiological	Geophysical	Soil Samples	Soil Samples		
						No. of Locations	No. of Samples	
13-2	Airborne Deposition				230			
13-2	Filter Buildings					26	130	
Total					230	26	130	

Section	Description	Boreholes										QA
		Shallow			Vertical			Angled				
		Number	Total Footage	No. of Samples	Number	Total Footage	No. of Samples	Number	Total Footage	No. of Samples		
13-2	Airborne Deposition											37
13-2	Filter Buildings	5	37.5	15								28
Total		5	37.5	15								65

13.1-II SUMMARY OF SAMPLE AND ANALYSIS FOR INITIAL INVESTIGATIONS BY SECTION FOR CHAPTER 13.

	From Table: 13-2-VI		13-2-VII								Total
Field Sample Screening											
Gross Gamma	230		145								375
Gross Alpha	230		145								375
Organic Vapor	230		145								375
Combustible Gas/Oxygen			10								10
Lithological Logging			10								10
Field Laboratory Measurements											
Gross Alpha			98								98
Gamma Spectrometry			98								98
Tritium			98								98
Volatile Organics			98								98
PCB											
Soil Moisture											
Laboratory Analysis											
Gamma Spectrometry	255		41								296
Tritium	255		41								296
Total Uranium	255		41								296
Isotopic Plutonium	255		41								296
Isotopic Uranium											
Strontium 90	255		41								296
VOA (SW 8240)			41								41
Semivolatiles (SW 8270)			59								59
Metals (SW 6010)	267		49								316
PCB (SW 8080)											
TCLP Metals											

13.1-III SUMMARY OF SUBSEQUENT INVESTIGATIONS BY SECTION FOR CHAPTER 13.

Section	Description	Survey Areas			Surface	Near Surface	
		Land	Radiological	Geophysical	Soil Samples	Soil Samples No. of Locations	Soil Samples No. of Samples
13-2	Airborne Deposition				112		
Total					112		

Section	Description	Boreholes									Q A
		Shallow			Vertical			Angled			
		Number	Total Footage	No. of Samples	Number	Total Footage	No. of Samples	Number	Total Footage	No. of Samples	
13-2	Airborne Deposition										19
Total											19

13.1–IV SUMMARY OF SAMPLE AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS BY SECTION FOR CHAPTER 13.

	13–2										Total
Field Sample Screening											
Gross Gamma	112										112
Gross Alpha	112										112
Organic Vapor	112										112
Combustible Gas/Oxygen											
Lithological Logging											
Field Laboratory Measurements											
Gross Alpha											
Gamma Spectrometry											
Tritium											
Volatile Organics											
PCB											
Soil Moisture											
Laboratory Analysis											
Gamma Spectrometry	125										125
Tritium	125										125
Total Uranium	125										125
Isotopic Plutonium	125										125
Isotopic Uranium											
Strontium 90	125										125
VOA (SW 8240)											
Semivolatiles (SW 8270)											
Metals (SW 6010)	131										131
PCB (SW 8080)											
TCLP Metals											
Isotopic Thorium											

described in Chapter 11.

13.2 Airborne Emissions

13.2.1 Site Description

The SWMUs in this chapter address potential surface soil contamination from past airborne emissions from incinerators, stacks, and filter houses within the TA-21 area and near-surface contamination at the former location of Filter Buildings 12 and 153 (SWMU 21-020). Table 13.2-I gives a description of each of the stacks that may have contributed to surface contamination at the TA-21 OU. SWMUs 21-007, -008, -019 (a)–(m), -020(a), (b), and -021 are addressed herein as a single potential release site addressing surface contamination for the entire TA-21 OU. Where known, stack, filter house, and incinerator locations are shown in Fig. 13.2-1. SWMU 21-021 is not shown because documentation on specific stacks is lacking. Stack locations are shown because they may help determine most likely areas of surface contamination at the TA-21 OU.

13.2.1.1 Site History

Detailed history of stack, filter house, incinerator locations, and the materials they burned are presented in Nyhan (1990). Because this chapter addresses surface and near-surface soil contamination at the TA-21 OU, specific stack information is not summarized herein.

13.2.1.2 Existing Information

SWMU 21-007, Salamanders

Studies on use of salamanders and components of their emissions (Christenson et al. no date) found that no contamination of the ground surrounding the burner occurred. Soot in the stack and burner ash contained $^{239/240}$ Pu. The ash was sent to radioactive waste burial pits, assumed to be MDA G. The objective of using salamanders at MDA T was to incinerate "waste oils and organics in salamander heaters to reduce their volumes and to convert them to a form which would mix with cement" (Christenson 1975).

The HSE-7 records on the amounts of oils burned in the salamanders and radionuclide assays on the ashes are detailed in Nyhan 1990, Table XIII. Approximately 1102.25 gal. of TCP and 156 gal. of TBP oils were burned in the salamanders between 1964 and 1967 and between 1970 through 1972. Based on Group HSE-7 records, the $^{239/240}$Pu releases for the years 1970, 1971,

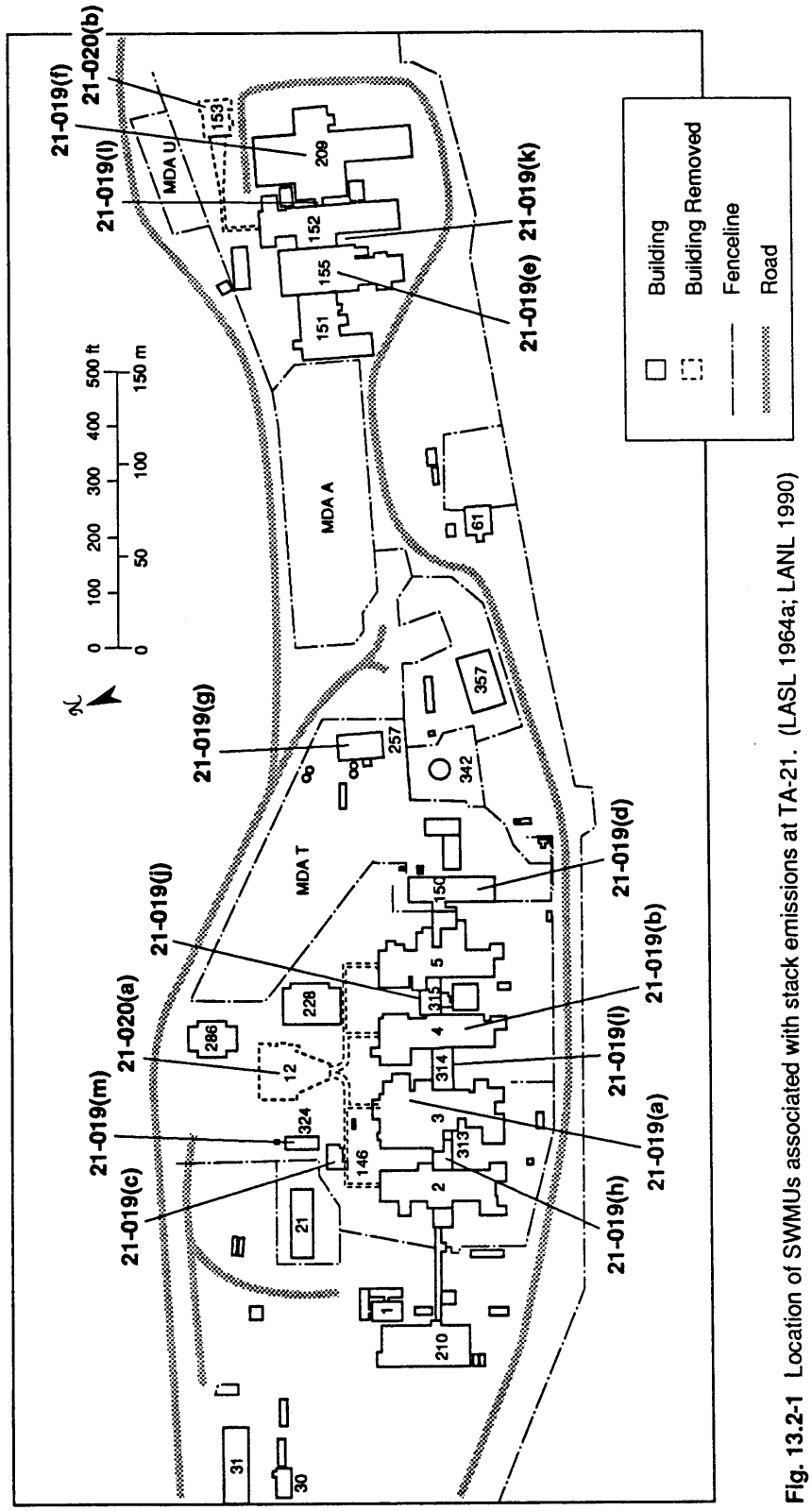


Fig. 13.2-1 Location of SWMUs associated with stack emissions at TA-21. (LASL 1964a; LANL 1990)

TABLE 13.2-I DESCRIPTION OF INCINERATORS, STACKS AND FILTER HOUSES AT TA-21.

SWMU	Short Description	Period of Use[a]	Available information on emissions that may be present in surface soil contamination.
21-007	Salamander incinerators at TA-21 used to burn oils and fats; three located within MDA T, other locations unknown	1964-1972	Material incinerated was tricresylphospate phosphate (TCP) contaminated with ^{239}Pu (approximately 10^3 dpm/m) and diluted with one-half part kerosene
21-008	Scrap incinerator in TA-21-2 Rag incinerator in TA-21-3, Room 313, hood 2	1945?-1962 1945?-1970?	plutonium waste rags for recovery of ^{235}U oxide
21-019(a)	Exhaust stack at TA-21-3	1945?-Present	^{235}U, ^{238}U
21-019(b)	Exhaust stack at TA-21-4	1945?-Present	^{239}Pu
21-019(c)	Filter house TA-21-146 immediately north of TA-21-3	1960-Present	Unknown
21-019(d)	Exhaust stack at TA-21-150	1962-Present	^{239}Pu
21-019(e)	Exhaust stack at TA-21-155 (TSTA: formerly Building 55)	1949?-Present	Tritium
21-019(f)	Exhaust stack at TA-21-209	1965-Present	Tritium (gas)
21-019(g)	Exhaust stack at TA-21-257	1967-Present	^{239}Pu
21-019(h)	Exhaust stack at TA-21-313	1945-Present	^{239}Pu, ^{38}D
21-019(i)	Exhaust stack at TA-21-314	1945-Present	^{239}Pu
21-019(j)	Exhaust stack at TA-21-315	1945-Present	Pu

SWMU	Short Description	Period of Use	Available information on emissions that may be present in surface soil contamination.
21-019(k)	Exhaust stack at TA-21-322	1971-Present?	radionuclides
21-019(l)	Exhaust stack at TA-21-323	1971-Present?	radionuclides
21-019(m)	Filter house TA-21-324	1974-Present	^{239}Pu, ^{235}Pu, ^{238}Pu
21-020(a)	Filter house TA-21-12 for DP west rooms and processes; was immediately north of TA-21-4	1945-1972	radionuclides; 239/240Pu present at 30-cm depth when buidling was decommissioned in 1973
TA-020(b)	Filter house TA-21-153 for DP east operations; was immediately south of MDA U	1945-1970	radionuclides, ^{227}Ac present in building when it was decommissioned
21-021	Stack emissions throughout TA-21 to the airport (300,000 m^2 area)	1945?-Present	

[a]Although some stacks are still active, only the potential surface soil contamination resulting from past stack emissions is of concern herein. Present stack emissions are monitored as part of the Laboratory's routine environmental surveillance program.

and 1972 are estimated to be 0.5, 29.4 and 0.8 dpm/m^3 (Valentine 1990). This corresponds to a total release for these three years of 30.7 dpm/m^3, or 6.51 µCi of $^{239/240}$Pu (Valentine 1990).

SWMU 21-008, Incinerator

No data exist regarding contamination in the area of either the scrap incinerator previously located in TA-21-2 or the rag incinerator located in TA-21-3, Room 313.

SWMU 21-019, Filter Houses/Exhaust Stacks

Detailed information on each stack and radionuclide emissions from 1951 through 1989 are presented in Nyhan 1990, and summarized here in Tables 13.2-II and 13.2-III. The amount of radionuclides emitted with time fluctuated greatly. However, in 1988 and 1989, volumes and radionuclide concentrations were less than in previous years. Also, after Building 12 ceased operation in 1973, the total quantity of radionuclides discharged decreased dramatically.

The only available nonradionuclide emission quantity data are from a toxic air pollutant emissions survey conducted in 1987 and 1988 for each TA-21 building (see Nyhan 1990, Fig. 21-58). The survey found no values above limits in the Air Quality Control Regulation 752—Registration of Existing Toxic Air Pollution Sources. However, because this regulation does not address "typical" air pollutants, such as sulfur dioxide and lead, the survey did not analyze for these pollutants. Although these air pollutants may be present at TA-21, radionuclide emissions predominate.

SWMU 21-020, Decommissioned Filter Houses

SWMU 21-020(a): TA-21-12

Stack emission data for TA-21-12 are detailed in Nyhan 1990, Tables XIV and XV. These data show that TA-21-12 made a significant contribution to stack emissions of plutonium at TA-21. For example, for the years 1951, 1952, and 1953, Building 12 accounted for 32, 38, and 24% of the annual stack emissions for all of DP West of 2.04, 2.85, and 2.14 Ci of $^{239/240}$Pu, respectively (Nyhan 1990, Table XV). Although Building 12 continued in service until February 1973, the 1973 Laboratory records (Valentine 1974) show that its four stacks emitted a total of 1370.50 µCi $^{239/240}$Pu for that year (Nyhan 1990, Table XIV) — considerably less than in the 1940s and 1950s. In comparison, all of the other stacks at TA-21 emitted only 6.41 Ci $^{239/240}$Pu in 1973.

Upon the decommissioning of this building in 1973, the 8-in. concrete floor was removed, and the underlying soil was removed to an approximate depth of 30 cm. Core samples were taken and analyzed; the readings indicated 1.3 to 70 pCi/g of $^{239/240}$Pu. The area was backfilled with soil,

TABLE 13.2-II
TA-21 RADIOACTIVE AIRBORNE EFFLUENT RELEASE SUMMARIES, 1951–1971[a]

Year	Total Alpha Activity Discharged d/m/year X 10E10	Total for July d/m/8 hr X 10E10
1951	452 (8/8)[b]	
1952	632 (8/8)	
1953	474 (8/16)	0.4 (8/16)
1954	68 (4/4)	

Year	Total Pu Discharged $d/m/M^3$	Total Fission Products Discharged $d/m/M^3$	Total ^{235}U Discharged $d/m/M^3$
1963	938 (7/11)	22 (1/11)	790 (3/11)
1964	7084 (7/11)	435 (1/11)	6631 (3/11)
1965	2791 (7/11)	56 (1/11)	34526 (3/11)
1966	3425 (7/11)	5 (1/11)	27217 (3/11)
1967	4036 (6/11)	8 (1/11)	12013 (3/11)
1968	900 (6/11)		1142 (3/11)
1969	7768 (6/11)		
1970	210124 (13/15)	488473 (13/15)	385 (13/15)

Year	Total uCi Discharged
1971	2486 (8/8)

[a]CRM–12 Monthly Reports.
[b](6/11) = Measurements made on six of eleven stacks samples.

TABLE 13.2-III
TA-21 RADIOACTIVE AIRBORNE EFFLUENT RELEASE SUMMARIES, 1973-1989

Year	Gross Volume (m^3) Discharged	Total µCi of $^{239/240}Pu$ Discharged	Total µCi of ^{238}Pu, $^{239/240}Pu$ Discharged	Total µCi of ^{238}Pu Discharged	Total µCi of ^{235}U Discharged	Total µCi of MFP[a] Discharged	Total µCi of Tritium Discharged	Total µCi of Tritium gas Discharged	Total µCi of Tritium HTO[b] Discharged	Total µCi of ^{241}Am Discharged
1973	4.17 E+09 (24/24)[c]	1376.92 (12/24)	4.9 (4/24)	1.6 (1/24)	907.6 (7/24)	1 (1/24)	4.00 E+06 (1/24)			
1974	3.70 E+09 (20/20)	2.71 (8/20)	2.4 (4/20)	0.6 (1/20)	46.49 (7/20)	2.9 (1/20)	0.00 E+00 (1/20)			
1975	3.47 E+09 (21/21)	6.61 (8/21)	1.62 (4/21)	2.82 (1/21)	80.68 (7/21)	1.44 (1/21)	3.06 E+08 (2/21)			
1976	3.77 E+09 (21/21)	3.55 (8/21)	8.16 (4/21)	0.45 (1/21)	870.27 (7/21)	0.55 (1/21)	9.43 E+07 (2/21)			
1977	3.49 E+09 (21/21)	7.97 (8/21)	1.76 (4/21)	0.27 (1/21)	316.62 (7/21)	3.26 (1/21)	1.33 E+08 (2/21)			
1978	3.36 E+09 (19/19)	27.15 (8/19)	3.15 (4/19)	0.43 (1/19)	305.4 (3/19)	1.03 (1/19)	7.16 E+07 (2/19)			0.034 (1/19)
1979	3.21 E+09 (16/17)	2.57 (7/17)	3.66 (4/17)	0.23 (1/17)	654.73 (3/17)	0.47 (1/17)	9.49 E+07 (1/17)			0.019 (1/17)
1980	2.97 E+09 (17/17)	0.6 (7/17)	1.67 (5/17)		633.26 (3/17)	4.18 (1/17)	1.06 E+08 (1/17)			0.061 (1/17)
1981	3.33 E+09 (15/15)	7.28 (5/15)	5.82 (5/15)		1021.33 (3/15)	2.8 (1/15)	1.08 E+08 (1/15)			0.029 (1/15)
1982	2.83 E+09 (14/14)		15.84 (10/14)		1042.82 (3/14)	0.44 (1/14)		1.69 E+08 (1/14)		
1983	2.73 E+09 (14/14)		9.92 (10/14)		706.15 (3/14)	0.8 (1/14)		1.80 E+08 (1/14)		
1984	2.66 E+09 (14/14)		17.34 (9/14)		990.38 (3/14)	0.31 (1/14)		8.02 E+08 (2/14)		
1985	2.74 E+09 (14/14)		10.57 (9/14)		381.88 (3/14)	0.36 (1/14)		3.67 E+08 (2/14)		
1986	2.77 E+09 (13/13)		3.57 (9/13)		212.3 (2/13)	0.32 (1/13)		4.48 E+08 (2/13)	1.36 E+06 (1/13)	
1987	2.47 E+09 (13/13)		1.43 (9/13)		207.3 (2/13)	0.19 (1/13)		5.81 E+08 (2/13)	1.45 E+07 (1/13)	
1988	1.85 E+09 (12/12)		0.71 (8/12)		58.8 (2/12)	0.15 (1/12)		4.76 E+08 (2/12)	3.35 E+07 (1/12)	
1989	1.76 E+09 (12/12)		1.39 (8/12)		28.93 (2/12)	0.03 (1/12)		4.20 E+08 (2/12)	3.43 E+07 (1/12)	

[a]MFP is Mixed Fission Products
[b]HTO is Tritiated Water Vapor
[c](12/24) = measurements made on twelve of twenty-four stacks sampled.

a composite of which contained 1.3 +/- 0.1 pCi/g plutonium (Christensen et al. 1975). The area remains vacant with the exception of DP-402, an open shed along the northernmost line of the previous location of Building 12. The area is covered with dirt and has a small driveway across its breadth for access to DP-286.

SWMU 21-020(b): TA-21-153

Stack emission data for TA-21-153 are detailed in Nyhan 1990, Tables XIV and XV. Upon decommissioning in 1978, soil under and around this facility was removed until the entire area was measured to less than 30 pCi gross alpha/g soil (the detection limit of the Laboratory's ZnS system), according to the final Laboratory report (Harper and Garde 1981).

SWMU 21-021, Stack Emissions

Table 13.2-IV presents the range and average concentrations of ^{238}Pu, $^{239/240}Pu$, ^{90}Sr, and $^{239/240}Pu/^{90}Sr$ activity ratio in referenced soils that could be attributed to worldwide fallout in the area.

Surface soil samples were collected from 12 locations across TA-21 in 1970 as shown in Fig. 13.2-2 (Kennedy and Purtymun 1971). The samples were taken from flat, undisturbed areas to avoid concentration or dilution of contaminants by wash from any storm run-off or contribution by spills from past Laboratory activities. The samples were collected from a 4- by 4-in. area to a depth of 2 in. The analytical results for ^{238}Pu indicated that samples from locations 3, 4, 5, 8, and 11 contained concentrations of ^{238}Pu in excess of that expected from worldwide fallout. The locations of these sampling stations indicate that the source of the ^{238}Pu may be from stack emissions at TA-21.

The analytical results for $^{239/240}Pu$ indicated that samples from locations 1, 2, 3, 5, 8, 9, 12, and perhaps 7, contained concentrations of $^{239/240}Pu$ in excess of that expected from worldwide fallout. The location of the sampling stations in relation to the concentrations indicates that stack emissions may be the source of the $^{239/240}Pu$. The concentrations decrease with increased distance from the stacks.

Initially, the ^{90}Sr analyses were performed to distinguish worldwide fallout from local material by activity ratio $^{239/240}Pu/^{90}Sr$. The ratio method proved invalid for this area because of traces of ^{90}Sr added to the soils by activities in the area many years ago. Short-lived gamma-emitting isotopes were used as tracers in atmospheric release experiments performed before 1962.

TABLE 13.2-IV
WORLDWIDE FALLOUT DATA[a]

Isotope or Activity Ratio	Number of Samples	Concentrations dpm/g Range	Aver-age
^{238}Pu	19	0.001-0.008	0.0_{03}
^{239}Pu	20	0.001-0.051	0.021
^{90}Sr	18	0.152-1.921	0.711
$^{239}Pu/^{90}Sr$	18	0.003-0.138	0.038

[a](Kennedy and Purtymun 1971)

TABLE 13.2-V
PROBABILITY OF NOT FINDING AN EXISTING CONTAMINATED AREA (b)
AS THE GRID SIZE INCREASES.

Grid Size (m)	b (%)
44	0
49	5
52	10
55	20
59	25

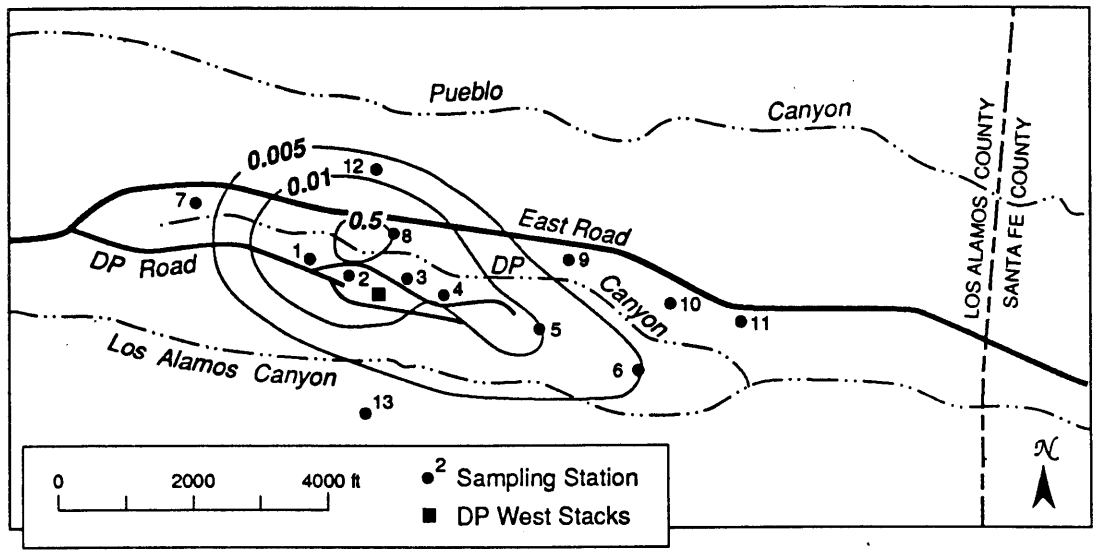


Fig. 13.2-2 Isoplutonium plutonium-239/240 contours around DP West stacks, contour values in $\mu Ci/m^2$.

These were separated from mixed fission products and contained a trace of ^{90}Sr that was carried over into the experiment. This same ^{90}Sr was also released to the atmosphere along with the gamma tracer. Any ^{90}Sr found locally is under suspicion of originating from sources other than worldwide fallout. Samples from locations 4 and 5 contain concentrations of ^{90}Sr that cannot be attributed to worldwide fallout or stack emissions from TA-50.

The $^{239/240}Pu/^{90}Sr$ activity ratios in samples from locations 6, 7, 9, 10, and 11 are generally equivalent to ratios found by other laboratories in worldwide fallout. The activity ratios in samples from locations 1, 2, 3, 8, and 12 reflect the $^{239/240}Pu$ emissions from stacks at TA-21. The ratio from the samples from locations 4 and 5 are anomalous because of excessive ^{90}Sr.

An estimate of the $^{239/240}Pu$ deposition in soils was made by using average concentrations in $\mu Ci/m^2$ of the two sets of samples collected at each location during 1970. Iso-plutonium contours were constructed at 0.005, 0.01, and 0.05 $\mu Ci/m^2$ (Fig. 13.2-2). The estimated deposition of $^{239/240}Pu$ within the 0.005 $\mu Ci/m^2$ contour was 0.026 Ci or about 0.42 g.

13.2.1.3. Source Term

Stack emissions. The source terms from all SWMUs in this chapter are addressed together because surface contamination cannot be traced back to a specific stack. Available data suggest a minimum of approximately 2 Ci $^{239/240}Pu$ per year exited all TA-21 stacks in the 1950s. High values occurred in 1973 when TA-21-12 emitted 1370 μCi $^{239/240}Pu$ itself. However, in 1989,

TA-21 stacks emitted 1.39 Ci $^{239/240}Pu$. Additionally, ^{235}U and tritium vapor and gas have been released from TA-21 stacks (Nyhan 1990). No data are available on nonradionuclide air emissions. However, given knowledge of processes conducted at TA-21, radionuclide emissions are of greater concern.

Previous sampling has shown that $^{239/240}Pu$ concentration in the top 2 in. of soil is elevated above worldwide fallout levels (Kennedy and Purtymun 1971) well beyond TA-21 (see Fig. 13.2-2). Their data suggest decreasing concentrations with increasing distance from TA-21 stacks. However, their sampling was solely north of TA-21. Whether similar conditions exist in all directions from TA-21 stacks is unknown.

Filter buildings. Subsurface soil contamination was documented when both filter buildings, TA-21-12 and TA-21-153, were removed in 1973 and 1978, respectively. Plutonium-239/240 contamination at TA-21-12 was present in concentrations as high as 70 pCi/g to a depth of 30 cm (12 in.); gross alpha contamination at TA-21-153 was less than 30 pCi gross alpha/gm soil, the as-low-as-practicable level (Harper and Garde 1981). The extent of contamination at either filter building is unknown.

13.2.2 Objectives and Data Needs

Stack emissions. The purpose of this investigation is to document the presence of areas of elevated radionuclide deposition in surface soil at the TA-21 OU resulting from airborne emissions. The preferred remedial alternative is to use data collected in this investigation to document (with sampling results and, as needed, a risk assessment) that surface soils at the TA-21 OU do not present a significant risk to human health or the environment. The specific data required to attain this objective are as follows:

1. Identify the presence of surface soil contamination from radionuclide airborne emissions within the TA-21 operable unit, bounded by DP and Los Alamos canyons.

2. If contamination is identified, determine the concentration of indicator contaminant species in soils through evaluation of sample analysis results.

3. If contaminants are identified, determine vertical and lateral extent of contaminant migration by first evaluating data in conjunction with surface soil sampling conducted at the same sampling points in Chapter 12. If needed, conduct additional surface and subsurface soil sampling and analysis.

4. If contaminants are identified, define the presence of any potential surface soil contaminant plumes from stack emissions.

5. If contaminant migration is identified, determine primary migration pathways

through evaluation of sample analysis results.

Filter buildings. The objective of this investigation is to define the extent of remaining contamination at the location of the former filter buildings. Specific data required to assess contamination at SWMU 21-020 include the following:

1. Determine the location of the former filter buildings by examining old drawings to determine survey location.

2. Identify the presence of contaminants in surface and subsurface samples using Level II/III data. It is known that the former location of Building TA-21-12 was backfilled to cover known contamination present at a depth of 30 cm.

3. Determine the lateral and vertical extent of contaminant migration by subsurface soil sampling using Level II/III field laboratory analyses initially, followed by Level III/IV analytical laboratory data on a subset of the samples.

13.2.3 Sampling/Investigation Rationale

Stack emissions. The objective of this soil sampling plan is to determine if there are localized areas of contamination resulting from stack emissions. Because historical data show that only radionuclide emissions have occurred, analysis will focus on these analytes.

Because little information exists regarding the presence of stack plumes or contamination resulting from emissions anywhere in the TA-21 OU, the preliminary investigation will look for broad areas of elevated radionuclide deposition, assuming no prior information. The only assumption will be that those areas are larger than 3,000 m^2. These area estimates are from the Waste Information Network (WIN) data base.

A two-phase sequential surface sampling plan will be employed. The objective of the initial investigation of surface sampling is to locate localized contaminated areas greater than 3,000 m^2. The subsequent surface sampling will focus on characterizing the extent of any contaminated areas found in the initial investigation. For the method of deposition-layer surface soil sampling to be performed during the initial and subsequent investigation, see Sec. 11.5.2.4.

A full suite of radionuclides will be measured in the analytical laboratory for each sample.

There are three implicit assumptions in the sampling rationale. The first assumption is that current TA-21 stack emissions are monitored and are not contributing significantly to surface contamination. The second is that the other 23 OUs at the Laboratory are not sources for contamination found at the TA-21 OU. The third assumption is that other SWMUs at TA-21 are not sources of contamination that will interfere with the goals of this investigation. While the first two

assumptions are likely to be valid, the third assumption may not be valid. This assumption may require evaluation through comparisons to SWMU-specific results (Chapter 14–18) and to the OU-wide surface soil sampling results (Chapter 12).

Filter buildings. The initial investigation consists of near-surface and shallow borehole soil sampling to determine the levels of radionuclides at the former filter building locations. These samples will be analyzed in the field laboratory for radionuclides, and a percentage will be submitted to an analytical laboratory for confirmatory analyses. In addition, a percentage of the samples submitted for analytical laboratory analysis will be subjected to a full analytical suite to assess presence of other contaminants.

At TA-21-12, $^{239/240}Pu$ is the major contaminant expected. At TA-21-153, ^{227}Ac is the major contaminant. Sample analyses for ^{227}Ac will be based on gamma spectrometry for its decay progeny.

An initial investigation is expected to be sufficient at both filter buildings. Any subsequent investigation would include additional near-surface, shallow borehole, and borehole sampling to further define the lateral and vertical extent of contamination.

13.2.4 Sampling Plan

13.2.4.1 Initial Investigation

Stack emissions. The objective of the initial investigation is to identify, with high confidence, local areas of contamination greater than 3,000 m^2. These potential large areas of contamination are from incinerator and other stack emissions. The sampling technique to be used (Gilbert 1982) assumes that the contaminated areas are described by an ellipse whose semimajor axis (L) is twice the semiminor axis, which gives a "skinny" ellipse. This approach is conservative compared with the assumption of a circular distribution of contaminants (Gilbert 1982). For an area of 3,000 m^2, this assumption gives L = 44 m. For this case, assuming the worst orientation of the ellipse with respect to the grid, a square grid of 40 by 40m gives a zero probability of missing the contaminated area. Gilbert (1982) derived the probability of missing the target as a function of the grid and ellipse size, averaging over all orientations of the ellipse. Some of those results are given in Table 13.2-V. Note that averaging over all orientations gives a somewhat larger grid size compared to the worst case assumption.

Possible sample locations are displayed in Fig. 13.2-3 (for method see Sec. 11.5.2.4). The

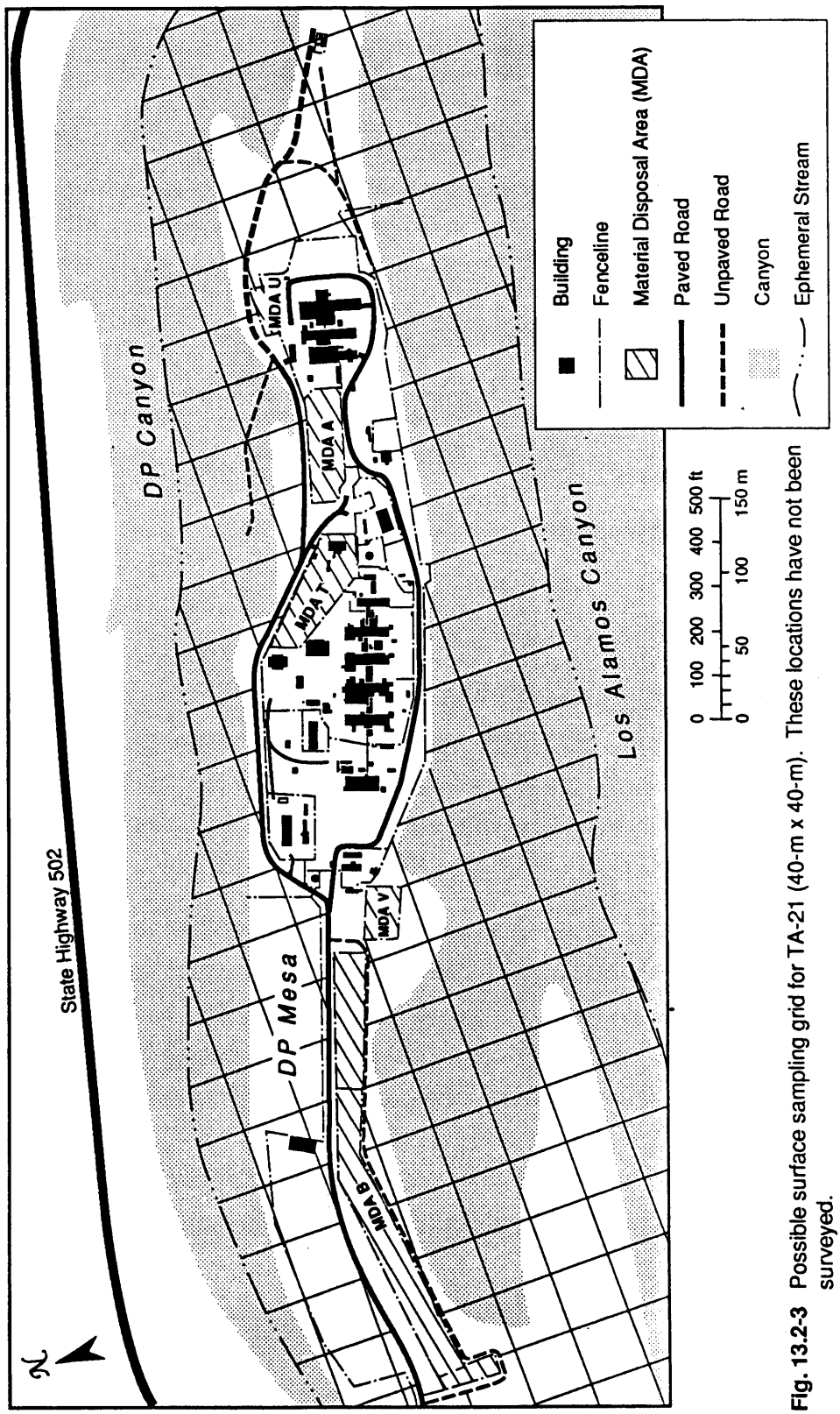


Fig. 13.2-3 Possible surface sampling grid for TA-21 (40-m x 40-m). These locations have not been surveyed.

number of sample points required is approximately 180. This approach makes no assumptions about the plume dispersion patterns from the emissions. Actual grid locations will be defined by choosing a random starting point and then surveying in all grid points prior to sampling (for method see Sec. 11.3.3).

The grid technique is not appropriate for the areas with buildings. For these areas, sample points are the centers of overlapping circles with radii of 20 m (the semiminor axis). Thirty proposed sampling locations are shown in Fig. 13.2-4 (for method see Sec. 11.5.2.4). This technique guarantees that areas of contamination under the previously described assumptions will not be missed.

TA-21 will be stratified into four areas that include

- DP Canyon side
- Los Alamos Canyon side
- Mesa top — building area
- Mesa top — no buildings

These areas were chosen because, in combination with the MDAs, they represent the diversity of conditions at TA-21. Twenty additional samples will be taken at a distance of 10 m from the 20 grid sampling locations, five in each area selected for stratification. This additional sampling will enable estimation of local variability for spatial prediction surfaces such as kriged surfaces. The stratification makes it possible to determine if the local variability differs between areas.

All samples obtained from the initial investigation will be deposition-layer soil samples, as defined in Sec. 11.5.2.4. They will be submitted for analytical laboratory analysis and will be analyzed for gamma spectometry, tritium, total uranium, isotopic plutonium, ^{90}Sr, and metals. Although no existing data show metals associated with stack emissions, metals are commonly associated with the radionuclides in the processes that produced these stack emissions. No VOAs are planned for these samples because they are surface samples. Table 13.2-VI identifies the screening and analysis requirements for the samples to be collected during the initial investigation.

Filter buildings. Initial investigations at the previous locations of both filter buildings will consist of near-surface soil samples and shallow boreholes.

TA-21-12. The initial investigation around the former location of TA-21-12 will include near-surface soil samples at 16 locations where samples will be taken at 6-in. intervals from 12 to 30

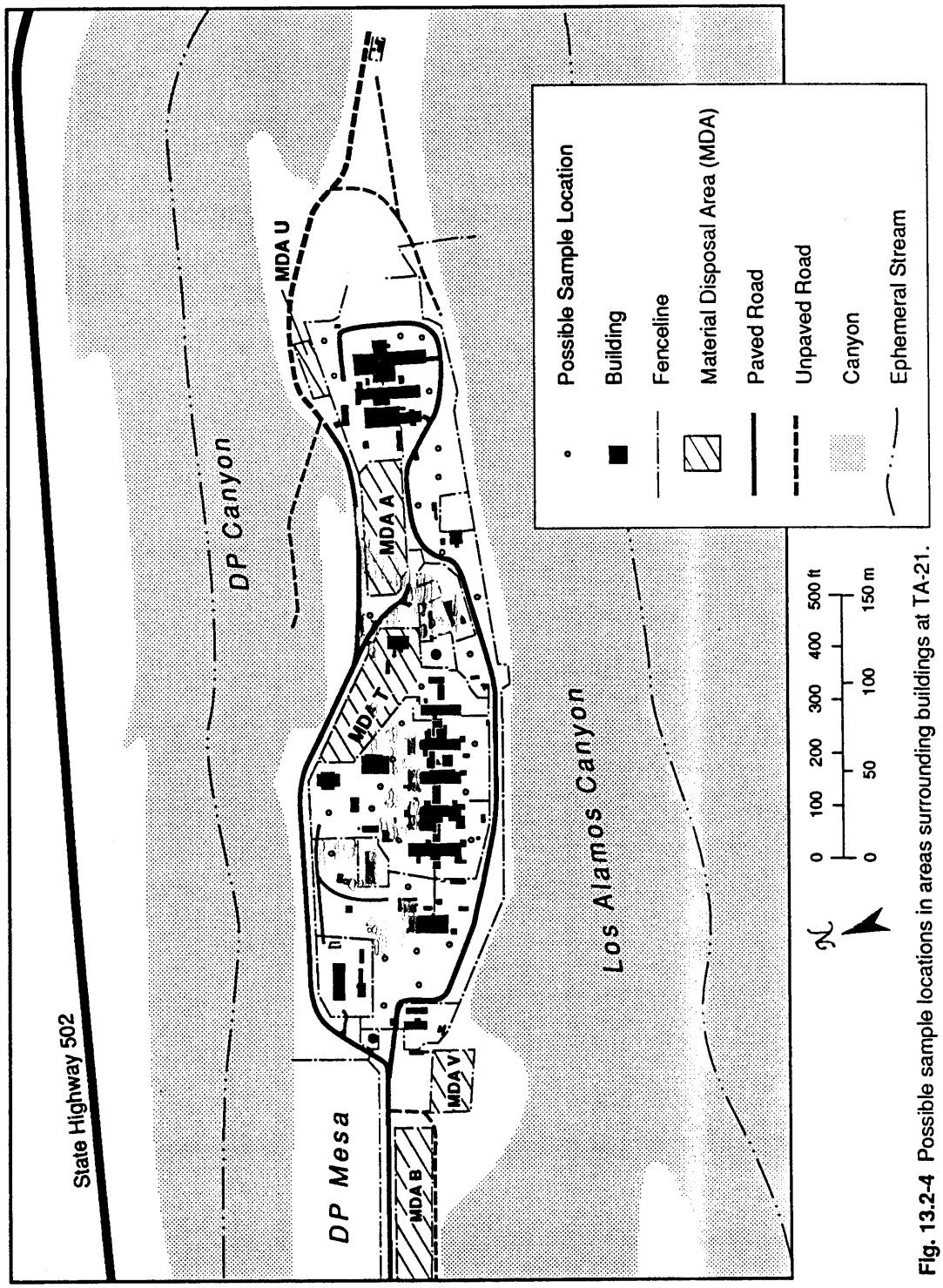


Fig. 13.2-4 Possible sample locations in areas surrounding buildings at TA-21.

Table 13.2-VI

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS FOR AIRBORNE DEPOSITION.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals		
Airborne Deposition Sampling																																	
Surface Soil Sample	1	0.0 - 1.0 in																															
	2	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X	X	X	X			
	3	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X	X	X	X			
	4	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X	X	X	X			
	5	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X	X	X	X			
Field Duplicate																																	
	6	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X	X	X	X			
	7	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X	X	X	X			
	8	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X	X	X	X			
	9	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X	X	X	X			
	10	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X	X	X	X			
Rinsate Blank																																	
Field Blank																																	
	11	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X	X	X	X			
	12	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X	X	X	X			
	13	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X	X	X	X			
	14	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X	X	X	X			
	15	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X	X	X	X			
	16	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X	X	X	X			
	17	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X	X	X	X			
	18	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X	X	X	X			
	19	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X	X	X	X			
	20	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X	X	X	X			
	21	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X	X	X	X			

Table 13.2-VI

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS FOR AIRBORNE DEPOSITION.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis													
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals				
	22	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	23	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	24	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	25	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
Field Duplicate																						X	X	X	X		X			X				
	26	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	27	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	28	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	29	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	30	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
Rinsate Blank																						X	X	X	X		X			X				
Field Blank																														X				
	31	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	32	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	33	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	34	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	35	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	36	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	37	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	38	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	39	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	40	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	41	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	42	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	43	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	44	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				

Table 13.2-VI

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS FOR AIRBORNE DEPOSITION.

	Sample Identification	Interval	Sampling Location	Sample Type
Field Surveys				
Gross Gamma				
Low-Energy Gamma				
Electromagnetic				
Land Survey				
Field Screening				
Gross Gamma		0.0 - 1.0 in	45	Field Duplicate
Gross Alpha		0.0 - 1.0 in	46	
		0.0 - 1.0 in	47	
Organic Vapor		0.0 - 1.0 in	48	Rinsate Blank
Combustible Gas/Oxygen				Field Blank
Lithological Logging		0.0 - 1.0 in	49	
Field Laboratory Measurements		0.0 - 1.0 in	50	
Gross Alpha		0.0 - 1.0 in	51	
Gamma Spectrometry		0.0 - 1.0 in	52	
Tritium		0.0 - 1.0 in	53	
Volatile Organics		0.0 - 1.0 in	54	
PCB		0.0 - 1.0 in	55	
Soil Moisture		0.0 - 1.0 in	56	
		0.0 - 1.0 in	57	
		0.0 - 1.0 in	58	
Laboratory Analysis		0.0 - 1.0 in	59	
Gamma Spectrometry		0.0 - 1.0 in	60	
Tritium		0.0 - 1.0 in	61	
Total Uranium		0.0 - 1.0 in	62	
Isotopic Plutonium		0.0 - 1.0 in	63	
Isotopic Uranium		0.0 - 1.0 in	64	Field Duplicate
Strontium 90		0.0 - 1.0 in	65	
VOA (SW 8240)		0.0 - 1.0 in	66	
Semivolatiles (SW 8270)				
Metals (SW 6010)				
PCB (SW 8080)				
TCLP Metals				

Table 13.2-VI

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS FOR AIRBORNE DEPOSITION.

				Field Surveys				Field Screening					Field Laboratory Measurements								Laboratory Analysis												
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
	67	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	68	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	69	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	70	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	71	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	72	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
Rinsate Blank																						X	X	X	X		X			X				
Field Blank																														X				
	73	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	74	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	75	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	76	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	77	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	78	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	79	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	80	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
Field Duplicate																						X	X	X	X		X			X				
	81	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	82	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	83	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	84	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
Rinsate Blank																						X	X	X	X		X			X				
Field Blank																														X				
	85	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	86	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	87	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				

Table 13.2-VI

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS FOR AIRBORNE DEPOSITION.

Sample Identification	Sampling Location	Interval	Sample Type	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
	88	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	89	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	90	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	91	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	92	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	93	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	94	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	95	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
Field Duplicate	96	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	97	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	98	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	99	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	100	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	101	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	102	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	103	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
Rinsate Blank	104	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
Field Blank	105	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	106	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	107	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	108	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	109	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	110	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			

Table 13.2-VI

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS FOR AIRBORNE DEPOSITION.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis													
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals				
	111	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	112	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	113	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
Field Duplicate																						X	X	X	X		X			X				
	114	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	115	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	116	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	117	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	118	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	119	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	120	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	121	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	122	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	123	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	124	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	125	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
Rinsate Blank																						X	X	X	X		X			X				
Field Blank																														X				
	126	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	127	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	128	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	129	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	130	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	131	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	132	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				
	133	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X				

Table 13.2-VI

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS FOR AIRBORNE DEPOSITION.

Sample Identification	Sampling Location	Interval	Sample Type	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
	134	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	135	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	136	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	137	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	138	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	139	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	140	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	141	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	142	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	143	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	144	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
Rinsate Blank																																	
Field Blank																																	
	145	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	146	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	147	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	148	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	149	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	150	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	151	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	152	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	153	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
	154	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			
Field Duplicate																																	
	155	0.0 - 1.0 in						X	X		X											X	X	X	X	X	X			X			

Table 13.2-VI

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS FOR AIRBORNE DEPOSITION.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha	Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals
	156	0.0 – 1.0 in						X	X	X				X	X	X	X	X	X	X	X	X	X	X		X		
	157	0.0 – 1.0 in						X	X	X				X	X	X	X	X	X	X	X	X	X	X		X		
	158	0.0 – 1.0 in						X	X	X				X	X	X	X	X	X	X	X	X	X	X		X		
	159	0.0 – 1.0 in						X	X	X				X	X	X	X	X	X	X	X	X	X	X		X		
	160	0.0 – 1.0 in						X	X	X				X	X	X	X	X	X	X	X	X	X	X		X		
	161	0.0 – 1.0 in						X	X	X				X	X	X	X	X	X	X	X	X	X	X		X		
	162	0.0 – 1.0 in						X	X	X				X	X	X	X	X	X	X	X	X	X	X		X		
	163	0.0 – 1.0 in						X	X	X				X	X	X	X	X	X	X	X	X	X	X		X		
	164	0.0 – 1.0 in						X	X	X				X	X	X	X	X	X	X	X	X	X	X		X		
Rinsate Blank																												
Field Blank																												
	165	0.0 – 1.0 in						X	X	X				X	X	X	X	X	X	X	X	X	X	X		X		
	166	0.0 – 1.0 in						X	X	X				X	X	X	X	X	X	X	X	X	X	X		X		
	167	0.0 – 1.0 in						X	X	X				X	X	X	X	X	X	X	X	X	X	X		X		
	168	0.0 – 1.0 in						X	X	X				X	X	X	X	X	X	X	X	X	X	X		X		
	169	0.0 – 1.0 in						X	X	X				X	X	X	X	X	X	X	X	X	X	X		X		
	170	0.0 – 1.0 in						X	X	X				X	X	X	X	X	X	X	X	X	X	X		X		
	171	0.0 – 1.0 in						X	X	X				X	X	X	X	X	X	X	X	X	X	X		X		
	172	0.0 – 1.0 in						X	X	X				X	X	X	X	X	X	X	X	X	X	X		X		
	173	0.0 – 1.0 in						X	X	X				X	X	X	X	X	X	X	X	X	X	X		X		
	174	0.0 – 1.0 in						X	X	X				X	X	X	X	X	X	X	X	X	X	X		X		
Field Duplicate																												
	175	0.0 – 1.0 in						X	X	X				X	X	X	X	X	X	X	X	X	X	X		X		
	176	0.0 – 1.0 in						X	X	X				X	X	X	X	X	X	X	X	X	X	X		X		
	177	0.0 – 1.0 in						X	X	X				X	X	X	X	X	X	X	X	X	X	X		X		
	178	0.0 – 1.0 in						X	X	X				X	X	X	X	X	X	X	X	X	X	X		X		

Table 13.2-VI

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS FOR AIRBORNE DEPOSITION.

Sample Identification	Sampling Location	Interval	Sample Type	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
	179	0.0 - 1.0 in																															
	180	0.0 - 1.0 in																															
	181	0.0 - 1.0 in																															
	182	0.0 - 1.0 in																															
	183	0.0 - 1.0 in																															
	184	0.0 - 1.0 in																															
Rinsate Blank																																	
Field Blank																																	
	185	0.0 - 1.0 in																															
	186	0.0 - 1.0 in																															
	187	0.0 - 1.0 in																															
	188	0.0 - 1.0 in																															
	189	0.0 - 1.0 in																															
	190	0.0 - 1.0 in																															
	191	0.0 - 1.0 in																															
	192	0.0 - 1.0 in																															
	193	0.0 - 1.0 in																															
	194	0.0 - 1.0 in																															
	195	0.0 - 1.0 in																															
Field Duplicate																																	
	196	0.0 - 1.0 in																															
	197	0.0 - 1.0 in																															
	198	0.0 - 1.0 in																															
	199	0.0 - 1.0 in																															
	200	0.0 - 1.0 in																															
	201	0.0 - 1.0 in																															

Table 13.2-VI

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS FOR AIRBORNE DEPOSITION.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electr magnetic	Field Surveys: Land survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha		Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals		
	202	0.0 – 1.0 in		X				X	X		X				X	X	X	X												X			
	203	0.0 – 1.0 in		X				X	X		X				X	X	X	X												X			
	204	0.0 – 1.0 in		X				X	X		X				X	X	X	X												X			
Rinsate Blank																																		
Field Blank																																		
	205	0.0 – 1.0 in		X				X	X		X				X	X	X	X												X			
	206	0.0 – 1.0 in		X				X	X		X				X	X	X	X												X			
	207	0.0 – 1.0 in		X				X	X		X				X	X	X	X												X			
	208	0.0 – 1.0 in		X				X	X		X				X	X	X	X												X			
	209	0.0 – 1.0 in		X				X	X		X				X	X	X	X												X			
	210	0.0 – 1.0 in		X				X	X		X				X	X	X	X												X			
	211	0.0 – 1.0 in		X				X	X		X				X	X	X	X												X			
	212	0.0 – 1.0 in		X				X	X		X				X	X	X	X												X			
	213	0.0 – 1.0 in		X				X	X		X				X	X	X	X												X			
	214	0.0 – 1.0 in		X				X	X		X				X	X	X	X												X			
Field Duplicate																																		
	215	0.0 – 1.0 in		X				X	X		X				X	X	X	X												X			
	216	0.0 – 1.0 in		X				X	X		X				X	X	X	X												X			
	217	0.0 – 1.0 in		X				X	X		X				X	X	X	X												X			
	218	0.0 – 1.0 in		X				X	X		X				X	X	X	X												X			
	219	0.0 – 1.0 in		X				X	X		X				X	X	X	X												X			
	220	0.0 – 1.0 in		X				X	X		X				X	X	X	X												X			
	221	0.0 – 1.0 in		X				X	X		X				X	X	X	X												X			
	222	0.0 – 1.0 in		X				X	X		X				X	X	X	X												X			
	223	0.0 – 1.0 in		X				X	X		X				X	X	X	X												X			
	224	0.0 – 1.0 in		X				X	X		X				X	X	X	X												X			

Table 13.2-VI

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS FOR AIRBORNE DEPOSITION.

	Sample Type	Sampling Location	Interval	Sample Identification
Field Surveys	Gross Gamma			
	Low-Energy Gamma			
	Electromagnetic			
	Land Survey			
Field Screening	Gross Gamma	225	0.0 - 1.0 in	
	Gross Alpha	226	0.0 - 1.0 in	
		227	0.0 - 1.0 in	
	Organic Vapor	228	0.0 - 1.0 in	
	Combustible Gas/Oxygen	229	0.0 - 1.0 in	
	Lithological Logging	230	0.0 - 1.0 in	
Field Laboratory Measurements	Gross Alpha			
	Gamma Spectrometry			
	Tritium			
	Volatile Organics			
	PCB			
	Soil Moisture			
Laboratory Analysis	Gamma Spectrometry	X	0.0 - 1.0 in	
	Tritium	X	0.0 - 1.0 in	
	Total Uranium	X	0.0 - 1.0 in	
	Isotopic Plutonium	X	0.0 - 1.0 in	
	Isotopic Uranium			
	Strontium 90	X	0.0 - 1.0 in	
	VOA (SW 8240)			
	Semivolatiles (SW 8270)			
	Metals (SW 6010)	X	0.0 - 1.0 in	
	PCB (SW 8080)			
	TCLP Metals			
	Rinsate Blank			
	Field Blank			
	Field Duplicate			

in. (for method see Sec. 11.5.2.2). Samples will be taken from inside and outside of the previous building location (see Fig. 13.2-5). All samples deeper than 12 in. (48 samples) will be analyzed in the field laboratory. Thirty percent of these samples will be analyzed in the analytical laboratory for the full analytical suite. Because this investigation presupposes that this area is contaminated, the purposes of sending samples to the analytical laboratory is twofold: (1) to define the source term and (2) to define the edges of the contaminant plume. Therefore, samples sent to the analytical laboratory for confirmatory analysis will include "hot" samples to define the source term and samples from the edges of the plume to confirm absence of contamination.

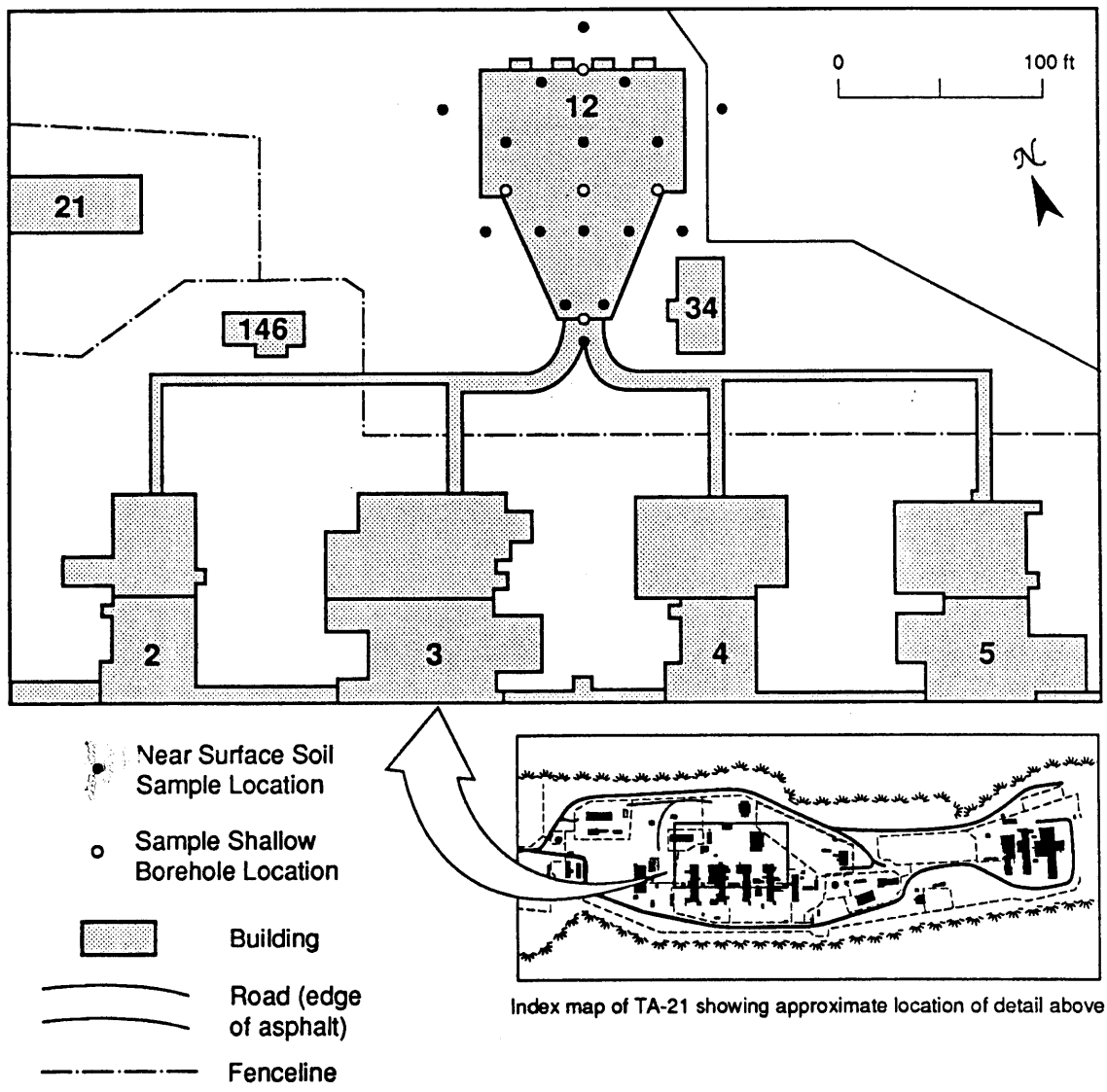


Fig. 13.2-5 Location of former filter building TA-21-12 showing initial investigation sample locations. (LASL 1964a; Christensen et al. 1975)

Field laboratory results from near-surface soil samples will assist in placement of five shallow boreholes at locations where contamination is greatest at the 24- to 30-cm depth. If the area is uniformly contaminated, these boreholes will be placed in the center and at the perimeter of the former building location as shown in Fig.13.2-5.

For planning purposes, it is assumed five shallow boreholes to a nominal depth of 7.5 ft will be drilled. Samples for analysis will only be taken beyond the 2.5-ft depth. The criteria defined above will be used to determine which samples will be sent to the analytical laboratory. All samples will be sent to the field laboratory, and 5 of the 10 samples will be sent to the analytical laboratory.

The screening and sample analysis requirements for the initial investigation are shown in Table 13.2-VII.

TA-21-153. Initial investigation around the former location of TA-21-153 will consist of near-surface soil samples at 10 locations where samples will be taken at 6-in. depth intervals from 6 to 30 in. (Fig. 13.2-6). The initial 6-in. layer will not be sampled because the site has been contoured and revegetated. If this interval field screens "hot," samples will be taken for field laboratory analysis. All 40 samples will be analyzed in the field laboratory. Using the rationale described for TA-21-12, 30% of the samples will be sent to an analytical laboratory for confirmatory analyses. The screening and sample analyses requirements for the initial investigation are shown in Table 13.2-VII.

13.2.4.2. Subsequent Investigations

Stack emissions. A subsequent investigation will be used to characterize the extent of contamination if contamination is found in the initial investigation (for method see Sec. 11.5.2.4). Initial sampling results will be used to determine the appropriate area to be sampled and the necessary grid size. Replicate data from the initial investigation will give information about the spatial correlation structure and determine if kriging techniques can be employed to predict contamination levels at locations not sampled. Sampling under the subsequent investigation will involve refined grid or depth sampling as needed, depending upon initial sampling results.

Any plume dispersion patterns from emissions found from initial sampling results will be modeled (if appropriate), and that information will be taken into account when planning subsequent sampling.

Table 13.2-VII

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-020(A) AND (B), FILTER BUILDINGS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	
TA-21-12																																	
Near Surface Soil (bias)	1	0.0 – 6.0 in						X	X	X	X			X	X	X	X					E	E	E		E	E	E	E			
		6.0 – 12.0 in						X	X	X	X			X	X	X	X					E	E	E		E	E	E	E			
		12.0 – 18.0 in						X	X	X	X			X	X	X	X					E	E	E		E	E	E	E			
		18.0 – 24.0 in						X	X	X	X			X	X	X	X					E	E	E		E	E	E	E			
		24.0 – 30.0 in						X	X	X	X			X	X	X	X					E	E	E		E	E	E	E			
	2	0.0 – 6.0 in						X	X	X	X			X	X	X	X					E	E	E		E	E	E	E			
		6.0 – 12.0 in						X	X	X	X			X	X	X	X					E	E	E		E	E	E	E			
		12.0 – 18.0 in						X	X	X	X			X	X	X	X					E	E	E		E	E	E	E			
		18.0 – 24.0 in						X	X	X	X			X	X	X	X					E	E	E		E	E	E	E			
Rinsate Blank																																	
Field Blank																																	
	3	24.0 – 30.0 in						X	X	X	X			X	X	X	X												X				
		0.0 – 6.0 in						X	X	X	X			X	X	X	X												X				
		6.0 – 12.0 in						X	X	X	X			X	X	X	X												X				
		12.0 – 18.0 in						X	X	X	X			X	X	X	X												X				
		18.0 – 24.0 in						X	X	X	X			X	X	X	X												X				
		24.0 – 30.0 in						X	X	X	X			X	X	X	X												X				
Trip Blank																																	
	4	0.0 – 6.0 in						X	X	X	X			X	X	X	X												X				
		6.0 – 12.0 in						X	X	X	X			X	X	X	X												X				
		12.0 – 18.0 in						X	X	X	X			X	X	X	X												X				
		18.0 – 24.0 in						X	X	X	X			X	X	X	X												X				
		24.0 – 30.0 in						X	X	X	X			X	X	X	X												X				
	5	0.0 – 6.0 in						X	X	X	X			X	X	X	X												X				

Table 13.2-VII

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-020(A) AND (B), FILTER BUILDINGS.

Sample Identification	Sample Type	Sampling Location	Interval	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
			6.0 – 12.0 in					X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
			12.0 – 18.0 in					X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
			18.0 – 24.0 in					X	X		X			X	X	X	X																
			24.0 – 30.0 in					X	X		X			X	X	X	X																
		6	0.0 – 6.0 in					X	X		X			X	X	X	X																
			6.0 – 12.0 in					X	X		X			X	X	X	X																
			12.0 – 18.0 in					X	X		X			X	X	X	X																
			18.0 – 24.0 in					X	X		X			X	X	X	X																
			24.0 – 30.0 in					X	X		X			X	X	X	X					X	E	E	E		E	E	E	E			
		7	0.0 – 6.0 in					X	X		X			X	X	X	X																
			6.0 – 12.0 in					X	X		X			X	X	X	X																
			12.0 – 18.0 in					X	X		X			X	X	X	X																
			18.0 – 24.0 in					X	X		X			X	X	X	X																
			24.0 – 30.0 in					X	X		X			X	X	X	X																
		8	0.0 – 6.0 in					X	X		X			X	X	X	X																
			6.0 – 12.0 in					X	X		X			X	X	X	X																
			12.0 – 18.0 in					X	X		X			X	X	X	X																
			18.0 – 24.0 in					X	X		X			X	X	X	X																
			24.0 – 30.0 in					X	X		X			X	X	X	X																
		9	0.0 – 6.0 in					X	X		X			X	X	X	X																
			6.0 – 12.0 in					X	X		X			X	X	X	X																
			12.0 – 18.0 in					X	X		X			X	X	X	X																
			18.0 – 24.0 in					X	X		X			X	X	X	X																
	Rinsate Blank																																
	Field Blank																																
	Trip Blank																																

Table 13.2-VII

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-020(A) AND (B), FILTER BUILDINGS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha	Organic Vap	Combustible %/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals
Trip Blank		24.0 – 30.0 in						X	X	X			X	X	X	X			E	E	E	E				X		
	10	0.0 – 6.0 in						X	X	X			X	X	X	X			E	E	E	E				X		
		6.0 – 12.0 in						X	X	X			X	X	X	X			E	E	E	E				X		
		12.0 – 18.0 in						X	X	X			X	X	X	X			E	E	E	E				X		
		18.0 – 24.0 in						X	X	X			X	X	X	X			E	E	E	E				X		
Rinsate Blank																			X	X	X	X	X	X	X	X	X	X
Field Blank																			X	X	X	X	X	X	X	X	X	X
		24.0 – 30.0 in						X	X	X			X	X	X	X			E	E	E	E				X		
	11	0.0 – 6.0 in						X	X	X			X	X	X	X			E	E	E	E				X		
		6.0 – 12.0 in						X	X	X			X	X	X	X			E	E	E	E				X		
		12.0 – 18.0 in						X	X	X			X	X	X	X			E	E	E	E				X		
		18.0 – 24.0 in						X	X	X			X	X	X	X			E	E	E	E				X		
		24.0 – 30.0 in						X	X	X			X	X	X	X			E	E	E	E				X		
	12	0.0 – 6.0 in						X	X	X			X	X	X	X			E	E	E	E				X		
		6.0 – 12.0 in						X	X	X			X	X	X	X			E	E	E	E				X		
		12.0 – 18.0 in						X	X	X			X	X	X	X			E	E	E	E				X		
		18.0 – 24.0 in						X	X	X			X	X	X	X			E	E	E	E				X		
Field Duplicate		24.0 – 30.0 in						X	X	X			X	X	X	X			E	E	E	E				X		
Trip Blank																										X		
	13	0.0 – 6.0 in						X	X	X			X	X	X	X			E	E	E	E				X		
		6.0 – 12.0 in						X	X	X			X	X	X	X			E	E	E	E				X		
		12.0 – 18.0 in						X	X	X			X	X	X	X			E	E	E	E				X		
		18.0 – 24.0 in						X	X	X			X	X	X	X			E	E	E	E				X		
		24.0 – 30.0 in						X	X	X			X	X	X	X			E	E	E	E				X		

Table 13.2-VII

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-020(A) AND (B), FILTER BUILDINGS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
	14	0.0 - 6.0 in																				E										
		6.0 - 12.0 in						X	X		X											E										
		12.0 - 18.0 in						X	X		X											E										
		18.0 - 24.0 in						X	X		X											E										
Rinsate Blank																							X									
Field Blank																							X									
	15	24.0 - 30.0 in						X	X		X			X	X		X					E										
		0.0 - 6.0 in						X	X		X			X	X		X					E										
		6.0 - 12.0 in						X	X		X			X	X		X					E										
		12.0 - 18.0 in						X	X		X			X	X		X					E										
		18.0 - 24.0 in						X	X		X			X	X		X					E										
		24.0 - 30.0 in						X	X		X			X	X		X					E										
Trip Blank																							X									
	16	0.0 - 6.0 in						X	X		X											E										
		6.0 - 12.0 in						X	X		X			X	X		X					E										
		12.0 - 18.0 in						X	X		X			X	X		X					E										
		18.0 - 24.0 in						X	X		X			X	X		X					E										
		24.0 - 30.0 in						X	X		X			X	X		X					E										
Shallow Borehole (bias)	1	0.0 - 2.5 ft						X	X		X			X	X		X					E										
		2.5 - 5.0 ft						X	X		X			X	X		X					E										
		5.0 - 7.5 ft						X	X		X		X	X	X		X					E										
	2	0.0 - 2.5 ft						X	X		X		X	X	X		X					E										
		2.5 - 5.0 ft						X	X		X		X	X	X		X					E										
		5.0 - 7.5 ft						X	X		X		X	X	X		X					E										
	3	0.0 - 2.5 ft						X	X		X		X	X	X		X					E										
		2.5 - 5.0 ft						X	X		X		X	X	X		X					E										

Table 13.2-VII

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-020(A) AND (B), FILTER BUILDINGS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
		5.0 - 7.5 ft																																
Rinsate Blank																																		
Field Blank																																		
	4	0.0 - 2.5 ft						X	X		X			X	X	X	X					E	E	E		E	E	E	E				
		2.5 - 5.0 ft						X	X		X			X	X	X	X					E	E	E		E	E	E	E				
		5.0 - 7.5 ft						X	X		X			X	X	X	X					E	E	E		E	E	E	E				
	5	0.0 - 2.5 ft						X	X		X			X	X	X	X					E	E	E		E	E	E	E				
		2.5 - 5.0 ft						X	X		X			X	X	X	X					E	E	E		E	E	E	E				
		5.0 - 7.5 ft						X	X		X			X	X	X	X					E	E	E		E	E	E	E				
Trip Blank																																		
TA-21-153																																		
Near Surface Soil (bias)	1	0.0 - 6.0 in						X	X		X			X	X	X	X					E	E	E		E	E	E	E				
		6.0 - 12.0 in						X	X		X			X	X	X	X					E	E	E		E	E	E	E				
		12.0 - 18.0 in						X	X		X			X	X	X	X					E	E	E		E	E	E	E				
		18.0 - 24.0 in						X	X		X			X	X	X	X					E	E	E		E	E	E	E				
		24.0 - 30.0 in						X	X		X			X	X	X	X					E	E	E		E	E	E	E				
	2	0.0 - 6.0 in						X	X		X			X	X	X	X					E	E	E		E	E	E	E				
		6.0 - 12.0 in						X	X		X			X	X	X	X					E	E	E		E	E	E	E				
		12.0 - 18.0 in						X	X		X			X	X	X	X					E	E	E		E	E	E	E				
		18.0 - 24.0 in						X	X		X			X	X	X	X					E	E	E		E	E	E	E				
		24.0 - 30.0 in						X	X		X			X	X	X	X					E	E	E		E	E	E	E				
	3	0.0 - 6.0 in						X	X		X			X	X	X	X					E	E	E		E	E	E	E				
		6.0 - 12.0 in						X	X		X			X	X	X	X					E	E	E		E	E	E	E				
		12.0 - 18.0 in						X	X		X			X	X	X	X					E	E	E		E	E	E	E				
		18.0 - 24.0 in						X	X		X			X	X	X	X					E	E	E		E	E	E	E				
Rinsate Blank																																		

Table 13.2-VII

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-020(A) AND (B), FILTER BUILDINGS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Field Blank																																	
Trip Blank		24.0 - 30.0 in																															
	4	0.0 - 6.0 in						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
		6.0 - 12.0 in						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
		12.0 - 18.0 in						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
		18.0 - 24.0 in						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
		24.0 - 30.0 in						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
	5	0.0 - 6.0 in						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
		6.0 - 12.0 in						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
		12.0 - 18.0 in						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
		18.0 - 24.0 in						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
		24.0 - 30.0 in						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
	6	0.0 - 6.0 in						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
		6.0 - 12.0 in						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
		12.0 - 18.0 in						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
		18.0 - 24.0 in						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
		24.0 - 30.0 in						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
	7	0.0 - 6.0 in						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
		6.0 - 12.0 in						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
		12.0 - 18.0 in						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
		18.0 - 24.0 in						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
		24.0 - 30.0 in						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
Trip Blank																													X				
Rinsate Blank																						X	X	X	X	X	X	X	X				
Field Blank																						X	X	X	X	X	X	X	X				
		24.0 - 30.0 in						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			

Table 13.2-VII

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-020(A) AND (B), FILTER BUILDINGS.

				Field Surveys				Field Screening						Field Laboratory Measurements										Laboratory Analysis													
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals				
	8	0.0 - 6.0 in						X	X		X																									
		6.0 - 12.0 in						X	X		X			X	X	X	X																			
		12.0 - 18.0 in						X	X		X			X	X	X	X																			
		18.0 - 24.0 in						X	X		X			X	X	X	X																			
		24.0 - 30.0 in						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E						
	9	0.0 - 6.0 in						X	X		X																									
		6.0 - 12.0 in						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E						
		12.0 - 18.0 in						X	X		X			X	X	X	X																			
		18.0 - 24.0 in						X	X		X			X	X	X	X																			
		24.0 - 30.0 in						X	X		X			X	X	X	X																			
Trip Blank																													X							
	10	0.0 - 6.0 in						X	X		X																									
		6.0 - 12.0 in						X	X		X			X	X	X	X																			
		12.0 - 18.0 in						X	X		X			X	X	X	X																			
		18.0 - 24.0 in						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E						
		24.0 - 30.0 in						X	X		X			X	X	X	X																			
Field Duplicate																						X	X	X	X		X	X	X	X					
Rinsate Blank																						X	X	X	X		X	X	X	X					
Field Blank																													X	X					
Trip Blank																													X						

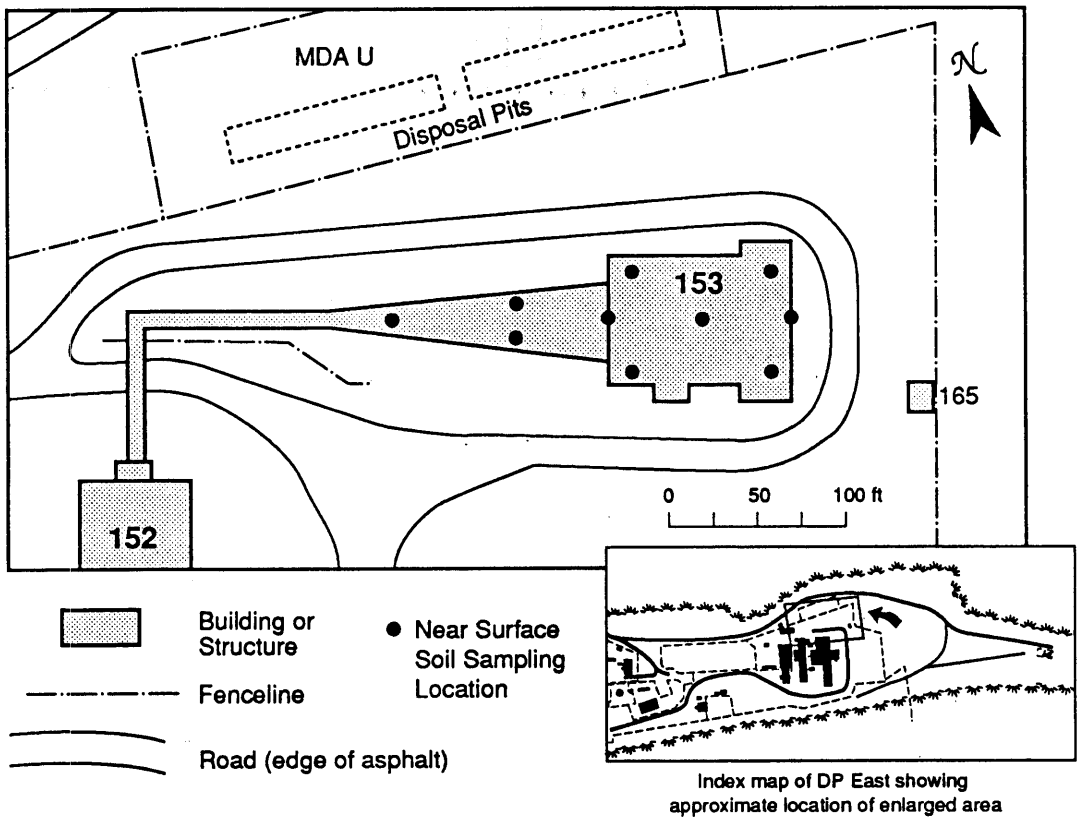


Fig. 13.2-6 Location of former filter buidling TA-21-153 showing initial investigation sampling locations (LASL 1958).

As appropriate, all samples in the subsequent investigation will be submitted to an analytical laboratory for analysis of a focused analytical suite determined using the results of initial sampling. For planning purposes, it is assumed that the subsequent investigation will require analysis of 112 samples, approximately 50% of the initial effort. The screening and analysis requirements for the subsequent investigation, assuming the same analytical suite as that used during initial investigation, are shown in Table 13.2-VIII.

Filter buildings. A subsequent investigation is not planned at either filter building. If results of initial investigations suggest that further sampling is required, additional field activities will be planned.

Table 13.2-VIII

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS FOR AIRBORNE DEPOSITION.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Airborne Deposition Sampling																																	
Surface Soil Sample	1	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X			
	2	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X			
	3	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X			
	4	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X			
	5	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X			
Field Duplicate																						X	X	X	X		X			X			
	6	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X			
	7	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X			
	8	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X			
	9	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X			
	10	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X			
Rinsate Blank																						X	X	X	X		X			X			
Field Blank																														X			
	11	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X			
	12	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X			
	13	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X			
	14	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X			
	15	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X			
	16	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X			
	17	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X			
	18	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X			
	19	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X			
	20	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X			
	21	0.0 - 1.0 in						X	X		X											X	X	X	X		X			X			

Table 13.2-VIII

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS FOR AIRBORNE DEPOSITION.

	Sample Identification	Interval	Sampling Location	Sample Type
		0.0 - 1.0 in	22	
		0.0 - 1.0 in	23	
		0.0 - 1.0 in	24	
		0.0 - 1.0 in	25	
				Field Duplicate
		0.0 - 1.0 in	26	
		0.0 - 1.0 in	27	
		0.0 - 1.0 in	28	
		0.0 - 1.0 in	29	
		0.0 - 1.0 in	30	
				Rinsate Blank
				Field Blank
		0.0 - 1.0 in	31	
		0.0 - 1.0 in	32	
		0.0 - 1.0 in	33	
		0.0 - 1.0 in	34	
		0.0 - 1.0 in	35	
		0.0 - 1.0 in	36	
		0.0 - 1.0 in	37	
		0.0 - 1.0 in	38	
		0.0 - 1.0 in	39	
		0.0 - 1.0 in	40	
		0.0 - 1.0 in	41	
		0.0 - 1.0 in	42	
		0.0 - 1.0 in	43	
		0.0 - 1.0 in	44	
Field Surveys	Gross Gamma			
	Low-Energy Gamma			
	Electromagnetic			
	Land Survey			
Field Screening	Gross Gamma	X	X	
	Gross Alpha	X	X	
	Organic Vapor	X	X	
	Combustible Gas/Oxygen			
	Lithological Logging			
Field Laboratory Measurements	Gross Alpha			
	Gamma Spectrometry			
	Tritium			
	Volatile Organics			
	PCB			
	Soil Moisture			
Laboratory Analysis	Gamma Spectrometry	X	X	
	Tritium	X	X	
	Total Uranium	X	X	
	Isotopic Plutonium	X	X	
	Isotopic Uranium			
	Strontium 90	X	X	
	VOA (SW 8240)			
	Semivolatiles (SW 8270)			
	Metals (SW 6010)	X	X	
	PCB (SW 8080)			
	TCLP Metals			

Table 13.2–VIII

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS FOR AIRBORNE DEPOSITION.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys					Field Screening					Field Laboratory Measurements									Laboratory Analysis												
				Gross Gamma	Low–Energy Gamma	Electromagnetic	Land Survey		Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Field Duplicate																																		
	45	0.0 – 1.0 in							X		X												X	X	X	X	X	X	X				
	46	0.0 – 1.0 in							X		X												X	X	X	X	X	X	X				
	47	0.0 – 1.0 in							X		X												X	X	X	X	X	X	X				
	48	0.0 – 1.0 in							X		X												X	X	X	X	X	X	X				
Rinsate Blank																																		
Field Blank																																		
	49	0.0 – 1.0 in							X		X												X	X	X	X	X	X	X				
	50	0.0 – 1.0 in							X		X												X	X	X	X	X	X	X				
	51	0.0 – 1.0 in							X		X												X	X	X	X	X	X	X				
	52	0.0 – 1.0 in							X		X												X	X	X	X	X	X	X				
	53	0.0 – 1.0 in							X		X												X	X	X	X	X	X	X				
	54	0.0 – 1.0 in							X		X												X	X	X	X	X	X	X				
	55	0.0 – 1.0 in							X		X												X	X	X	X	X	X	X				
	56	0.0 – 1.0 in							X		X												X	X	X	X	X	X	X				
	57	0.0 – 1.0 in							X		X												X	X	X	X	X	X	X				
	58	0.0 – 1.0 in							X		X												X	X	X	X	X	X	X				
	59	0.0 – 1.0 in							X		X												X	X	X	X	X	X	X				
	60	0.0 – 1.0 in							X		X												X	X	X	X	X	X	X				
	61	0.0 – 1.0 in							X		X												X	X	X	X	X	X	X				
	62	0.0 – 1.0 in							X		X												X	X	X	X	X	X	X				
	63	0.0 – 1.0 in							X		X												X	X	X	X	X	X	X				
	64	0.0 – 1.0 in							X		X												X	X	X	X	X	X	X				
Field Duplicate																																		
	65	0.0 – 1.0 in							X		X												X	X	X	X	X	X	X				
	66	0.0 – 1.0 in							X		X												X	X	X	X	X	X	X				

Table 13.2-VIII

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS FOR AIRBORNE DEPOSITION.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
	67	0.0 – 1.0 in																															
	68	0.0 – 1.0 in						X	X		X											X	X	X		X			X				
	69	0.0 – 1.0 in						X	X		X											X	X	X		X			X				
	70	0.0 – 1.0 in						X	X		X											X	X	X		X			X				
	71	0.0 – 1.0 in						X	X		X											X	X	X		X			X				
	72	0.0 – 1.0 in						X	X		X											X	X	X		X			X				
Rinsate Blank																																	
Field Blank	73	0.0 – 1.0 in																															
	74	0.0 – 1.0 in						X	X		X											X	X	X		X			X				
	75	0.0 – 1.0 in						X	X		X											X	X	X		X			X				
	76	0.0 – 1.0 in						X	X		X											X	X	X		X			X				
	77	0.0 – 1.0 in						X	X		X											X	X	X		X			X				
	78	0.0 – 1.0 in						X	X		X											X	X	X		X			X				
	79	0.0 – 1.0 in						X	X		X											X	X	X		X			X				
	80	0.0 – 1.0 in						X	X		X											X	X	X		X			X				
Field Duplicate																																	
	81	0.0 – 1.0 in						X	X		X											X	X	X		X			X				
	82	0.0 – 1.0 in						X	X		X											X	X	X		X			X				
	83	0.0 – 1.0 in						X	X		X											X	X	X		X			X				
	84	0.0 – 1.0 in						X	X		X											X	X	X		X			X				
Rinsate Blank																																	
Field Blank	85	0.0 – 1.0 in						X	X		X											X	X	X		X			X				
	86	0.0 – 1.0 in						X	X		X											X	X	X		X			X				
	87	0.0 – 1.0 in						X	X		X											X	X	X		X			X				

Table 13.2–VIII

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS FOR AIRBORNE DEPOSITION.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis													
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low–Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
	88	0.0 – 1.0 in						X	X		X											X	X	X	X		X			X				
	89	0.0 – 1.0 in						X	X		X											X	X	X	X		X			X				
	90	0.0 – 1.0 in						X	X		X											X	X	X	X		X			X				
	91	0.0 – 1.0 in						X	X		X											X	X	X	X		X			X				
	92	0.0 – 1.0 in						X	X		X											X	X	X	X		X			X				
	93	0.0 – 1.0 in						X	X		X											X	X	X	X		X			X				
	94	0.0 – 1.0 in						X	X		X											X	X	X	X		X			X				
	95	0.0 – 1.0 in						X	X		X											X	X	X	X		X			X				
Field Duplicate																						X	X	X	X		X			X				
	96	0.0 – 1.0 in						X	X		X											X	X	X	X		X			X				
	97	0.0 – 1.0 in						X	X		X											X	X	X	X		X			X				
	98	0.0 – 1.0 in						X	X		X											X	X	X	X		X			X				
	99	0.0 – 1.0 in						X	X		X											X	X	X	X		X			X				
	100	0.0 – 1.0 in						X	X		X											X	X	X	X		X			X				
	101	0.0 – 1.0 in						X	X		X											X	X	X	X		X			X				
	102	0.0 – 1.0 in						X	X		X											X	X	X	X		X			X				
	103	0.0 – 1.0 in						X	X		X											X	X	X	X		X			X				
	104	0.0 – 1.0 in						X	X		X											X	X	X	X		X			X				
Rinsate Blank																														X				
Field Blank																														X				
	105	0.0 – 1.0 in						X	X		X											X	X	X	X		X			X				
	106	0.0 – 1.0 in						X	X		X											X	X	X	X		X			X				
	107	0.0 – 1.0 in						X	X		X											X	X	X	X		X			X				
	108	0.0 – 1.0 in						X	X		X											X	X	X	X		X			X				
	109	0.0 – 1.0 in						X	X		X											X	X	X	X		X			X				
	110	0.0 – 1.0 in						X	X		X											X	X	X	X		X			X				

Table 13.2-VIII

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS FOR AIRBORNE DEPOSITION.

	Sample Identification	Interval	Sampling Location	Sample Type	Field Duplicate
Field Surveys	Gross Gamma				
	Low-Energy Gamma				
	Electromagnetic				
	Land Survey				
Field Screening	Gross Gamma	0.0 - 1.0 in	111		
	Gross Alpha	0.0 - 1.0 in	112		
	Organic Vapor				
	Combustible Gas/Oxygen				
	Lithological Logging				
Field Measurements	Gross Alpha				
	Gamma Spectrometry				
	Tritium				
	Volatile Organics				
	PCB				
	Soil Moisture				
Laboratory Analysis	Gamma Spectrometry				
	Tritium				
	Total Uranium				
	Isotopic Plutonium				
	Isotopic Uranium				
	Strontium 90				
	VOA (SW 8240)				
	Semivolatiles (SW 8270)				
	Metals (SW 6010)				
	PCB (SW 8080)				
	TCLP Metals				

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Volume II

TA-21 Operable Unit RFI Work Plan for Environmental Restoration

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A Department of Energy environmental clean-up program

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NATIONAL LABORATORY

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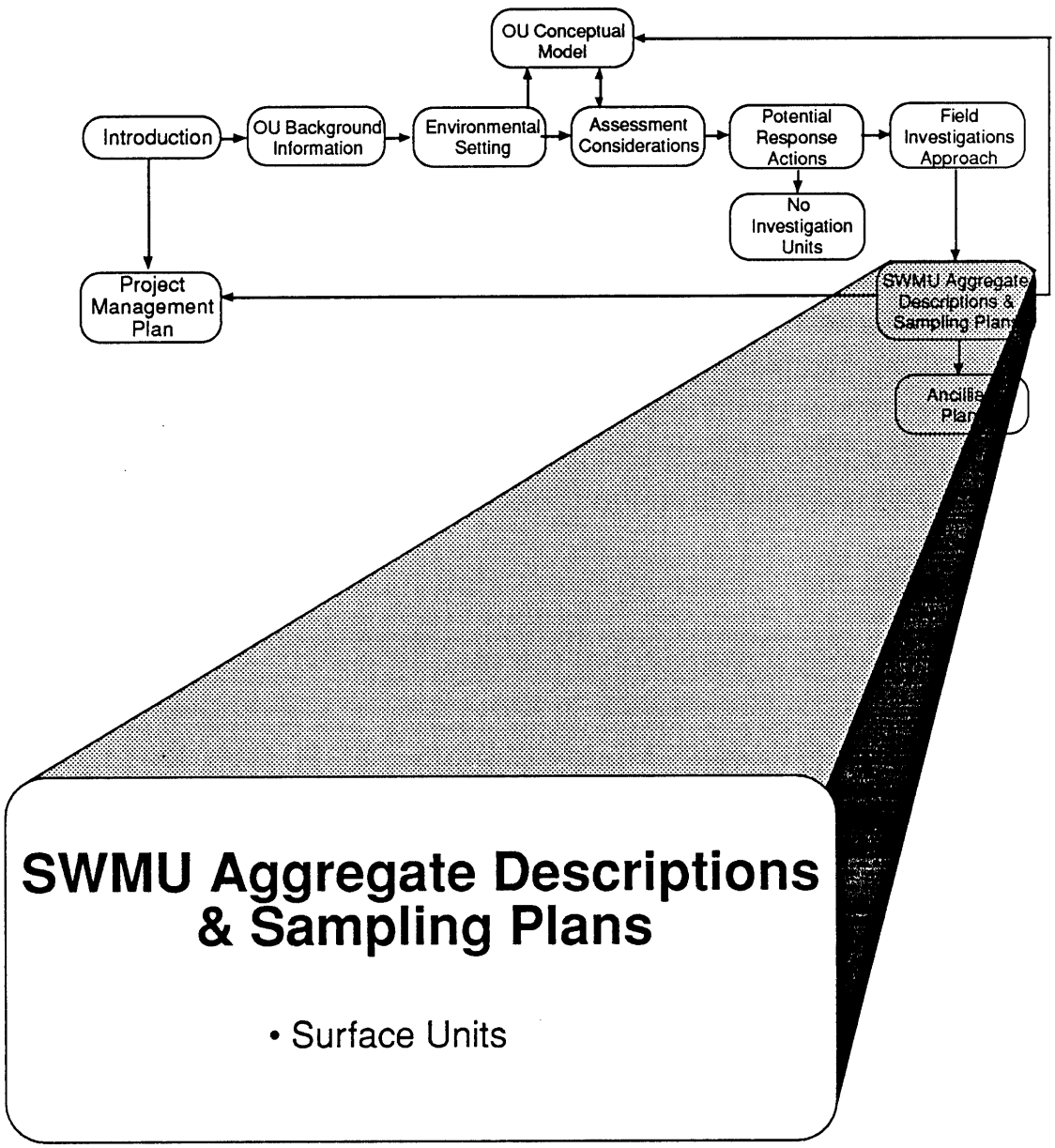
CHAPTER 14


OU Conceptual Model
Introduction
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Project Management Plan
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Ancillary Plans
SWMU Aggregate Descriptions & Sampling Plans
• Surface Units

14. SURFACE UNITS DESCRIPTION AND SAMPLING PLAN

14.1. Introduction

This chapter provides site descriptions and field sampling plans for several SWMUs that have the potential for past releases that were confined primarily to surface soils. The list below identifies the SWMUs addressed in this chapter, the general group in which they fall, and the section in which they are addressed.

- Storage Areas and Tanks
    - Section 14.2
      SWMU 21-003, PCB Container Storage Area
    - Section 14.3
      SWMU 21-004, Aboveground Tanks and Drain Lines
    - Section 14.4
      SWMU 21-028(d), (e), Active Container Storage Areas
    - Section 14.5
      SWMU 21-029, DP Tank Farm
    - Section 14.6
      SWMU 21-002(b), Inactive Container Storage Areas
- Surface Disposals
    - Section 14.7
      SWMU 21-013(b)–(f), Surface Disposal Areas
- Sewage Treatment Plant
    - Section 14.8
      SWMU 21-013(a), Surface Disposal Area, and
      SWMU 21-026, Sewage Treatment Plant

For all of the SWMUs in this chapter, data are needed on the presence or absence of contaminants in surface soil and subsurface soil. Identified potential contaminant migration pathways for all of the SWMUs include surface run-off, infiltration, and vapor phase transport (see Chapter 5). The erosive exposure of wastes is identified as a potential pathway at three SWMUs, 21-028 (d) and (e), 21-013 (b)–(g), and 21-013(a). Exposure routes and potential receptors for each environmental transport pathway are identified in Chapter 6.

The criteria for preliminary identification of potential response actions at TA-21 SWMUs are presented in Chapter 10. For the SWMUs listed in this chapter, the no-action alternative is identified as a potential appropriate remedial alternative for all SWMUs with the exception of SWMU 21-003, PCB container storage area. The field investigations at five of the SWMUs included in this chapter may determine that not all of these SWMUs are release sites. If it is determined that the SWMU is not a release site, the SWMU will be proposed for no further investigation. Other preliminary remedial alternatives identified for the SWMUs in this chapter include institutional controls, monitoring, treatment, removal and disposal, and removal and treatment (see Table 10-I).

The following paragraphs present a brief description of each of the SWMUs in this chapter and the field investigation proposed for each. For all SWMUs in this chapter, the field measurements and laboratory analyses for initial investigations are summarized by section in Tables 14-I and 14.1-II. The same information for subsequent investigations is presented in Tables 14.1-III and 14.1-IV. The strategy for field and laboratory analyses is presented for each SWMU in flow charts in Figs. 14.1-1 through 14.1-7.

PCB Container Storage Area (SWMU 21-003). This SWMU was a storage area for PCB-bearing equipment and PCB-contaminated waste, oils, solvents, and trash between 1978–1989. PCB contamination in surface soils is documented. The strategy for the field investigation at the PCB container storage area is presented in Fig. 14.1-1. Field measurements and laboratory analyses are summarized in Tables 14.1-I through 14.1-IV.

The field investigation is designed to incorporate and confirm earlier analytical data on PCB concentrations in surface soil samples. Results from an initial investigation of contamination in surface soils will be used to guide a required subsequent investigation to determine the lateral and vertical extent of contamination.

Aboveground Tanks and Drain Lines (SWMU 21-004). The SWMU includes three aboveground tanks and a drain line. No information on past releases from these units is available. The strategy for the field investigation is presented in Fig. 14.1-2. Field measurements and laboratory analyses are summarized in Tables 14.1-I and 14.1-II. No field investigation will be performed at TA-21-335 if analyses of swipe samples from the tank indicate that contaminants are not present.

Active Container Storage Area (SWMU 21-028(d) and (e). The areas for investigation are loading docks on the north side of Buildings TA-21-209 and -210. The sites are currently subject

to RCRA regulations. Because use of the sites predates RCRA definitions, the sites will be investigated to confirm that no environmental releases occurred before RCRA regulations went into effect. The strategy for the field investigation is presented in Fig. 14.1-3. Field measurements and laboratory analyses are summarized in Tables 14.1-I and 14.1-II.

DP Tank Farm (SWMU 21-029). The DP tank farm, consisting of 15 tanks, was active from January 1946 until February 1985. Tank removal was completed by July 1988. During excavation, only one tank, which contained diesel fuel, was found to have leaked. Soils in the area of fill stations were contaminated with fuel. Contaminated soils at the fill stations were remediated in 1988.

The objective of the field investigation at SWMU 21-029 is to confirm that contaminants are not present. The strategy for the field investigation is presented in Fig. 14.1-4. Field measurements and laboratory analyses are summarized in Tables 14.1-I and 14.1-II.

Inactive Container Storage Areas [SWMU 21-002(b)]. The site to be investigated is a former drum storage structure, TA-21-38, which is located southeast of Building TA-21-31. The structure was built in August 1945 and decommissioned in February 1966. No data are available on the contents of the drums that were stored in the building, nor is there a recorded history of spills or leaks.

The objective of the field investigation is to confirm the absence of contamination. The strategy for the field investigation is presented in Fig. 14.1-5. Field measurements and laboratory analyses for an initial investigation and a possible subsequent investigation are summarized in Tables 14.1-I through 14.1-IV.

Surface Disposal Area [SWMU21-013(b)–(f)]. This SWMU grouping addresses areas known or suspected to have been used in the past for surface disposal of various materials. No previous sampling data exist regarding potential contaminants at these sites.

The objective of the field investigation is to confirm the absence of contamination. The strategy for the field investigation is presented in Fig. 14.1-6. Field measurements and laboratory analyses for an initial and a possible subsequent investigation are summarized in Tables 14.1-I through 14.1-IV.

Surface Disposal Area and Sewage Treatment Plant. This grouping of SWMUs addresses three active sites at the sewage treatment plant and an inactive surface disposal area. The disposal area received sand from sand filter beds and sludge-drying beds of the sewage treat-

ment plant. No data exist regarding contamination of the inactive disposal area or of the area surrounding the sewage treatment plant. However, radionuclide assays on liquid effluents and sludges show that elevated values were present in some samples. Inorganic assays on sludges show that concentrations for many metals were considerably higher than concentrations considered to be background in area soils.

The objective of the field investigation is to confirm the presence or absence of contamination on subsurface soils, and, if contamination is present, to determine the extent of contamination. The strategy for the investigation is presented in Fig. 14.1-7. Field measurements and laboratory analyses are summarized in Tables 14.1-I and 14.1-II.

14.1-I SUMMARY OF INITIAL INVESTIGATIONS BY SECTION FOR CHAPTER 14.

Section	Description	Survey Areas			Surface Soil Samples	Near Surface Soil Samples		Tank Samples	
		Land	Radiological	Geophysical	Soil Samples	No. of Locations	No. of Samples	Swipes	Liquid
14.2	PCB Ctr. Stg. Area	1			63				
14.3	Aboveground Tanks		10		5			3*	3*
14.4	Active Ctr. Stg. Area		4			8	8		
14.5	DP Tank Farm	6			2				
14.6	Inactive Ctr. Stg. Areas	1			8				
14.7	Surface Disposal Areas	6	10		36	36	180		
14.8	Sewage Treatment Plant		2		12	3	9		
	Total	14	26		126	47	197		3*

* Either Swipes or liquid samples will be collected, not both.

Section	Description	Boreholes									Q A
		Shallow			Vertical			Angled			
		Number	Total Footage	No. of Samples	Number	Total Footage	No. of Samples	Number	Total Footage	No. of Samples	
14.2	PCB Ctr. Stg. Area										10
14.3	Aboveground Tanks	2	10	4							8
14.4	Active Ctr. Stg. Area										4
14.5	DP Tank Farm	10	100	40							10
14.6	Inactive Ctr. Stg. Areas										4
14.7	Surface Disposal Areas	36	270	108							32
14.8	Sewage Treatment Plant				1	30	6	3	151	32	13
	Total	48	380	152	1	30	6	3	151	32	81

14.1-II SUMMARY OF SAMPLE AND ANALYSIS FOR INITIAL INVESTIGATIONS BY SECTION FOR CHAPTER 14.

	14.2	14.3	14.4	14.5	14.6	14.7	14.8			Total
Field Sample Screening										
Gross Gamma			9	8	42	8	323			390
Gross Alpha		63	9	8	42	8	323	59		512
Organic Vapor		63	9	8	42	8	323	59		512
Combustible Gas/Oxygen			4		40		108	59		211
Lithological Logging			4		40		323	38		405
Field Laboratory Measurements										
Gross Alpha		17	6		42		251	59		375
Gamma Spectrometry		17	6		42		251	59		375
Tritium		17					251	38		306
Volatile Organics		63	5		42		251			361
PCB		63								63
Soil Moisture								38		38
Chlorides, Nitrates								38		38
Laboratory Analysis										
Gamma Spectrometry		27	11	10	22	10	79	25		184
Tritium		27	11	10		10	79	25		162
Total Uranium		27	11	10		10	79	25		162
Isotopic Plutonium		27	11	10		10	79	25		162
Isotopic Uranium										
Strontium 90			11	10		10	79	25		135
VOA (SW 8240)		32	15	12	26	12	94	33		224
Semivolatiles (SW 8270)		31	13	11	25	11	90	29		210
Metals (SW 6010)		31	13	11	25	11	90	29		210
PCB (SW 8080)		31								31
TCLP Metals					25					25
Asbestos										
Ethanol					25					25

14.1-III SUMMARY OF SUBSEQUENT INVESTIGATIONS BY SECTION FOR CHAPTER 14.

Section	Description	Survey Areas: Land	Survey Areas: Radiological	Survey Areas: Geophysical	Surface: Soil Samples	Near Surface Soil Samples: No. of Locations	Near Surface Soil Samples: No. of Samples
14.2	PCB Ctr. Stg. Area						
14.3	Aboveground Tanks						
14.4	Active Ctr. Stg. Area						
14.5	DP Tank Farm						
14.6	Inactive Ctr. Stg. Areas				6		
14.7	Surface Disposal Areas				4	4	20
14.8	Sewage Treatment Plant						
	Total				10	4	20

Section	Description	Boreholes: Shallow: Number	Boreholes: Shallow: Total Footage	Boreholes: Shallow: No. of Samples	Q A
14.2	PCB Ctr. Stg. Area	8	65	26	7
14.3	Aboveground Tanks				
14.4	Active Ctr. Stg. Area				
14.5	DP Tank Farm				
14.6	Inactive Ctr. Stg. Areas	3	15	6	4
14.7	Surface Disposal Areas	4	30	12	9
14.8	Sewage Treatment Plant				
	Total	15	110	44	20

14.1-IV SUMMARY OF SAMPLE AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS BY SECTION FOR CHAPTER 14.

	14.2					14.6	14.7				Total
Field Sample Screening											
Gross Gamma						7	36				43
Gross Alpha		26				7	36				69
Organic Vapor		26				7	36				69
Combustible Gas/Oxygen		26				2	12				40
Lithological Logging		26				2	36				64
Field Laboratory Measurements											
Gross Alpha		26				7	28				61
Gamma Spectrometry		26				7	28				61
Tritium						7	28				35
Volatile Organics		26				7	28				61
PCB		26									26
Soil Moisture											
Chlorides, Nitrates											
Laboratory Analysis											
Gamma Spectrometry		9				5	13				27
Tritium		9				5	13				27
Total Uranium		9				5	13				27
Isotopic Plutonium		9				5	13				27
Isotopic Uranium											
Strontium 90		9				5	13				27
VOA (SW 8240)		16				7	16				39
Semivolatiles (SW 8270)						6	15				21
Metals (SW 6010)						6	15				21
PCB (SW 8080)		15									15
TCLP Metals											
Asbestos							13				13
Ethanol											

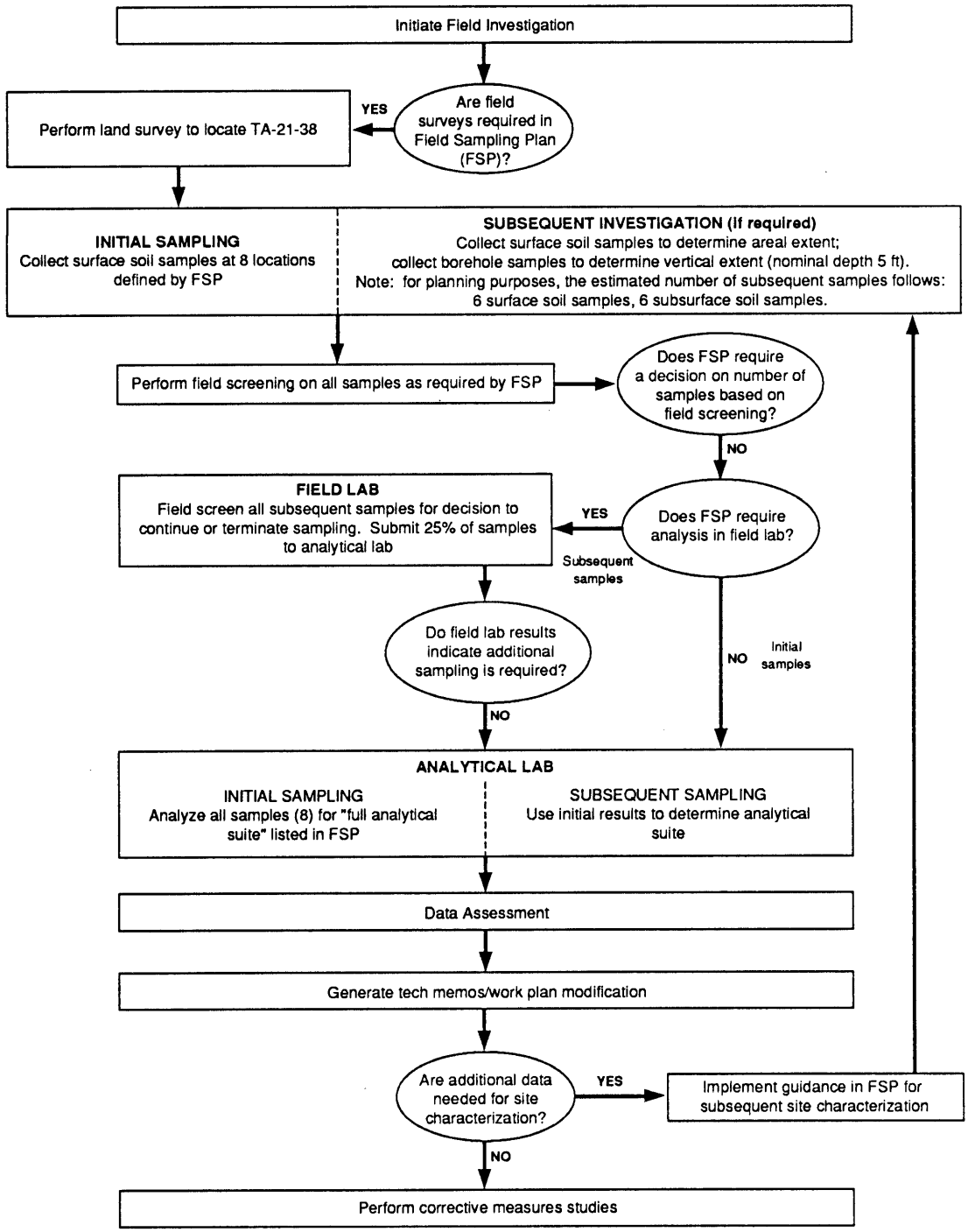

Fig. 14.1-1 Logic flow for the field investigations to investigate contamination at SWMU 21-002(b) former drum storage structure

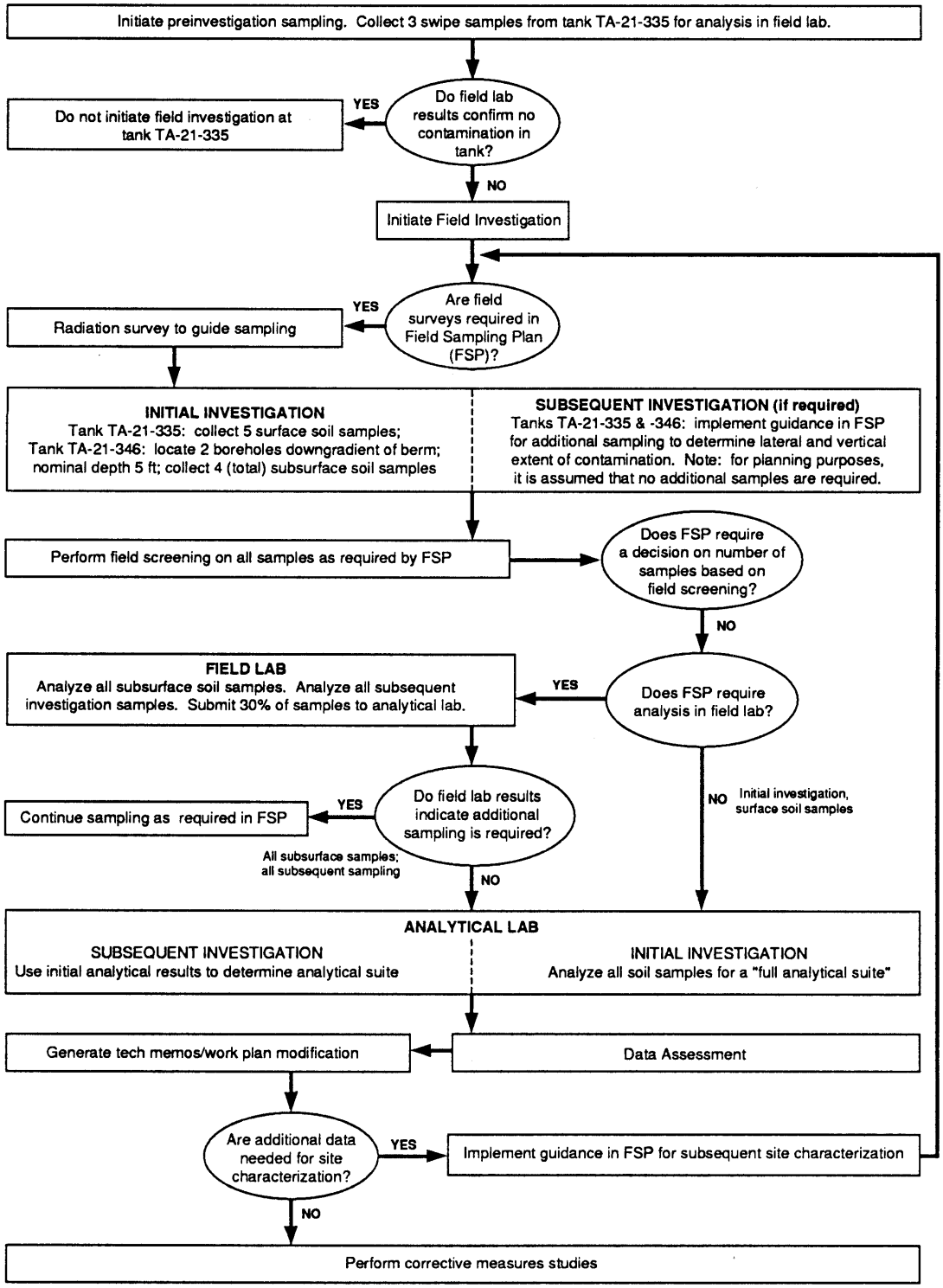

Fig. 14.1-2 Logic flow for the field investigation at SWMU 21-004, aboveground tanks and drain lines.

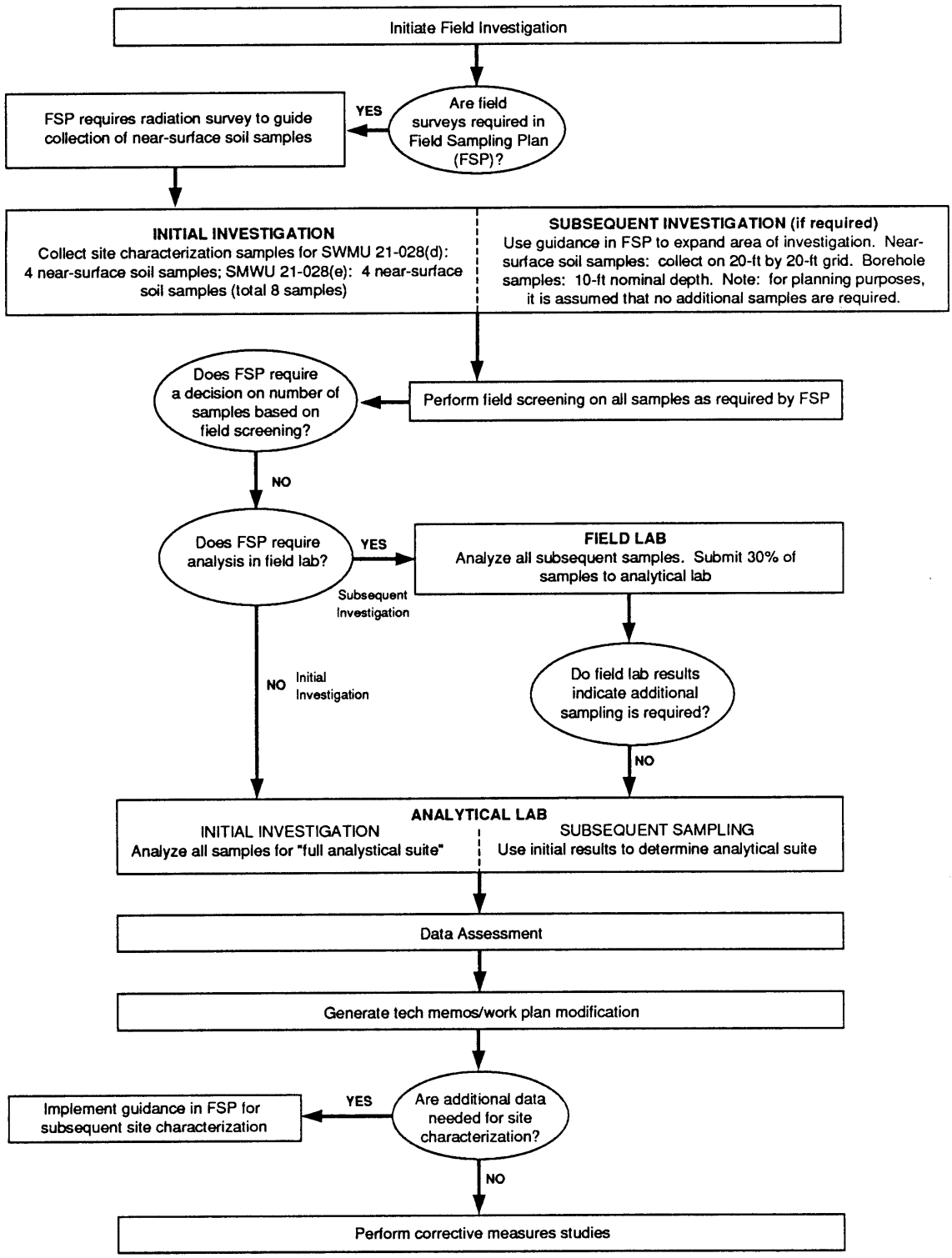

Fig. 14.1-3 Logic flow for the field investigation at SWMU 21-028(d), (e), active container storage areas.

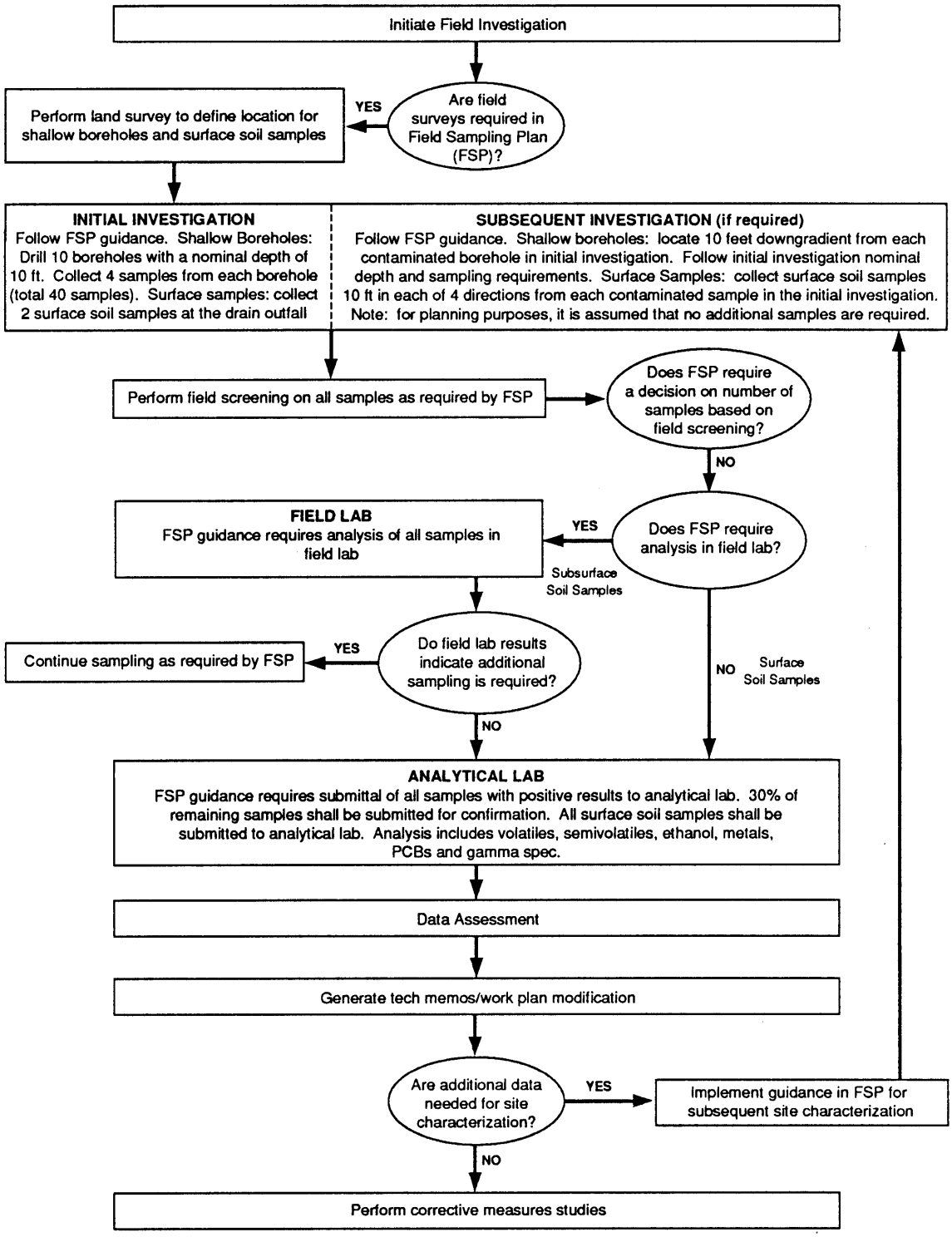

Fig. 14.1-4 Logic flow for field investigations at SWMU 21-029, DP tank farm.

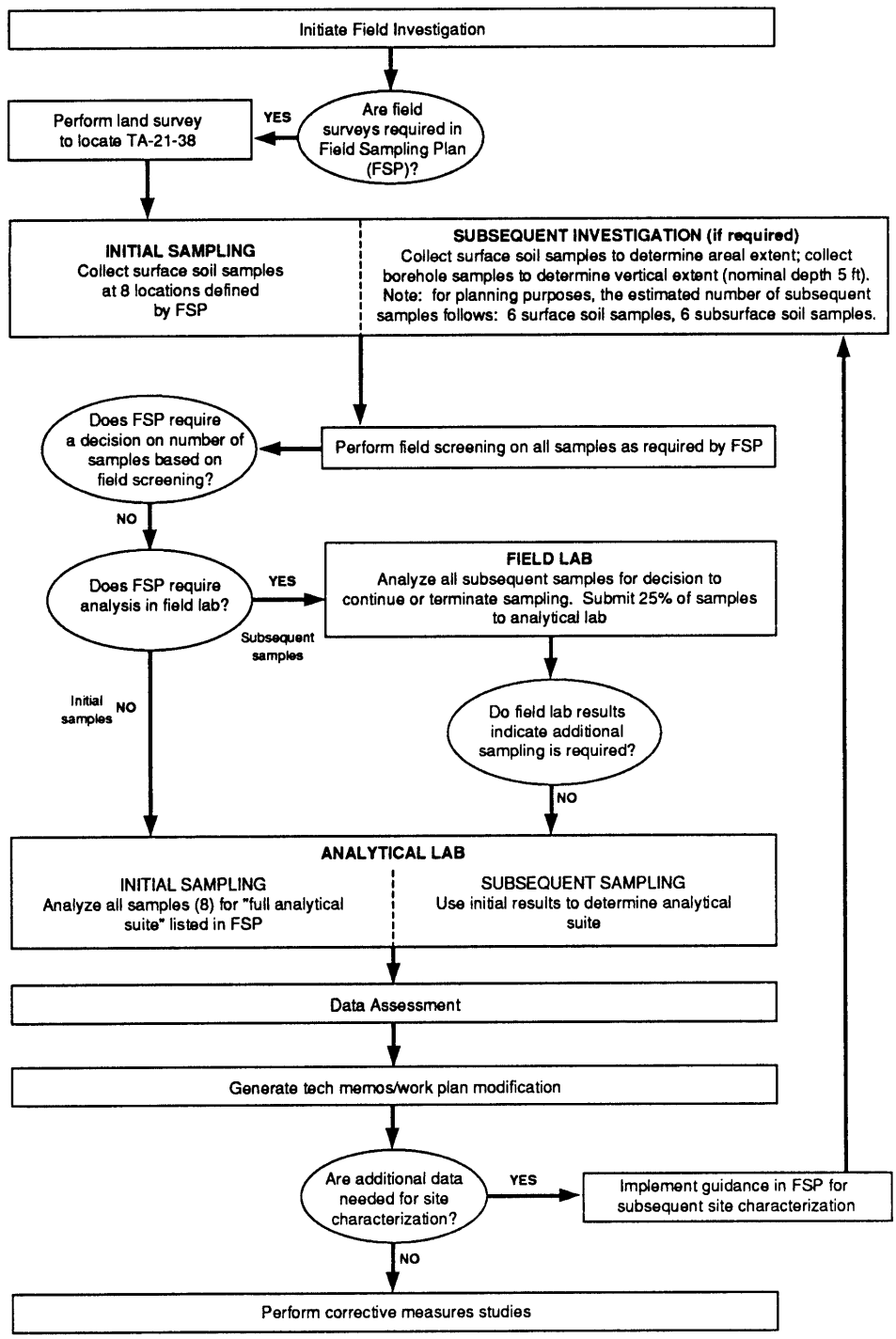

Fig. 14.1-5 Logic flow for the field investigations to investigate contamination at SWMU 21-002(b), inactive drum storage structure.

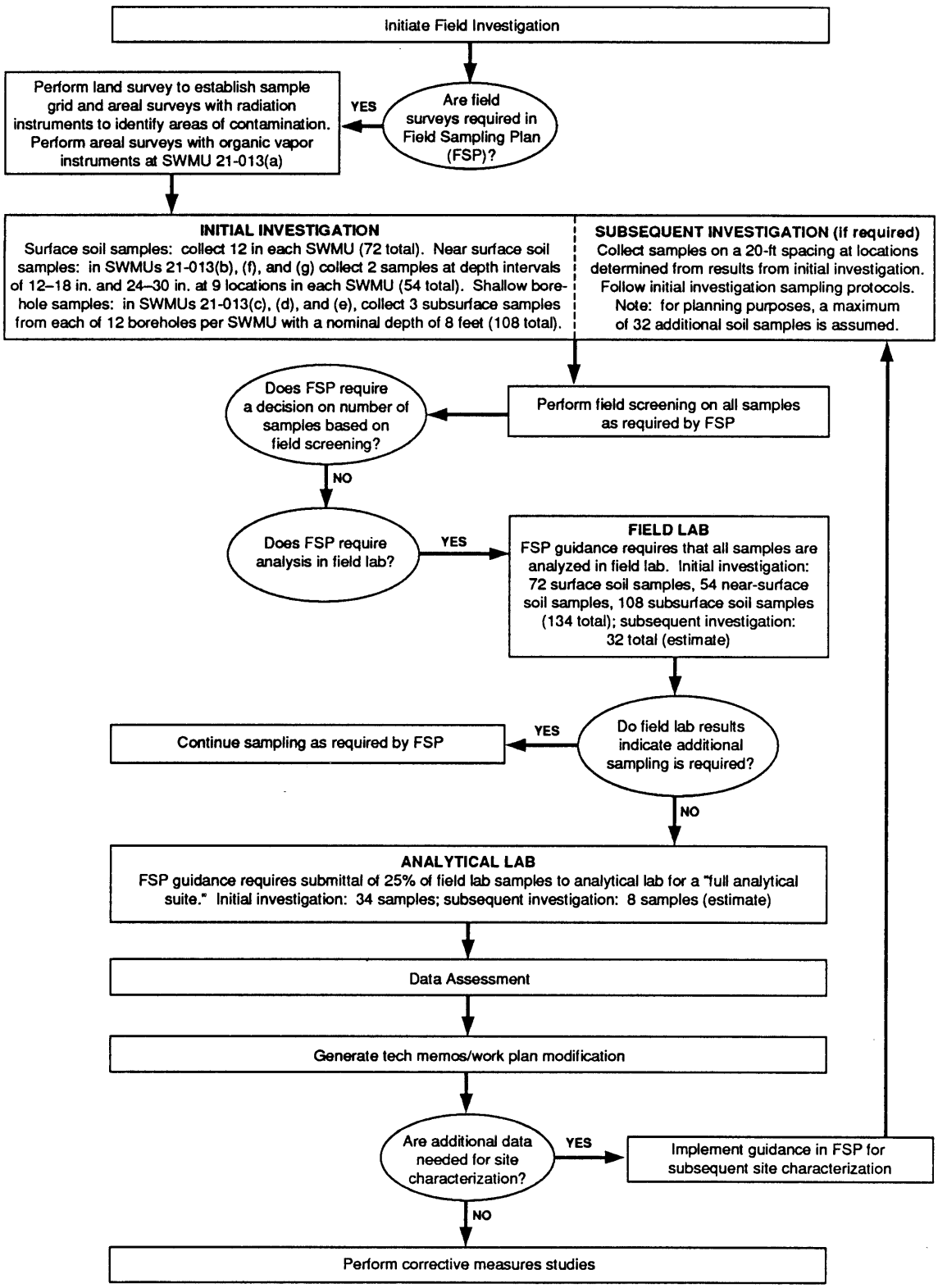

Fig. 14.1-6 Logic flow for field investigations at surface disposal areas.

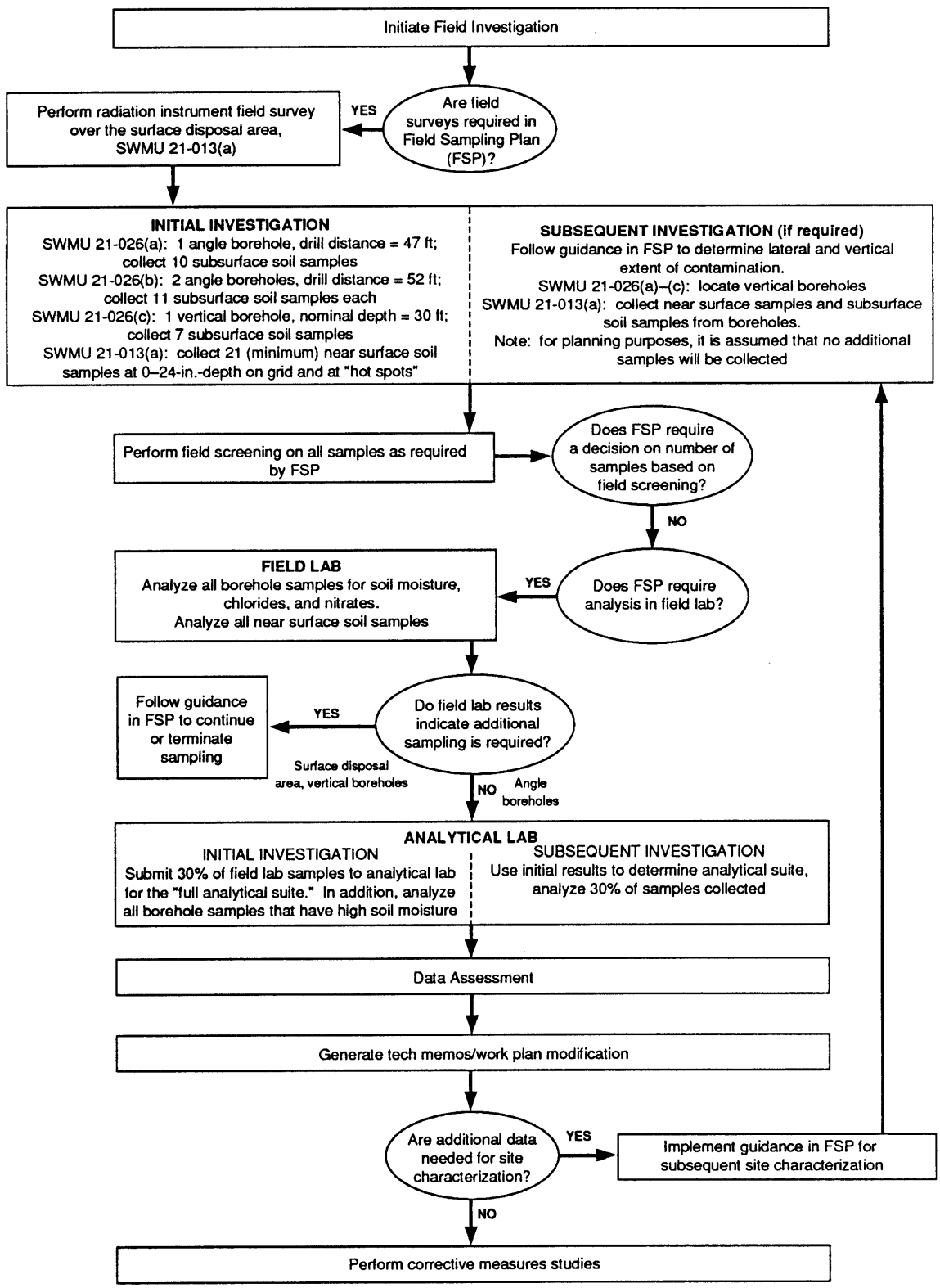

Fig. 14.1-7 Logic flow for the field investigation at SWMU 21-013(a), surface disposal area, and SWMU 21-026, sewage treatment plant.

14.2. PCB Container Storage Area

14.2.1. Site Description

This chapter describes the field investigations for the PCB-container storage area (SWMU 21-003). PCB-contaminated materials were stored inside Building TA-21-61, as well as on an area immediately east of the building (see Fig. 14.2-1). A portion of the storage area adjacent to the building is currently asphalted (a bermed drum storage pad). In the past, however, PCB-contaminated materials were stored there on the ground. Previous sampling has shown contamination to be present as a result of past operations at the storage area.

14.2.1.1. Site History

Construction of TA-21-61 was completed on September 30, 1950 (LASL no date). The building was originally used for nuclear propulsion program work (LASL 1958). No potential contaminants are known to be related to that work. Beginning in February 1978, the building and a bare earth pad directly east of the building were used for storage of capacitors and transformers containing PCB oil, PCB-contaminated pumps, and drums of PCB-contaminated waste oil, solvents and trash (Warren 1979; Warren 1980).

Use of the bare earth pad for storage of PCB-contaminated materials continued until October 1981 when part of the area was paved with asphalt and bermed. No excavation of the soil was performed prior to laying the asphalt pad (Weston 1991). Thereafter, the new asphalt pad was used for the temporary storage of drums containing less than 500 ppm PCB, and drums containing greater than 500 ppm PCB were stored inside TA-21-61 (Balo and Warren 1981). Building TA-21-61 and the asphalt storage pad continued to be used for storage of PCB-contaminated materials until August 1989 when the PCB storage area was moved to TA-54-39 (Hupke 1990).

The history of the PCB operations at TA-21-61 and the storage area east of the building is discussed in the Waste Management Site Plans for 1979-1981 and 1986 (Warren 1979; Warren 1980; Balo and Warren 1981; Warren and Balo 1987).

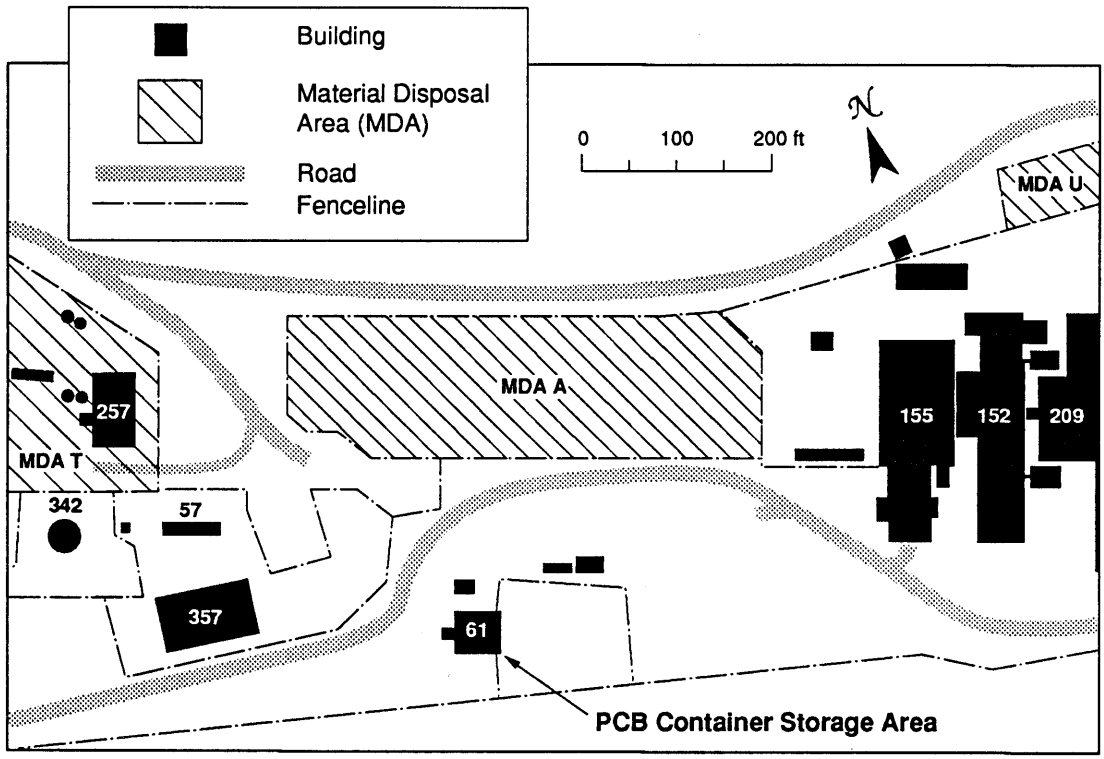

Fig. 14.2-1 Location of the former PCB Container Storage Area, TA-21-61 (Balo and Warren 1981; Warren and Balo 1987).

14.2.1.2. Existing Information

Grab samples of soil and asphalt were collected on July 21, 1988, on and around the asphalt pad adjacent to building TA-21-61. The sampling locations and analytical results are shown in Fig. 14.2-2. (Specific analytical results can be obtained from Group HSE-9 via data request number 7132 (LANL 1988e). These data indicate that the contamination is nonuniform, ranging from less than 10 ppm to approximately 95,000 ppm. The highest PCB concentrations are on or adjacent to the asphalt pad. PCB contamination was found to extend at least 30 ft east and west of the pad and 4 and 8 ft south and north, respectively. Concentrations off the pad remain elevated (in the range 10 to 1000 ppm), with a few interior and perimeter samples having concentrations less than 10 ppm. No data are available for greater distances from the pad.

During 1989, the interior of building TA-21-61 was decontaminated. PCB levels were reduced to 10 µg/100 cm^2 throughout the building. However, one area "outside of the TA-21-61 door on a concrete pad" could not be cleaned to that level (Alexander 1989). This may indicate the presence of PCB contamination around the exterior of the building.

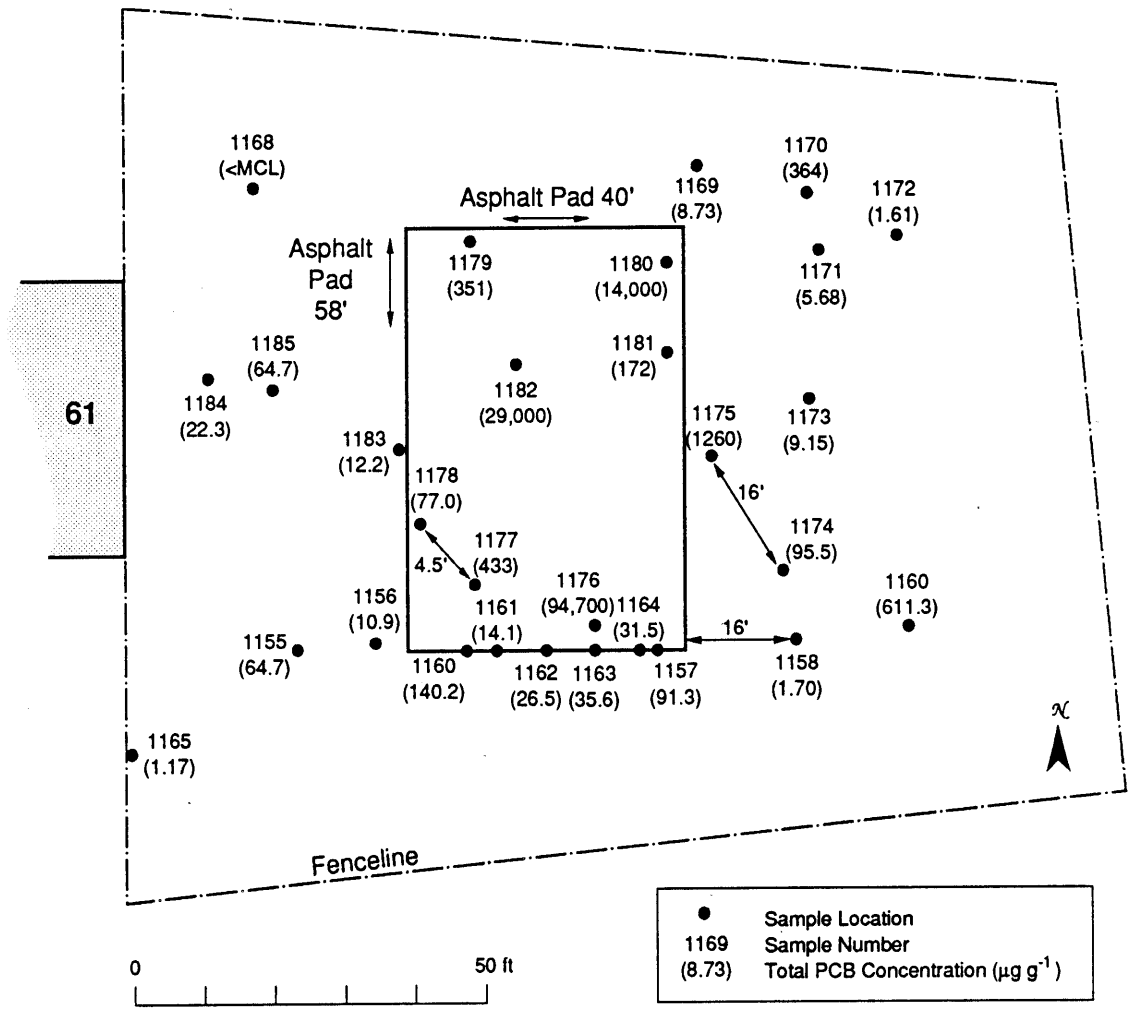

Fig. 14.2-2 Results of TA-21-61 sampling effort by HSE-7. (LANL 1989b)

14.2.1.3. Source Term

The primary contaminant of concern is PCB-contaminated oil and solvents. Kerosene and petroleum-based solvents were used at the storage area to rinse the transformers and capacitors after they had been drained of PCB oil. The frequency of performing this operation and the amount of solvent used each time are not known. It is possible, however, that releases of PCB-bearing solvents may have occurred.

Contaminants other than the PCB-bearing oils and solvents (such as organics, metals or radionuclides) are not known to be either present or absent at SWMU 21-003.

14.2.2. Objectives and Data Needs

The objective of this investigation is to confirm the presence and determine the extent of contamination at SWMU 21-003. Specific data required to assess contamination at SWMU 21-003 include the following:

1. Identify the presence of PCB-related contaminants (PCBs, oils, solvents) and other contaminants (organics, metals and radionuclides) using Level II and III data. PCBs have been identified in area soils. It is not known how extensive contamination is around the area, or beneath the asphalt pad.

2. If contaminants are identified in the area, determine the lateral and vertical extent of contaminant migration using surface and subsurface sampling and Level III analyses.

3. Identify the contaminants present using Level II and III data from drainages in the area of SWMU 21-003. Surface soil contamination known to exist in the area may have the potential for transport of contamination by water erosion in surface drainages.

14.2.3. Sampling/Investigation Rationale

PCBs are soluble in oil and in some solvents but are insoluble in water. Assuming the volume of oil and solvent releases was small and that water is ineffective for transporting PCBs, contaminant penetration is likely to be limited to the upper few feet of the soil profile. Thus, planned sampling depths are shallow.

Two phases of investigations can be planned for SWMU 21-003. The initial investigation consists of surface soil sampling to determine the extent of elevated levels of PCBs around Building TA-21-61 and at greater distances from the asphalt pad. These samples will be analyzed in the field laboratory for PCBs, with a percentage submitted to an analytical laboratory for confirmatory analyses. Field laboratory analyses will assist in defining the edge of the PCB contaminant plume. In addition, a percentage of the samples submitted for analytical laboratory analysis will be subjected to a full analytical suite to assess the presence of other contaminants. Results from the full analytical suite will be used to limit the analytical suites specified for samples collected in later investigations.

The drainage that collects run-off from the area of SWMU 21-003 is addressed in a separate investigation [see Sec. 15.3, SWMU 21-024(c)]. PCB analyses are specified for soil samples in the drainage investigation to supplement the information developed in this investigation.

The subsequent investigation will focus on determining the concentration levels and the depth of contaminant penetration into the soil beneath the asphalt pad and in other areas where surface contamination is observed. As above, the samples will be analyzed in the field laboratory for PCBs, with a percentage submitted to an analytical laboratory for a full suite of laboratory analyses.

14.2.4. Sampling Plan

14.2.4.1. Initial Investigation

Around the Asphalt Pad. Initial investigations in the vicinity of the asphalt pad will consist of 57 surface soil samples (for method see Sec. 11.5.2.1, Surface Soil Samples). The previously sampled area will be expanded to approximately 60 ft from the edges of the pad, with the new samples placed on a 20-ft grid, except at grid nodes in close proximity to previous sampling locations. The planned sampling locations are shown in Fig. 14.2-3.

If elevated contaminant levels in perimeter samples are identified by field laboratory analysis for PCBs (for method see Sec. 11.7.2.2, PCB Field Screening), the grid will be expanded, and additional surface samples will be taken until field laboratory results are uniformly below 10 ppm PCB.

Building TA-21-61. The initial investigation around building TA-21-61 is planned to include six surface soil samples taken within 5 ft of the building perimeter, two samples each on the north, west and south sides (the east side is covered by the grid described above). If elevated contaminant levels are identified by field laboratory analysis for PCBs, additional surface samples will be taken. It is planned that any additional surface samples will be located on grid nodes obtained by extending the 20-ft grid setup for investigations around the asphalt pad. Fig. 14.2-3 shows the planned locations of the initial six samples.

Numbers of Samples/Sample Analysis. For planning purposes, it is assumed that sampling around the asphalt pad results in 57 samples with no extension of the grid and that sampling around building TA-21-61 results only in the initial six samples.

It is planned that 30% of these surface soil samples (19 samples) will be subjected to analytical laboratory analysis for the full suite of analyses (in addition to PCB analyses) to determine if other contaminants are present at the edge of the contaminant plume where field laboratory analyses indicate an absence of contaminants. Based on the results, a more focused analytical suite can

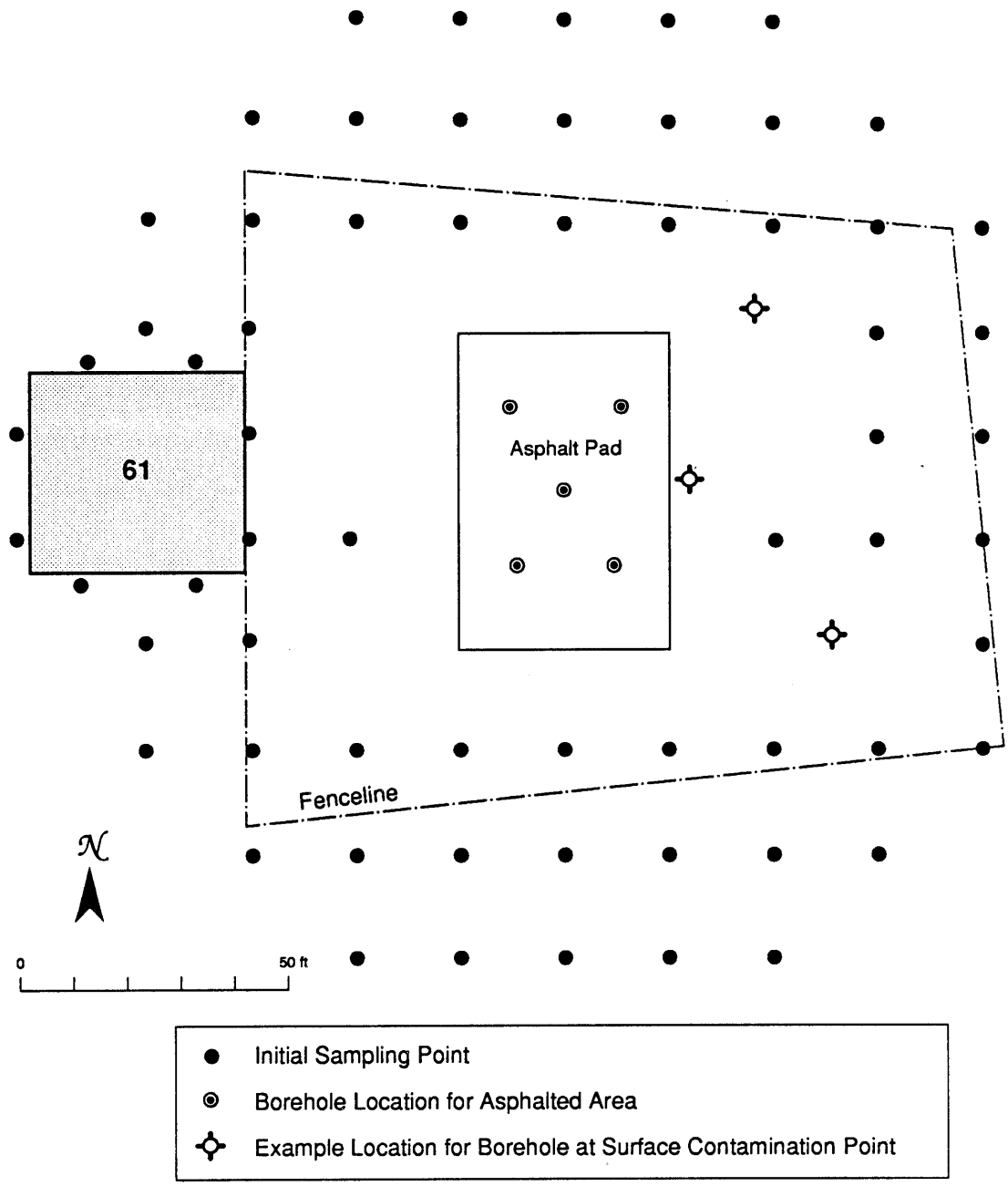

Fig. 14.2-3 Sampling locations at PCB container storage area.

be specified for subsequent sample analyses. The analytical requirements for initial investigation of SWMU 21-003 are shown in Table 14.2-I.

14.2.4.2 Subsequent Investigation

For SWMU 21-003, the subsequent investigation is not optional as it is for some other SWMU investigations. Rather, it is a planned subsequent investigation that allows results from the initial investigation to more closely focus the analytical requirements.

Around Building TA-21-61 and the Asphalt Pad. Based on the results of the initial investigations and the existing data from previous sampling, three boreholes will be sampled in areas of known surface contamination to evaluate the related depth of contamination (for method see Sec. 11.5.3.1, Shallow Boreholes). Figure 14.2-3 shows example locations for such boreholes. The nominal depth for these boreholes is 5 ft. This will result in the collection of six samples. No criterion for deciding to place additional boreholes is presented: it is not expected that additional boreholes will be needed.

Beneath the Asphalt Pad. An array of five boreholes will be sampled through the asphalt pad to determine contaminant concentrations as a function of depth (for method see Sec. 11.5.3.1, Shallow Boreholes). Figure 14.2-3 shows the planned locations for these boreholes. The nominal borehole depth is 10 ft. This will result in the collection of 20 samples. No criterion for deciding to place additional boreholes is presented: it is not expected that additional boreholes will be needed.

Numbers of Samples/Sample Analysis. The depth to which the boreholes will be drilled and sampled will be based on levels of PCBs or other indicator contaminants determined by field screening or field laboratory measurements (for methods see Sec. 11.6 and 11.7). For planning purposes, it is assumed that the boreholes terminate at the nominal depths and that the 26 samples are collected and analyzed in the field laboratory for radioactivity, volatile organics, and PCBs as indicated in Table 14.2-II. In addition, it is assumed that 30% of the samples will be submitted to the analytical laboratory for confirmatory analyses. The assumed analytical requirements for the subsequent investigation for SWMU 21-003 are shown in Table 14.2-II.

Table 14.2-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-003, PCB CONTAINER STORAGE AREA.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Field Laboratory Measurements: Chlorides, Nitrates	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals	Laboratory Analysis: Asbestos	Laboratory Analysis: Ethanol
Asphalt Pad							X																											
Surface Soil Sample	1	0.0 - 6.0 in							X		X			X	X	X	X	X			E	E	E	E	E		E	E	E	E				
	2	0.0 - 6.0 in							X		X			X			X	X																
	3	0.0 - 6.0 in							X		X			X			X	X			E	E	E	E	E		E	E	E	E				
	4	0.0 - 6.0 in							X		X			X	X	X	X	X			E	E	E	E	E		E	E	E	E				
	5	0.0 - 6.0 in							X		X			X	X		X	X																
	6	0.0 - 6.0 in							X		X			X			X	X			E	E	E	E	E		E	E	E	E				
	7	0.0 -, 6.0 in							X		X			X			X	X			E	E	E	E	E		E	E	E	E				
	8	0.0 - 6.0 in							X		X			X			X	X																
Rinsate Blank																																		
Field Blank																																		
	9	0.0 - 6.0 in							X		X			X	X	X	X	X			E	E	E	E	E		E	E	E	E				
	10	0.0 - 6.0 in							X		X			X			X	X																
	11	0.0 - 6.0 in							X		X			X			X	X			E	E	E	E	E		E	E	E	E				
	12	0.0 - 6.0 in							X		X			X			X	X			E	E	E	E	E		E	E	E	E				
	13	0.0 - 6.0 in							X		X			X	X	X	X	X			E	E	E	E	E		E	E	E	E				
Field Duplicate																																		
	14	0.0 - 6.0 in							X		X			X			X	X																
	15	0.0 - 6.0 in							X		X			X			X	X			E	E	E	E	E		E	E	E	E				
	16	0.0 - 6.0 in							X		X			X			X	X																
	17	0.0 - 6.0 in							X		X			X			X	X			E	E	E	E	E		E	E	E	E				
	18	0.0 - 6.0 in							X		X			X			X	X																
	19	0.0 - 6.0 in							X		X			X	X	X	X	X			E	E	E	E	E		E	E	E	E				
	20	0.0 - 6.0 in							X		X			X			X	X																
	21	0.0 - 6.0 in							X		X			X			X	X			E	E	E	E	E		E	E	E	E				

Table 14.2-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-003, PCB CONTAINER STORAGE AREA.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
	22	0.0 - 6.0 in							X		X							X				E	E	E	E								
	23	0.0 - 6.0 in							X		X							X				E	E	E	E								
	24	0.0 - 6.0 in							X		X							X				E	E	E	E								
	25	0.0 - 6.0 in							X		X				X			X				E	E	E	E		X	X	X	X				
Rinsate Blank																																		
Field Blank																																		
Rinsate Blank																																		
	26	0.0 - 6.0 in							X		X				X			X				E	E	E	E		X	X	X	X				
	27	0.0 - 6.0 in							X		X				X			X				E	E	E	E		X	X	X	X				
	28	0.0 - 6.0 in							X		X				X			X				E	E	E	E		X	X	X	X				
	29	0.0 - 6.0 in							X		X				X	X	X	X				E	E	E	E		X	X	X	X				
	30	0.0 - 6.0 in							X		X				X	X	X	X				E	E	E	E		X	X	X	X				
	31	0.0 - 6.0 in							X		X				X	X	X	X				E	E	E	E		X	X	X	X				
	32	0.0 - 6.0 in							X		X				X	X	X	X				E	E	E	E		X	X	X	X				
	33	0.0 - 6.0 in							X		X				X	X	X	X				E	E	E	E		X	X	X	X				
	34	0.0 - 6.0 in							X		X				X			X				E	E	E	E		X	X	X	X				
	35	0.0 - 6.0 in							X		X				X			X				E	E	E	E		X	X	X	X				
	36	0.0 - 6.0 in							X		X				X			X				E	E	E	E		X	X	X	X				
	37	0.0 - 6.0 in							X		X				X	X	X	X				E	E	E	E		X	X	X	X				
	38	0.0 - 6.0 in							X		X				X	X	X	X				E	E	E	E		X	X	X	X				
	39	0.0 - 6.0 in							X		X				X			X				E	E	E	E		X	X	X	X				
	40	0.0 - 6.0 in							X		X				X			X				E	E	E	E		X	X	X	X				
	41	0.0 - 6.0 in							X		X				X	X	X	X				E	E	E	E		X	X	X	X				
	42	0.0 - 6.0 in							X		X				X	X	X	X				E	E	E	E		X	X	X	X				
	43	0.0 - 6.0 in							X		X				X	X	X	X				E	E	E	E		X	X	X	X				
Rinsate Blank	44	0.0 - 6.0 in							X		X				X			X				E	E	E	E		X	X	X	X				

Table 14.2-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-003, PCB CONTAINER STORAGE AREA.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates	Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
Field Blank																										X	X	X	X				
	45	0.0 - 6.0 in							X		X			X	X	X	X	X															
	46	0.0 - 6.0 in							X		X						X	X			E	E	E	E			E	E	E	E			
	47	0.0 - 6.0 in							X		X						X	X															
	48	0.0 - 6.0 in							X		X						X	X															
	49	0.0 - 6.0 in							X		X			X	X	X	X	X			E	E	E	E			E	E	E	E			
	50	0.0 - 6.0 in							X		X						X	X															
	51	0.0 - 6.0 in							X		X						X	X															
	52	0.0 - 6.0 in							X		X						X	X			E	E	E	E			E	E	E	E			
	53	0.0 - 6.0 in							X		X			X	X	X	X	X															
	54	0.0 - 6.0 in							X		X						X	X															
	55	0.0 - 6.0 in							X		X						X	X			E	E	E	E			E	E	E	E			
	56	0.0 - 6.0 in							X		X						X	X															
	57	0.0 - 6.0 in							X		X			X	X	X	X	X															
Building TA-21-61																																	
Surface Soil Sample	1	0.0 - 6.0 in							X		X			X	X	X	X	X			E	E	E	E			E	E	E	E			
	2	0.0 - 6.0 in							X		X						X	X															
	3	0.0 - 6.0 in							X		X						X	X															
	4	0.0 - 6.0 in							X		X						X	X			E	E	E	E			E	E	E	E			
	5	0.0 - 6.0 in							X		X			X	X	X	X	X															
	6	0.0 - 6.0 in							X		X						X	X			E	E	E	E			E	E	E	E			
Rinsate Blank																					X	X	X	X			X	X	X	X			
Field Blank																											X	X	X	X			
Trip [illegible]																											X						

Table 14.2-II

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-003, PCB CONTAINER STORAGE AREA.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements									Laboratory Analysis													
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
Asphalt Pad and Building TA-21-61																																			
Shallow Borehole	1	0.0 - 2.5 ft							X		X	X	X	X	X		X	X					E	E	E	E		E	X			X			
		2.5 - 5.0 ft							X		X	X	X	X	X		X	X																	
	2	0.0 - 2.5 ft							X		X	X	X	X	X		X	X																	
Field Duplicate																													X			X			
		2.5 - 5.0 ft							X		X	X	X	X	X		X	X																	
	3	0.0 - 2.5 ft							X		X	X	X	X	X		X	X																	
		2.5 - 5.0 ft							X		X	X	X	X	X		X	X					E	E	E	E		E	X			X			
Asphalt Pad																																			
Shallow Borehole	1	0.0 - 2.5 ft							X		X	X	X	X	X		X	X																	
		2.5 - 5.0 ft							X		X	X	X	X	X		X	X																	
		5.0 - 7.5 ft							X		X	X	X	X	X		X	X											X			X			
		7.5 - 10.0 ft							X		X	X	X	X	X		X	X					E	E	E	E		E							
	2	0.0 - 2.5 ft							X		X	X	X	X	X		X	X																	
		2.5 - 5.0 ft							X		X	X	X	X	X		X	X											X			X			
		5.0 - 7.5 ft							X		X	X	X	X	X		X	X																	
		7.5 - 10.0 ft							X		X	X	X	X	X		X	X																	
	3	0.0 - 2.5 ft							X		X	X	X	X	X		X	X					E	E	E	E		E	X			X			
Rinsate Blank																							X	X	X	X		X	X			X			
Field Blank																													X			X			
		2.5 - 5.0 ft							X		X	X	X	X	X		X	X																	
		5.0 - 7.5 ft							X		X	X	X	X	X		X	X																	
		7.5 - 10.0 ft							X		X	X	X	X	X		X	X											X			X			
	4	0.0 - 2.5 ft							X		X	X	X	X	X		X	X																	
		2.5 - 5.0 ft							X		X	X	X	X	X		X	X					E	E	E	E		E							

Table 14.2-II

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-003, PCB CONTAINER STORAGE AREA.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
		5.0 - 7.5 ft							X		X	X	X	X	X		X	X				E	E	E	E		X			X			
		7.5 - 10.0 ft							X		X	X	X	X	X		X	X				E	E	E	E		X			X			
	5	0.0 - 2.5 ft							X		X	X	X	X	X		X	X				E	E	E	E	E	X			X			
		2.5 - 5.0 ft							X		X	X	X	X	X		X	X				E	E	E	E	E	X			X			
		5.0 - 7.5 ft							X		X	X	X	X	X		X	X				E	E	E	E	E	X			X			
Field Duplicate									X		X	X	X	X	X		X	X				X	X	X			X			X			
		7.5 - 10.0 ft							X		X	X	X	X	X		X	X				X	X	X			X			X			
Rinsate Blank																																	
Field Blank																																	
Trip Blank																																	

14.3. Aboveground Tanks and Drain Line

14.3.1. Site Description

This section describes the field investigations for three aboveground tanks [SWMUs 21-004(a)–(c)] and a drain line [SWMU 21-004(d)] at TA-21. The locations of these SWMU subunits are shown in Fig. 14.3-1. No information on past releases from these units is available.

14.3.1.1. Site History

Tank TA-21-335, SWMU 21-004(a), is a 6,000-gal. aboveground steel tank, 8-ft in diameter and 16-ft long, installed in 1974 (LANL 1990a). The tank is located about 2 ft above ground surface and is mounted on a steel cradle. The cradle that holds the tank is bolted to a concrete pad that covers the ground surface below the tank. No stains or evidence of leaks were noted on either the tank or the concrete pad during the TA-21 site reconnaissance walk-through (Roy F. Weston 1990).

There are conflicting explanations regarding the origin of the drain line connected to tank TA-21-335. A drawing (LASL 1960) shows a drain line originating from the mechanical room of Building TA-21-21. The drain line is described on the drawing as going to daylight, as well as going to sump TA-21-74. It is unclear, from these two descriptions, where the drain line is connected. Another drawing (LASL 1973) shows the tank connected to a drain line originating from Building TA-21-21, although it is not known where this line originates. A LANL source, onsite when the tank was installed in 1974, stated that the tank was connected to floor drains in building TA-21-21 (Trujillo 1991).

From the time of its installation in 1974, the tank has not been pumped out by HSE-7 (Buchholtz 1991), and there are no documented releases to the tank (Jones 1991; Trujillo 1991).

Tank TA-21-346 consists of two aboveground stainless steel tanks [SWMU 21-004(b)–(c)] located within an asphalt-lined berm, approximately 110 ft north of sump pump TA-21-223 (Fig. 14.3-1). Each tank is 9-ft high and 8 ft in diameter and has a capacity of 3,000 gal. (LANL 1990a). Both tanks are mounted on steel legs above the surface of the asphalt berm (Roy F. Weston 1990). The bermed area is 36-ft long by 18-ft wide and was originally designed to contain 6,000 gal. but actually has a capacity closer to 9,600 gal. (LASL 1979).

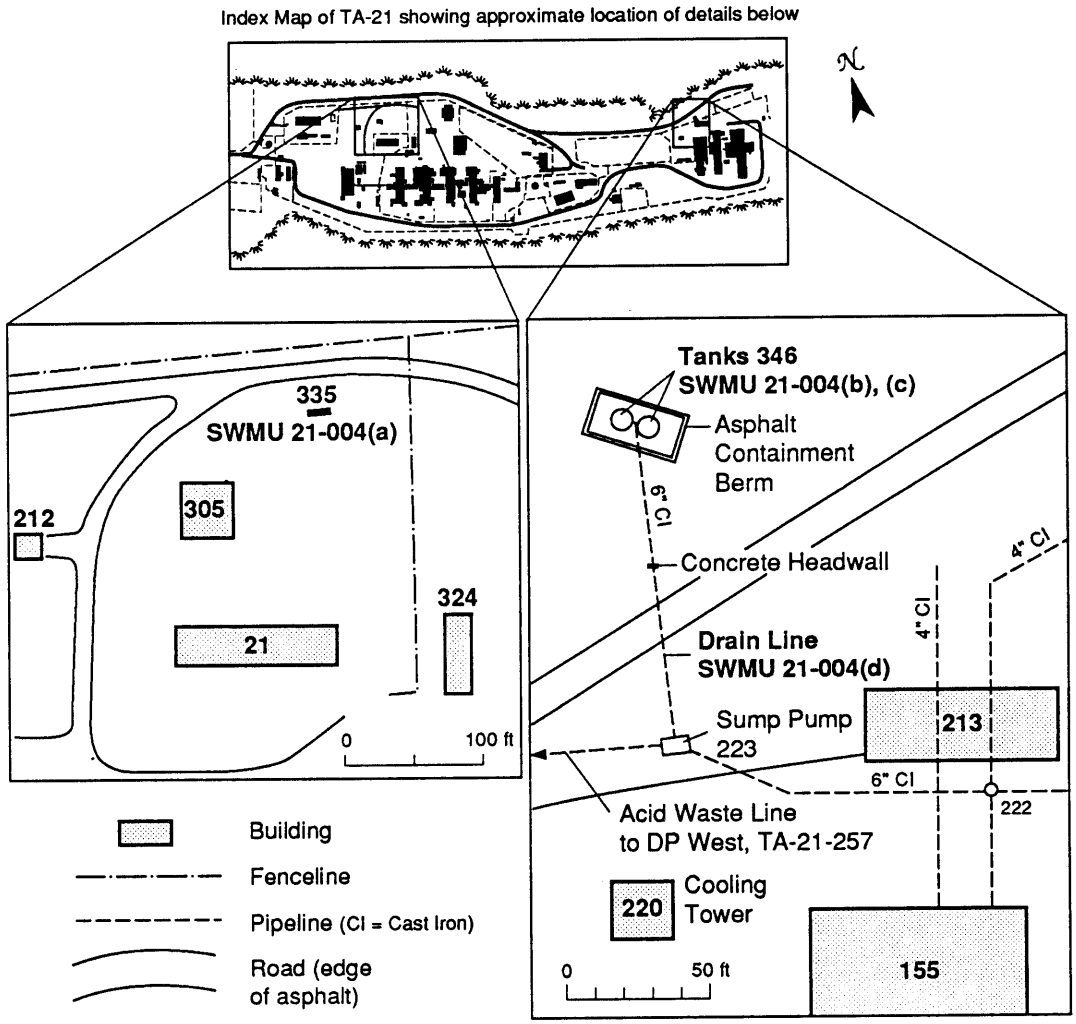

Fig. 14.3-1 Locations of the TA-21 aboveground tanks SWMU 21-004(a), (b), and (c) and the drain line [SWMU 21-004(d)] from sump TA-21-223 to aboveground tanks TA-21-346 [SWMU 21-004(b), (c)]. (LASL 1979; LANL 1983a)

pre-existing 6-in. drain line, SWMU 21-004(d), originating from sump pump TA-21-223. The sump pump is connected to the main TA-21 acid waste line and is responsible for pumping liquid waste produced at DP East to Building TA-21-257 at DP West for treatment (Fig. 14.3-1). The two tanks were installed to receive liquid waste from the sump, if it were to overflow.

Tanks TA-21-346 are reported to have been pumped out on two occasions over the past 12 years of operation. This liquid waste was sent back into sump TA-21-223. No leaks from the tanks or releases to the berm or the environment have occurred (Buchholtz 1991). No leaks on the tanks

or stains on the asphalt berm were observed during the TA-21 site reconnaissance walk-through (Roy F. Weston 1990).

A drain line, SWMU 21-004(d), discharged overflow from sump TA-21-223 directly into DP Canyon prior to 1964 and until 1979 when the tanks described above were installed (LASL 1967). The drain line was 61-ft long with a 6-in. diameter. Sometime during this 15-yr period, 14 ft of pipe was added to the end of the drain line, but any overflow from the sump would have continued to go to DP Canyon. During this time, the sump was not equipped with an overflow alarm system, and no discharges were documented (Garde 1975). The outfall from this drain line is addressed in Sec. 15.8. In 1979, the 14-ft section of pipe was replaced with 50 ft of new pipe, and the drain line was connected to tanks TA-21-346 (LASL 1979) as described above.

14.3.1.2. Existing Information

Tank TA-21-335. No data exist regarding contamination in or releases from SWMU 21-004(a). Some sample analysis results are available for outfall SWMU 21-024(l) (see Sec. 15.2), which is believed to have been located to the northeast of tank TA-21-335. The results showed zinc, ^{241}Am, $^{239/240}Pu$, and tritium to be present in concentrations above the normal background level for LANL (Ferenbaugh 1990; Purtymun et al. 1987). Semivolatile organic compounds present in concentrations above detection limits were all PAHs that are common constituents of asphalt. Therefore, they are not considered further.

Tank TA-21-346 and Drain Line. SWMUs 21-004(b)–(d) have received liquid waste from sump pump TA-21-223 and are assumed to be contaminated. No releases from the tanks to the asphalt berm or the environment are documented, and no chemical or radiological analyses have been performed on the liquid waste contained in the tanks TA-21-346 (Buchholtz 1991). Some sample analysis results are available for the outfall SWMU21-004(d), which predated SWMUs 21-004(b-c) (see Sec. 15.8). Mercury, $^{239/240}Pu$, and tritium were found to be present at concentrations above normal background level (DOE 1989).

14.3.1.3. Source Term

Tank TA-21-335. Vault TA-21-21 was used for storage of uranium and plutonium metal. Floor drains in the main vault rooms and the mechanical room of Building TA-21-21 might have carried liquids contaminated with uranium, plutonium, and organics. Although these contaminants may be suspected, no evidence exists that any liquids have reached SWMU 21-004(a) or have been released to the environment from it.

Tanks TA-21-346 and Drain Line. Waste potentially reaching SWMUs 21-004(b)–(d) is liquid industrial waste from DP East. This waste generally consists of diluted laboratory wastes and liquids from chilled water systems originating from operations at DP East. The waste discharged to the tanks may have been contaminated with tritium (Buchholtz 1991), polonium, and actinium (Merrill 1990), mercury and $^{239/240}Pu$, (DOE 1989). Other contaminants that may be present in the waste received by the tanks include uranium and thorium because materials containing these radionuclides were stored at DP East at the time of the TA-21 site reconnaissance walk-through (Roy F. Weston 1990). Chemical contaminants released to these tanks have not been documented (LANL 1990a).

14.3.2. Objectives and Data Needs

The objective of this investigation is to confirm the absence of contamination at SWMU 21-004. Specific data required to assess contamination at SWMU 21-004 include the following:

1. Identify contaminants present within or on tanks TA-21-335 and TA-21-346 using Level II data. No data exist regarding contamination in or releases from these tanks, although tank TA-21-346 may have received contaminated waste from a sump.

2. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by surface and subsurface soil sampling and Level III analyses.

14.3.3. Field Sampling/Investigation Rationale

Tank TA-21-335. Because no information is available regarding releases to or from SWMU 21-004(a), preinvestigation sampling will determine whether the tank contents are contaminated. This preinvestigation activity will consist of monitoring the outside of the tank, the concrete pad beneath the tank, and the exposed portion of the drain line connected to the tank with radiological survey instruments and will include sampling the inside of the tank and its contents. The presence of contamination in the tank will justify further investigation of potential releases to the environment. Detecting no contamination in the tank will end the investigation in the area because no environmental contamination could have resulted from an uncontaminated tank.

The initial investigation (if required) will consist of a radiological survey of the area around tank TA-21-335. Areas of above-background level readings will be marked for soil sampling. If no above-background level areas are identified, surface sampling will be conducted at predetermined locations to confirm the survey results and to address nonradiological contaminants.

The surface samples will be submitted for laboratory analysis and will be subjected to a full

analytical suite to determine the types and concentrations of contaminants present. If contaminants are identified in the initial surface soil samples, then a subsequent investigation will collect subsurface samples from boreholes located in close proximity to the surface sampling locations to investigate the presence of contamination at depth.

In the subsequent sampling, the lateral extent of contamination, either at depth or on the surface, will be addressed by expanding the sampling program to include surface or subsurface soils of a wider area. Analytical results from the the initial samples will be used to limit the analytical suites specified for samples collected in the subsequent investigation.

Tanks TA-21-346. Because SWMUs 21-004(b)–(c) have received liquid waste from sump TA-21-223, the tanks are assumed to be contaminated. Therefore, investigation of the area around tanks TA-21-346 is warranted. A radiological survey within the asphalt containment berm will be performed to identify any above-background level readings that might suggest that environmental releases have occurred. Because the radiological survey will only detect the presence of radionuclides and not any other potential contaminants, two shallow boreholes will be drilled on the downgradient side of the berm to identify any other contaminants that were not detected during the survey. These contaminants may have been washed over the edges of the containment berm onto the soil or leaked through the berm to the environment at depth. A full analytical suite will be performed on the samples.

As a subsequent investigation, if contamination is found in the samples, the sampling program will be expanded over a wider area to define the extent of surface or subsurface contamination. Initial analysis results will be used to limit the analytical suites specified for samples collected in later investigations.

The drain line, SWMU 21-004(d), which connects tanks TA-21-346, SWMU 21-004(b)–(c), to sump pump TA-21-223 (see Fig. 14.3-2) will not be investigated in this sampling plan. The presence of contamination resulting from the original outfall from sump pump TA-21-223 will be addressed with regard to the outfall SWMU 21-024(d) (see Sec. 15.8).

14.3.4. Sampling Plan

14.3.4.1. Preinvestigation Sampling at Tank TA-21-335

The outside of tank TA-21-335, the concrete pad, and the exposed portion of the drain line feeding the tank will be surveyed with hand-held instruments (for method see Sec. 11.4.1).

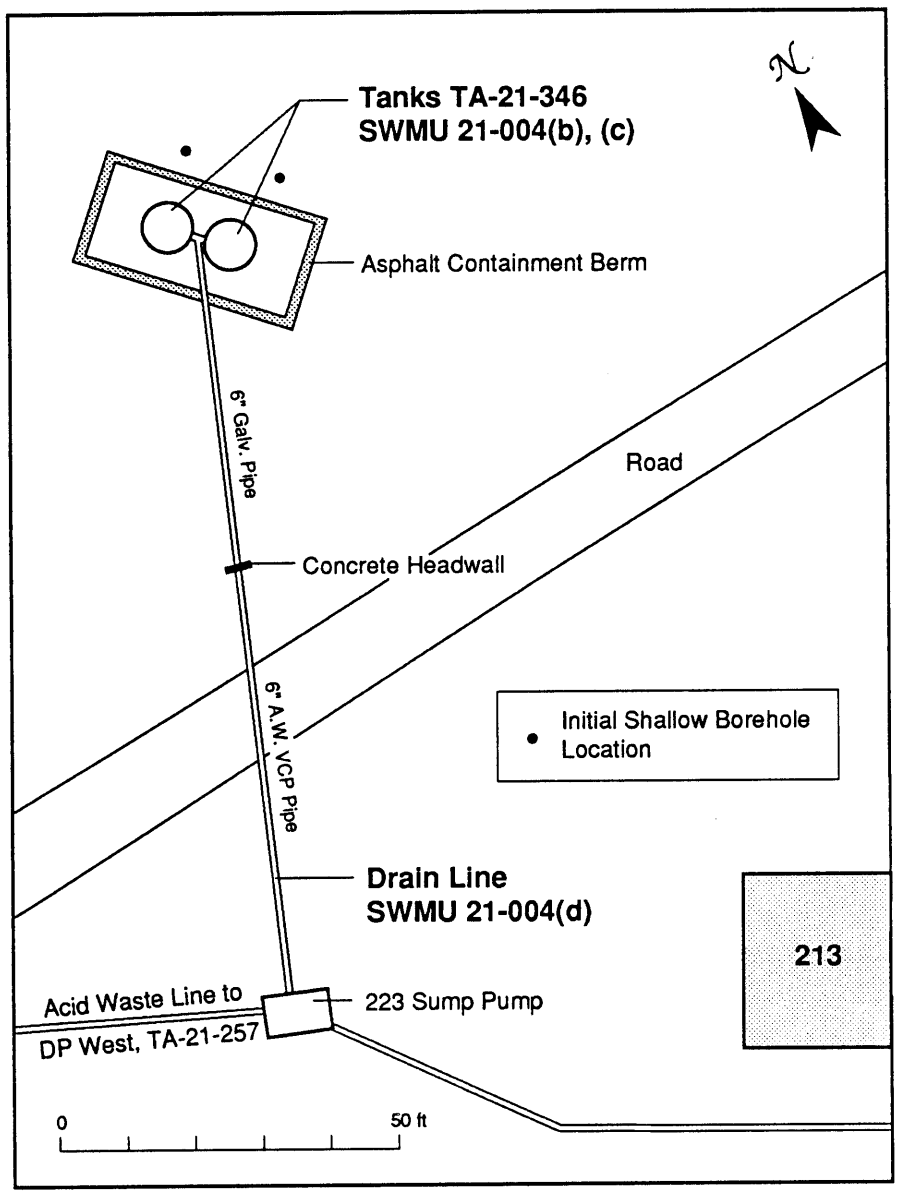

Fig. 14.3-2 Locations of the initial shallow boreholes to be drilled on the downgradient side of the asphalt berm at tanks TA-21-346. (LASL 1979)

Sampling within the tank will also be conducted (for method see Sec. 11.5.5). Because tank TA-21-335 has not received any documented releases, it is expected to be dry when sampling is performed (LANL 1990a; Trujillo 1991). A dry tank will require the collection of three replicate filter-paper swipes along the bottom of the tank (for method see Sec. 11.5.5.2). A tank containing liquid or sludge will require three replicate samples of the liquid (for method see Sec. 11.5.5.1). The purpose of tank sampling is not to gain quantitative data but only to determine if contamination is present in the tank; therefore, samples (swipes or liquid) will be sent to the field laboratory for analysis.

A total of three samples will be taken during tank sampling. The surveying and sample analysis requirements for the initial phase of the investigation are shown in Table 14.3-I. If no contamination is identified, no further action will be taken at tank TA-21-335.

14.3.4.2 Initial Investigation

Tanks TA-21-346. A radiological survey will be performed on the inside of the containment berm to assess whether environmental releases have occurred (for method see Sec. 11.4.1). In addition, two shallow boreholes will be drilled to a nominal depth of 5 ft on the downgradient (north) side of the asphalt berm (for method see Sec. 11.5.3.1) to identify any contamination that may have been released beneath the berm (Fig. 14.3-2).

A total of four samples will be analyzed from the area downgradient of tanks TA-21-346. The screening and sample analysis requirements for the initial phase of the investigation are shown in Table 14.3-I. If either no contamination is identified or contaminants are present at levels representative of TA-21 background level as determined by surface-sampling investigations detailed in Chapters 12 and 13, no further action will be taken at tanks TA-21-346.

Tank TA-21-335. If contamination is identified in the preinvestigation sampling, in the initial investigation a radiological survey of the area around the tank and the exposed portion of the drain line will be conducted within 15 ft of the structures (for methods see Sec. 11.4.1). Any areas of above-background level readings within the 15-ft area around the tank and the drain line will be marked and potentially sampled.

A total of three surface soil samples will be taken (for method see Sec. 11.5.2.1) from the marked areas having the highest readings. In addition, two surface soil samples will be taken at the northern and eastern edges of the concrete pad below the tank (Fig. 14.3-3).

If no areas of above-background level readings are identified from the radiological survey, the three surface samples that would have been taken in the areas of highest readings will be taken from the area around the tank and the drain line. Two will be taken at the southern and western edges of the concrete pad, and the third will be taken from a location along the drain line (Fig. 14.3-3).

A total of five surface samples will be taken from the area around tank TA-21-335 and its associated drain line. The samples will be submitted to the analytical laboratory. The analytical requirements for the initial investigation are shown in Table 14.3-I. If the five surface samples are found to be uncontaminated, the field investigation will end at this phase.

Table 14.3-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-004, ABOVEGROUND TANKS AND DRAINLINES.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis													
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
Tank Survey TA-21-335																																	
Outside of Tank				X	X																												
Concrete Pad				X	X																												
Drainline				X	X																												
Tank Sampling TA-21-335																																	
Three filter swipes if dry														X	X																		
Three liquid samples if it contains liquid.														X	X		X																
Tank TA-21-346																																	
Radiological Survey				X	X																												
Shallow Borehole	1	0.0 - 2.5 ft						X	X		X	X	X	X	X		X					X	X	X	X		X	X	X	X				
		2.5 - 5.0 ft						X	X		X	X	X	X	X		X																
	2	0.0 - 2.5 ft						X	X		X	X	X	X	X		X																
		2.5 - 5.0 ft						X	X		X	X	X	X	X		X					X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
Trip Blank																												X						
Tank TA-21-335																																	
Radiological Survey				X	X																												
Surface Soil Sample	1	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
	2	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
	3	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
	4	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
	5	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				

Table 14.3-1

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-004, ABOVEGROUND TANKS AND DRAINLINES.

Sample Identification	Interval	Sampling Location	Sample Type		
			Rinsate Blank		
			Field Blank		
			Trip Blank		
				Gross Gamma	Field Surveys
				Low-Energy Gamma	
				Electromagnetic	
				Land Survey	
				Gross Gamma	Field Screening
				Gross Alpha	
				Organic Vapor	
				Combustible Gas/Oxygen	
				Lithological Logging	
				Gross Alpha	Field Laboratory Measurements
				Gamma Spectrometry	
				Tritium	
				Volatile Organics	
				PCB	
				Soil Moisture	
				Chlorides, Nitrates	
			X	Gamma Spectrometry	Laboratory Analysis
			X	Tritium	
			X	Total Uranium	
			X	Isotopic Plutonium	
				Isotopic Uranium	
			X	Strontium 90	
		X	X	VOA (SW 8240)	
		X	X	Semivolatiles (SW 8270)	
		X	X	Metals (SW 6010)	
				PCB (SW 8080)	
				TCLP Metals	
				Asbestos	
				Ethanol	

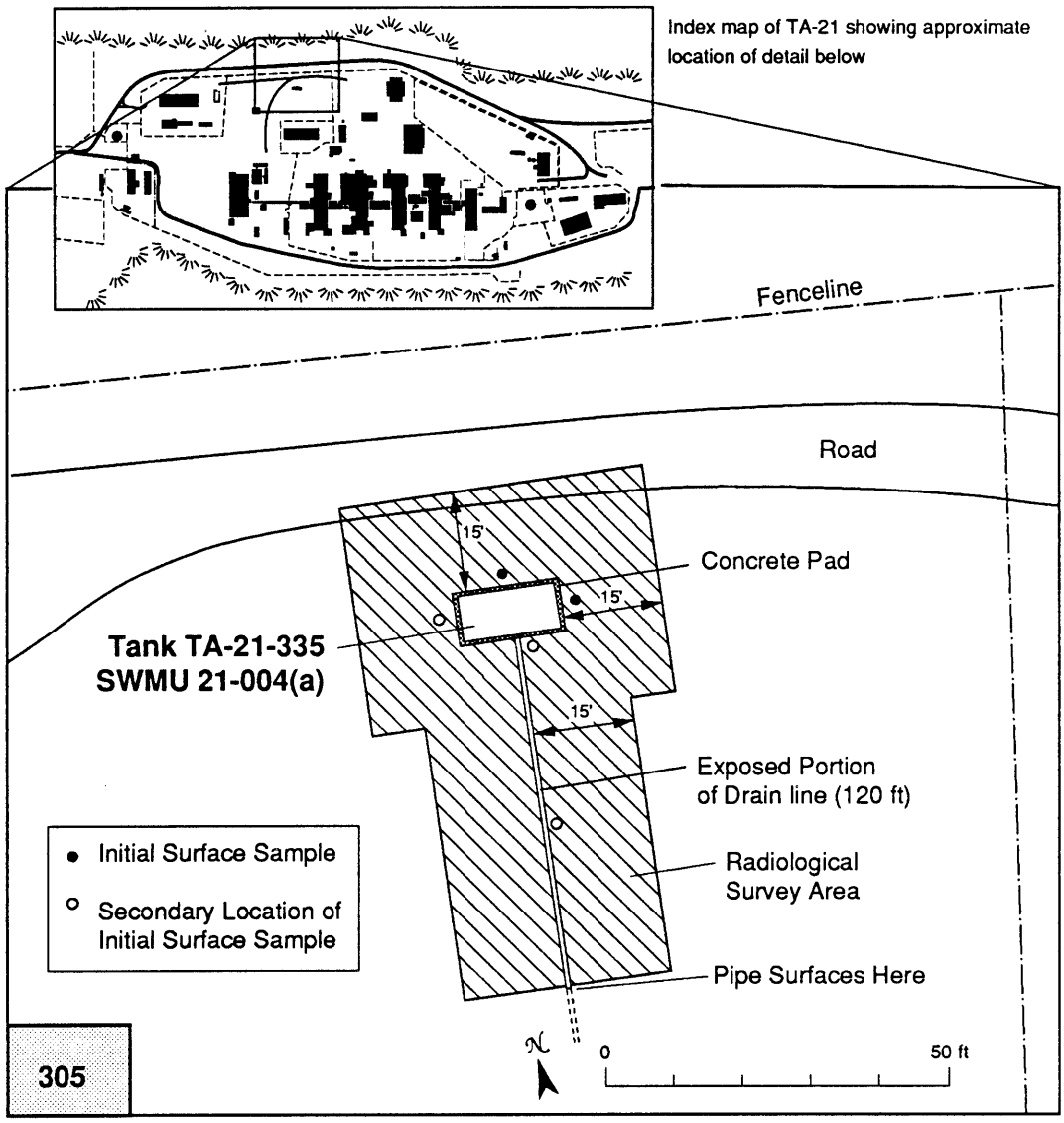

Fig. 14.3-3 Schematic showing the radiological survey around tank TA-21-335 and the drain line connected to the tank. Also shown are the two initial surface sampling locations and the three secondary sampling locations.

14.3.4.3 Subsequent Investigation

Tank TA-21-335. Although unexpected, if any surface soil samples are found by analytical laboratory analysis to be contaminated, shallow boreholes will be drilled to a nominal depth of 5 ft, in close proximity to the surface sampling locations to determine if deeper contamination is present (for method, see Sec. 11.5.3.1). For planning purposes, it is assumed that no subsequent investigation of surface or subsurface samples will be required.

Tanks TA-21-346. If contamination is found in the initial boreholes, the subsequent investigation in the area of these tanks will use additional surface soil samples (for method see Sec. 11.5.2.1) or shallow boreholes (for method see Sec. 11.5.3.1) to define the extent of contamination. A nominal depth of 5 ft would be used for each of the additional boreholes, unless initial results indicate another depth is appropriate. Additional borehole or surface sample locations would be placed at 20-ft spacings in an outward direction from the initial sampling points. However, for planning purposes it is anticipated that no additional boreholes or surface samples will be required.

14.4. Active Container Storage Areas

14.4.1 Site Description

This grouping of SWMUs addresses active sites that have historically been used as container storage areas (SWMU 21-028). Five subunits are included. SWMU 21-028(a) is discussed with MDA T in Sec. 16.3. SWMU 21-028(b) contains satellite container storage areas within buildings and is addressed in Chapter 20 as No Further Action Units. SWMU 21-0128(c) is addressed in Chapter 18 in conjunction with building decontamination and decommissioning. The remaining two subunits, SWMUs 21-028(d) and (e), are considered here. SWMU 21-028(e) units, located within Building 210, are addressed in Chapter 20.

These sites are currently a RCRA 90-day storage area and a satellite container storage area. However, the use of these areas predates those RCRA definitions, and concerns must be addressed regarding prior spills from waste containers. These sites will be investigated to confirm that there have been no prior environmental releases.

14.4.1.1 Site History

SWMU 21-028(d) is a 90-day storage site located on a 3-ft square concrete dock on the northwest side of Building TA-21-209, shown in Fig. 14.4-1. Building 209 is currently used for high-temperature chemistry, and in this building tritium is used for research. The starting date for the use of this area is assumed to be 1965, the date construction was completed (Nyhan 1990). Materials stored on the dock are

- 55-gal. drums of lithium-deuterium waste;
- 30- and 55-gal. drums of fissionable waste (waste containing natural uranium, natural thorium, ^{235}U, ^{238}U, ^{228}Th, ^{230}Th, and ^{232}Th); and
- gas cylinders of tritium-contaminated hydrogen and argon gas (Roy F. Weston 1990).

Containers not specifically labeled as waste but stored in the same area include

- cylinders of deuterium, argon, nitrogen, helium, and compressed hydrogen;
- 55-gal. drums of oil;
- acetone, convoil 20, ethanol, ethyl alcohol; and
- various solvents stored in a chemical safety cabinet (Roy F. Weston 1990).

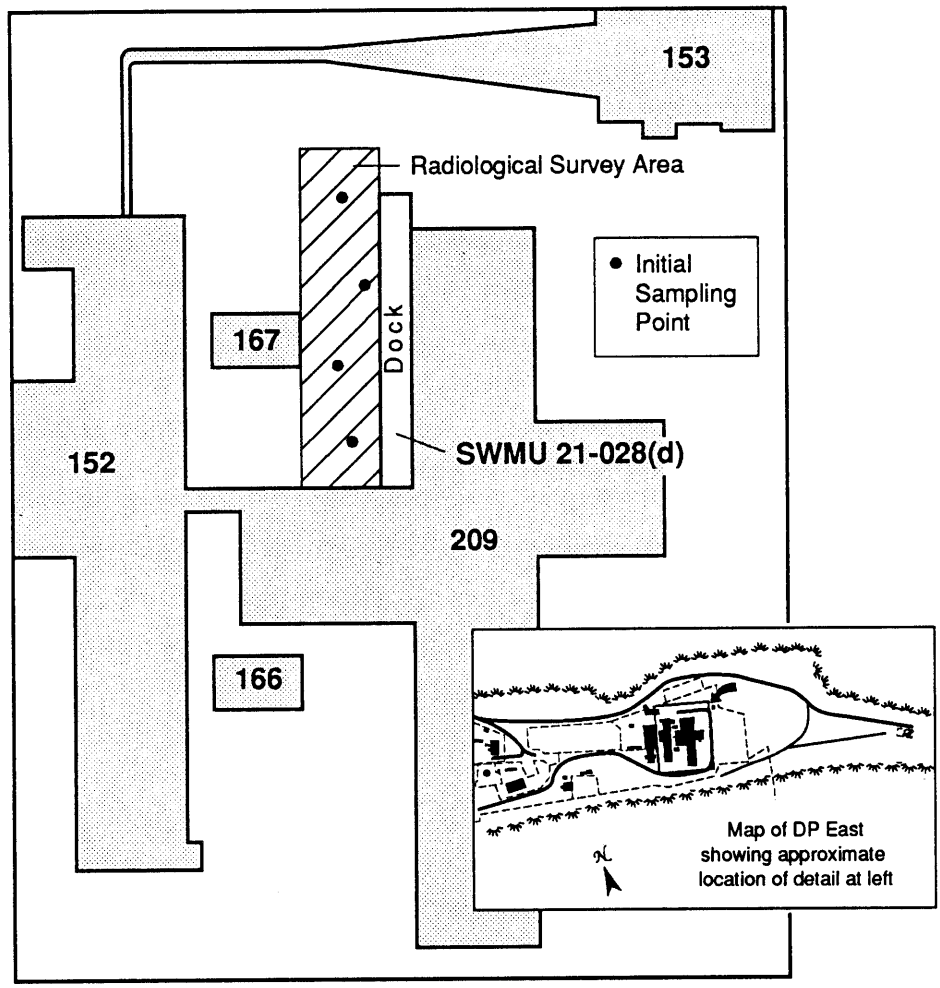

Fig. 14.4-1 Location of SWMU 21-028(d), radiological survey area, and potential sampling points. (LASL 1964)

SWMU 21-028(e) consists of three satellite container storage areas located at TA-21-210, shown in Fig. 14.4-2. The areas inside Room 128 and inside the south lab in Room 120 are addressed in Chapter 20. Only the area outside the north loading dock is considered here.

The starting date for the use of the north dock of Building TA-21-210 is assumed to be 1965, the date of construction (Nyhan 1990). The building is being used for geological core analysis (Roy F. Weston 1990) and, in the past, was listed as office space for plutonium research (LANL 1983c).

Materials reported stored on the north dock are

- alcohol, acetone, freon, acetone-contaminated wipes, and vacuum pump oil (LANL no date).

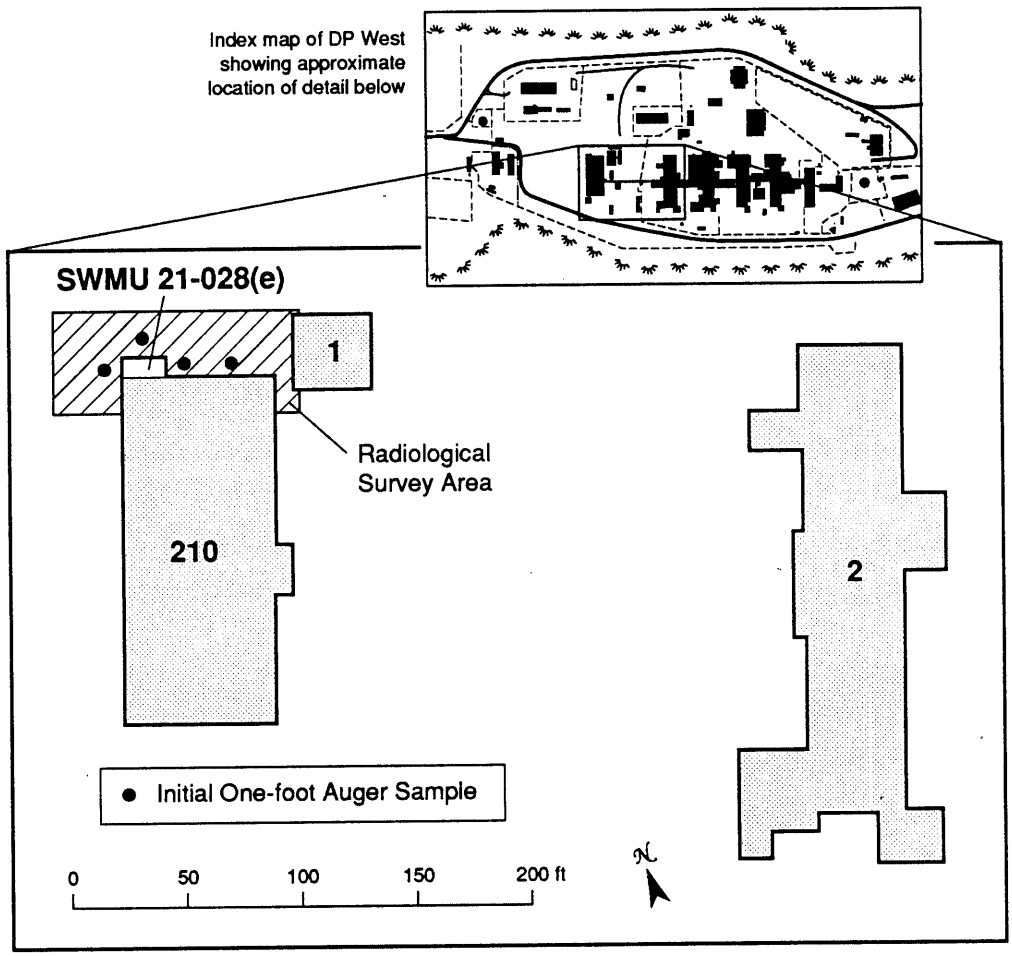

Fig. 14.4-2 Location of SWMU 21-028(e), radiological survey area, and potential sampling points. (LASL 1976)

During the TA-21 site reconnaissance walk-through, light cutting oil, dark cutting oil, sulfur-free cutting oil, and gas cylinders of helium and nitrogen were also observed on the dock. In addition, a chemical safety cabinet containing gasoline, freon, and acetone was located just east of the dock on the ground (Roy F. Weston 1990). Of the materials listed above, only the "acetone-contaminated wipes" labeling indicates waste.

14.4.1.2 Existing Information

No data exist regarding contamination on or around the docks of TA-21-209 and TA-21-210.

14.4.1.3 Source Term

There is no documentation of previous spills. No stains were noted on the docks or on the asphalt surrounding the docks (Roy F. Weston 1990). However, fissionable wastes at TA-21-209 and acetone-contaminated wipes at TA-21-210 were present. The source term would include those wastes as an indicator of the wastes that have historically been stored in those locations.

14.4.2 Objectives and Data Needs

The objective of this investigation is to confirm the absence of contamination at SWMU 21-028. Specific data required to assess contamination at SWMUs 21-028(d) and (e), are to identify the contaminants present using Level II and III data. Contamination may be associated with the docks on the northwest side of TA-21-209 and on the north side of TA-21-210.

14.4.3 Sampling/Investigation Rationale

Spills at either loading dock would be impeded from infiltrating the soil by the widespread asphalt pavement in both areas. Only spills predating the pavement would potentially be present beneath the pavement. The date the area was paved is not known but is probably the same as the date of the construction of the buildings. The initial investigation of these areas will consist of field radiological surveys of the areas around the docks and near surface soil samples from beneath the pavement in the immediate vicinity of the docks.

A full analytical suite will be used for these samples. Data interpretation will need to take into account contaminants that may be related to the asphalt pavement rather than waste spills.

If significant contamination is encountered in any of the samples, a subsequent investigation to collect surface and subsurface soil samples may be required. The analytical suite for the subsequent sampling may be adjusted to address more specific analytes based on the initial investigation.

14.4.4 Sampling Plan

14.4.4.1 Initial Investigation

SWMU 21-028(d). A 130-ft by 20-ft area will be marked off for field radiological surveys, as shown in Fig. 14.4-1 (for method see Secs. 11.4.1.1 and 11.4.1.2). The radiological survey will

identify contamination on the pavement from spills of radioactive material and may serve as a guide for selecting locations for soil sampling.

Four near-surface soil samples (to a 6-in. depth, after the removal of asphalt and base material) will initially be taken in the surveyed area (for method see Sec. 11.5.2.1). The sample locations will be placed in the areas of the highest readings from the field radiological surveys. If high readings are not noted, the placement of the sample locations should be as in Fig. 14.4-1.

SWMU 21-028(e). Radiological contamination is not expected here; however, a confirmatory field radiological survey will be conducted in the area identified in Fig. 14.4-2 (for methods see Secs. 11.4.1.1 and 11.4.1.2). If elevated readings are noted, soil-sampling locations will be placed at those points. Otherwise, four near-surface soil samples (to a 6-in. depth, after the removal of asphalt and base material) will be taken around the north dock at the locations identified in Fig. 14.4-2 (for methods see Sec. 11.5.2.1).

The investigations at these two SWMUs will result in eight soil samples. All samples will be submitted to the analytical laboratory for a full analytical suite. Analysis requirements are identified in Table 14.4-I. If no contamination is identified, no further action will be taken at SWMUs 21-028(d) and (e).

14.4.4.2 Subsequent Investigation

If contamination is detected in the initial soil samples, shallow boreholes will be used to investigate the presence of deeper contamination (for method see Sec. 11.5.3.1). A nominal depth of 10 ft will be used. Additional near-surface samples or shallow boreholes will be placed at 20-ft spacings until the lateral extent of contamination is determined.

For planning purposes, it is assumed that no subsequent investigation will be required.

Table 14.4-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMUS 21-028(D) AND (E), ACTIVE CONTAINER STORAGE AREAS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Field Laboratory Measurements: Chlorides, Nitrates	Field Laboratory Measurements:	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals	Laboratory Analysis: Asbestos	Laboratory Analysis: Ethanol
SWMU 21-028(d) Dock Area																																			
Radiological Survey				X	X																														
Near Surface Soil	1	0.0 - 6.0 in*						X	X		X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	2	0.0 - 6.0 in*						X	X		X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Field Duplicate																																			
	3	0.0 - 6.0 in*						X	X		X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	4	0.0 - 6.0 in*						X	X		X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
SWMU 21-028(e) Dock Area																																			
Radiological Survey				X	X																														
Near Surface Soil	1	0.0 - 6.0 in*						X	X		X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	2	0.0 - 6.0 in*						X	X		X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	3	0.0 - 6.0 in*						X	X		X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	4	0.0 - 6.0 in*						X	X		X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Rinsate Blank																						X	X	X	X		X	X	X	X	X	X	X	X	X
Field Blank																						X	X	X	X		X	X	X	X	X	X	X	X	X
Trip Blank																																			

* depth beneath removed asphalt pavement and base material

14.5. DP Tank Farm

14.5.1. Site Description

TA-21 contains a release-site identified as the DP Tank Farm, SWMU 21-029. The DP Tank Farm site is the former location of 15 fuel storage tanks and two fill stations located on the north side and at the far west end of DP Road (Zia Company 1948). All tanks and structures were decommissioned and removed in 1988. Sample analysis results indicate little potential for significant environmental contamination.

14.5.1.1. Site History

The DP Tank Farm, consisting of 15 tanks, was located near the northern edge of DP Mesa on a slope that descends from DP Road into DP Canyon. An earthen berm 4-ft high ran for 397 ft along the northern site boundary. A storm drain line extended through the northeastern corner of the earthen berm and discharged to an outfall in DP Canyon (Fig. 14-5.l).

The tank farm was active from January 1946 until February 1985 (Pan Am 1986). Tank removal was completed by July 1988. Descriptive information for the 15 tanks is presented in Table 14.5-l. There are discrepancies in the reported substances stored in the tanks. Each tank may have stored different products at different times; however, all of the tanks appear to have stored petroleum hydrocarbon products. Tank TA-21-ATF-11 may also have stored ethanol.

Of the 15 tanks that were excavated and removed in 1988, only one tank was found to have leaked. Tank TA-21-ATF-10 was found to have a leaking gasket (McInroy 1988). It is assumed that the leaking gasket was located where the gravity flow pipe met the tank. Approximately 4 cu yd of contaminated soil was removed. This tank contained diesel fuel; therefore, the contaminated soil was not considered a hazardous waste (Gunderson 1985).

14.5.1.2. Existing Information

Between November 1984 and July 1988, a number of sampling events took place. A variety of samples was obtained from different areas of the Tank Farm. Liquid and sludge samples from the tanks, as well as surface and subsurface soil samples, were taken to determine the presence of hazardous waste. The discussion below identifies general areas of potential contamination.

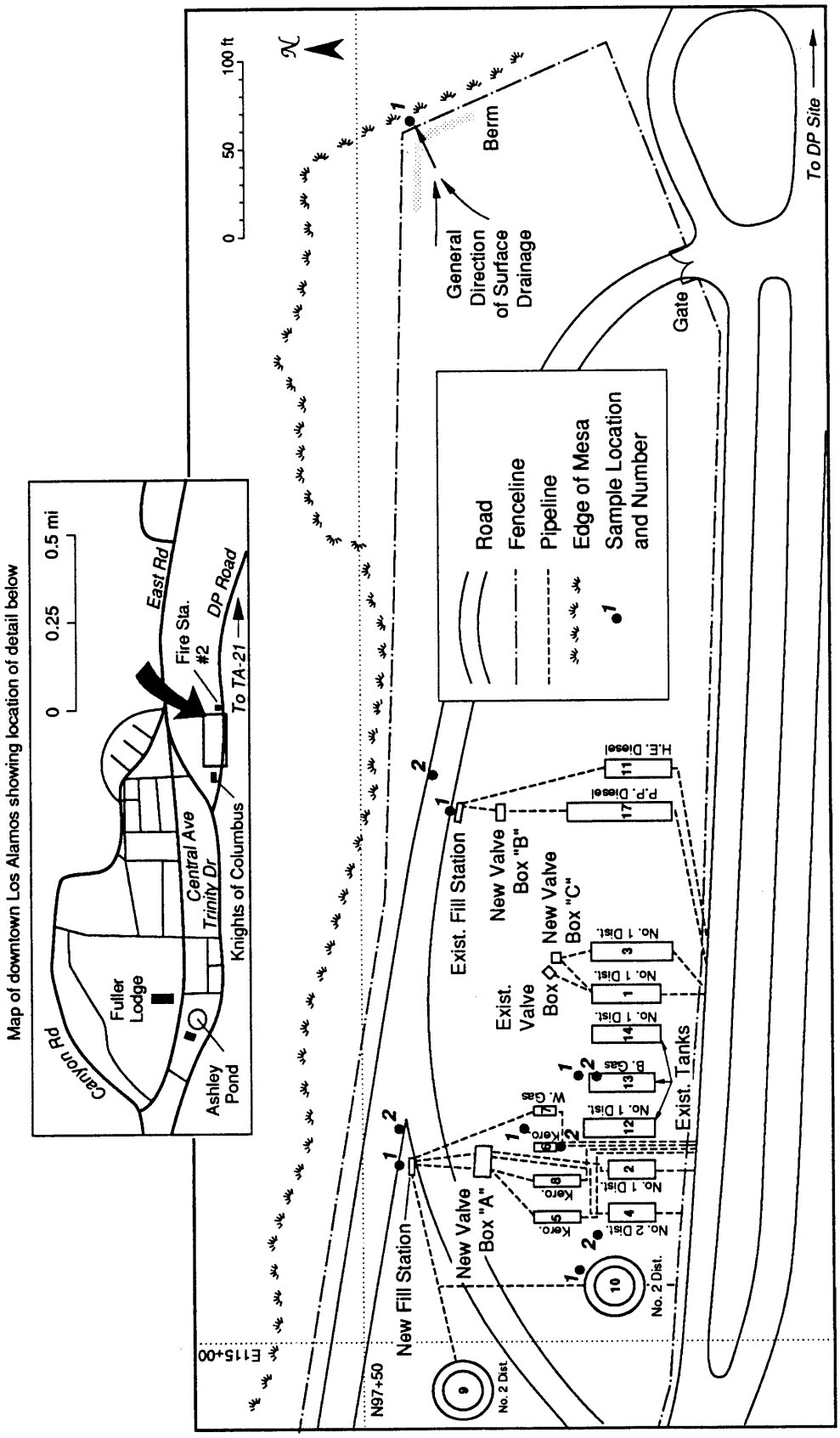

Fig. 14.5-1 Sampling locations for the field investigation of the former DP Tank Farm, SWMU 21-029 (shown as built). (Zia Company 1948)

TABLE 14.5-I
DESCRIPTION OF FORMER STORAGE TANKS AT DP TANK FARM (SWMU 21-030)[a]

Tank No.	Tank Structure Number	Capacity (gallons)	Substance Stored
1	TA-21-ATF-1	28,500 or 21,000	No. 2 fuel oil or diesel
2	TA-21-ATF-2	14,900 or 21,500 or 14,994	No. 2 fuel oil or diesel
3	TA-21-ATF-3	23,900 or 26,000 or 23,967	No. 2 fuel oil or diesel
4	TA-21-ATF-4	14,900 or 22,000 or 14,994	No. 2 fuel oil or diesel
5	TA-21-ATF-5	5100 or 5500 or 5170	kerosene or diesel
6	TA-21-ATF-6	2100 or 3000 or 2099	kerosene or gasoline
7	TA-21-ATF-7	2900 or 2500 or 2978	kerosene or leaded gasoline or gasoline
8	TA-21-ATF-8	5100 or 5500 or 5170	kerosene or diesel
9	TA-21-ATF-9	21,600 or 25,000 or 21,644	No. 2 fuel oil or diesel
10	TA-21-ATF-10	21,600 or 25,000 or 21,644	No. 2 fuel oil or diesel
11	TA-21-ATF-11	23,900 or 38,000 or 23,967	diesel or leaded gasoline or ethanol alcohol

Tank No.	Tank Structure Number	Capacity (gallons)	Substance Stored
12	TA-21-ATF-12	20,200 or 38,000 or 20,266	No. 2 fuel oil or kerosene
13	TA-21-ATF-13	24,700 or 36,000 or 24,770	gasoline or diesel
14	TA-21-ATF-14	20,200 or 26,500 or 20,226	No. 2 fuel oil or diesel
17	TA-21-ATF-17	51,000 or 49,000 or 51,015	diesel or leaded gasoline or gasoline

IT Corp. 1987; LANL 1989a; Pan Am. 1986a; and Zia Co. 1983.

Tanks

In 1985, liquid and sludge samples from the tanks were taken to determine if they must be classified as a hazardous waste (Gunderson 1985). The results indicated that the contents were mainly petroleum distillates and, in one instance, up to 50% ethyl alcohol (Fritz 1985). Analysis of the liquids for radiation showed no contamination (Montoya 1986). The information contained in this section was obtained from memos. The analytical methods, original laboratory reports, and chain of custody reports were not available.

Surface Soils

In 1984 and 1985, surface soils were obtained at the drain outfall, the fill stations, and along the southern base of the berm. A summary of the results is given in Tables 14.5-II and 14.5-III (Fritz 1985). Lead results were all less than the detection limit of 1 µg/L (LANL 1988b). Seven of eleven samples analyzed for arsenic were below the detection limit of 0.0016 mg/L. The concentration of arsenic in the remaining samples was very low and on the same order-of-magnitude as

TABLE 14.5-II
ANALYSES OF SOIL SAMPLES COLLECTED NOVEMBER 27, 1984 FROM DP ROAD TANK FARM[a]

Sample Location[b]	Lead Results ($mg\ L^{-1}$)	Arsenic Uncertainty (±)	Net Total[c] Results ($mg\ L^{-1}$)	Uncertainty (±)	Organic ($mg\ g^{-1}$)
B-2	<0.100	0.012	0.0019	0.0005	<19.0
B-4	<0.100	0.018	<0.0016	0.0001	<19.0
B-5B	<0.100	0.021	0.0025	0.0005	20.0
B-6	<0.100	0.042	<0.0016	0.0003	<19.0
B-8	<0.100	0.044	<0.0016	0.0002	<19.0
B-9W	<0.100	0.026	<0.0016	0.0003	<19.0
B-9E	<0.100	0.019	<0.0016	0.0004	20.0
B-10	<0.100	0.060	<0.0016	0.0002	<19.0
B-10E	<0.100	0.088	0.0042	0.0005	9.5
B-11	<0.100	0.030	0.0027	0.0004	0.5
B-11B	<0.100	0.026	<0.0016	0.0003	8.5

[a]Source: Ahlquist 1985a.
[b]See source for sample location.
[c]Lower limit of detection = 0.38 mg g-1 soil, uncertainty ± 25%.

TABLE 14.5-III
ANALYSES OF BACKGROUND SOIL SAMPLES (CONTROLS) COLLECTED JANUARY 17, 1985
FOR DP ROAD TANK FARM[a]

Sample Location[b]	Lead Results (mg L^{-1})	Lead Uncertainty (±)	Arsenic Results (µg L^{-1})	Arsenic Uncertainty (±)
1	<0.100	0.004	<0.0016	0.0002
2	<0.100	0.023	0.0018	0.0003

[a]Ahlquist 1985a.
[b]See source for sample location.

the detection limit for arsenic. Net total organics were detected in five of eleven samples and were highest at the two fill stations; uncertainties were on the order of 25%. Background soil samples analyzed for lead and arsenic provided results similar to actual samples (Table 14.5-III) (Fritz 1985). The Environmental Protection Group (HSE-8) concluded that the surface soil at the DP Tank Farm was not hazardous waste (Barr 1988), and the small volumes of contaminated soil could be mixed with onsite soil rather than being trucked to the dump (Ahlquist 1985a). It is not clear whether EPA analytical methodology was followed for the soil sample analysis or if the samples were analyzed by EPA Extraction Procedure (EP) Toxicity. The original laboratory reports and chain of custody reports were not available.

Subsurface Soils

In 1985, depth sampling was suggested for any areas where tank leaks were found and in the fuel-soaked soil in the vicinity of the two fill stations (Ahlquist 1985b). No documentation of the location or depth at which the 1985 samples were collected, nor laboratory results from their analysis, can be located. However, this does indicate that fuel-saturated soils existed at the tank farm.

During the decommissioning of the DP Tank Farm in 1988, soil sampling and analyses for lead by EP Toxicity were performed in the locations of former tanks TA-21-ATF-7, TA-21-ATF-11, and TA-21-ATF-17. Twenty-two samples were collected from these three former tank locations (McInroy 1988). The results for tanks TA-21-ATF-11 and TA-21-ATF-17 showed all soil samples

contained <1 µg/L lead (LANL 1988a; LANL 1988b). Five of the six samples of soil beneath tank TA-21-ATF-7 contained 1 µg/L or less lead (LANL 1988c). The sixth soil sample beneath tank TA-21-ATF-7 showed 238 µg/L lead. However, the high value was considered to be an outlier because a duplicate sample showed <l µg/L lead (LANL 1988c). Based upon these analyses, the soil beneath the three gasoline tanks was considered to be free of contamination. The original laboratory reports and chain of custody reports are not available.

In June 1988, soil sampling of the fill station areas was initiated. Soils were excavated, sampled, and analyzed for lead and BTX (benzene, toluene, o-xylene, and m-xylene). It is not clear whether EPA analytical methodology was followed for sample analysis, and the original laboratory reports and chain of custody reports are not available. All lead analyses showed concentrations <2 µg/L lead (LANL 1988d). The BTX results (Begay 1988a) from this round of sampling are presented in Table 14.5-IV. Elevated concentrations of BTX were documented in excavated soil. However, concentrations of BTX in soil remaining after excavation were one to two orders-of-magnitude lower. Surrogate recoveries for these BTX analyses ranged from 0 to 58%. The area was considered clean and was backfilled.

14.5.1.3. Source Term

Number 2 fuel oil, diesel, kerosene, gasoline, leaded gasoline, ethanol, and their hazardous constituents (such as lead and benzene) are considered to be potential contaminants in soil at the former DP Tank Farm.

14.5.2. Objectives and Data Needs

The objective of this investigation is to confirm the absence of contamination at SWMU 21-029. Specific data required to assess contamination at SWMU 21-029 include the following:

1. Determine the location of the former tank farm structures. This area has been decontaminated and decommissioned, and obvious locations of former structures no longer exist.

2. Identify the contaminants present using Level II and III data. Prior sampling may have addressed the major locations and contaminants of concern at the DP Tank Farm. However, available documentation is considered to be insufficient to support a recommendation of no further action for this site.

3. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by subsurface soil sampling and Level III analyses.

Table 14.5-IV
BTX Analyses of Soil Samples Collected June 16, 1988 from the East and West Fill Stations at DP Road Tank Farm[a]

Sample Description	Sample No.	% Surogate Recovery	Analyte Concentration ($\mu g\ kg^{-1}$) Benzene	Toluene	O-xylene	M-xylene
Soil Removed from West Dock	88.04804	32	4.5	47.2	16.0	39.5
	88.04805	0	26.1	1127.5	703.0	5.1
Soil Removed from East Dock	88.04806	58	12.7	340.1	156.4	36.1
	88.04807	43	9.1	73.5	12.7	33.8
	88.04808	0	669.7	<MDL	1928.3	135.9
Soil Remaining in Excavation (West Dock)	88.04799	25	<MDL	22.5	2.18	12.7
	88.04800	32	<MDL	29.9	25.4	23.2
Soil Remaining in Excavation (East Dock)	88.04801	30	<MDL	31.8	21.4	24.0
	88.04802	30	2.5	26.8	1.5	12.5
	88.04803	28	3.0	27.3	2.9	13.9

[a]Source: Begay 1988a.

MDLs (minimum detectable limit) for analytes are 5.0, 45.0, 3.0, and 10.0 $\mu g\ kg^{-1}$ for benzene, toluene, o-xylene, and m-xylene, respectively.

14.5.3. Sampling/Investigation Rationale

A single phase of investigation is expected to be sufficient for SWMU 21-029, although an approach for a subsequent investigation is identified in case it is needed. The investigation focuses on identification of the former structures where contamination was known to exist. Boreholes and surface samples will be taken to confirm the presence or absence of the compounds identified from previous sampling and analysis.

A possible subsequent investigation, which is not expected to be needed, would include additional boreholes or surface samples to identify migration of residual contamination.

The samples taken during the initial investigation will be submitted for VOAs, semivolatiles, metals analysis (SW-6010 and TCLP), and ethanol. This analytical suite was selected to address the following specific contaminants. VOAs were selected because benzene, toluene, ethyl benzene, and xylene are common contaminants of gasoline and diesel and are best characterized with VOA analysis. TCLP metals for lead and SW-6010 for total metals are being performed because tetraethyl lead (or TEL) was a common contaminant of leaded gasoline, which was stored in some of the tanks. Lead is considered a RCRA-regulated metal and for that reason TCLP analysis is appropriate. Arsenic is listed in the SW-6010 analysis and was included in earlier LANL analysis. Ethanol was identified as a contaminant of a tank liquid sample. Ethanol was not included in the volatile analyte list and is added as an additional required analysis. Semivolatiles are selected because some common gasoline contaminants are semivolatiles.

14.5.4. Sampling Plan

14.5.4.1. Initial Investigation

The former structures that are included in the initial investigation are: Tank TA-21-ATF-6 for confirmatory analyses because this tank may have held leaded gasoline; Tank TA-21-ATF-10, which had a leaking gasket; Tank TA-21-ATF-13 for confirmatory analyses because this tank may have held leaded gasoline; the east and west fill stations, which exhibited fuel-soaked soil during the course of decontamination and decommissioning; and the drain outfall. These former locations will be surveyed and marked in the field based on LANL Drawing #Z-252 (ZIA company 1948).

Tanks/Fill Stations. Two shallow boreholes will be drilled at each of the three tank and two fill locations (for method see Sec. 11.5.3.1). The first borehole will be placed 5 ft downgradient

(north) of the furthest downgradient point of the former structure. The second may be randomly placed within the area formerly occupied by the structure. These locations are roughly indicated in Fig. 14.5-1. The nominal depth of these boreholes is 10 ft. Each borehole will result in four samples, for a total of 40 to be collected. All samples that screen positive for volatile organic compounds (for method see Sec. 11.6.2.1 and 11.6.2.2) will be submitted for analytical laboratory analysis. Thirty percent of the remaining samples will also be submitted. The field screening and analytical requirements are shown in Table 14.5-V. If no contamination is identified, no further action will be taken at the tanks/fill stations.

Drain Outfall. Two surface soil samples will be taken at the drain outfall (see Sec. 11.5.2.1). The first surface soil sample will be placed 5 ft downgradient (northeast) of the release point of the drain outfall. The second may be randomly placed within the next 20 ft of the drainage pattern. These two locations are roughly indicated in Fig. 14.5-1. Both samples will be submitted for laboratory analysis as indicated in Table 14.5.V.

Numbers of Samples/Sample Analysis. For planning purposes it is assumed that an initial total of 40 samples will be taken for the tanks/fill stations and 2 samples for the drain outfall. Radiological screening will be performed; however, radionuclide contamination is not anticipated and is not expected to produce any samples. The analytical and screening requirements for the initial investigation of SWMU 21-029 are shown in Table 14.5-V. If no contamination is identified, no further action will be taken at the drain outfall.

14.5.4.2 Subsequent Investigation

Additional shallow boreholes and/or surface sample locations may be required if significant contamination is found during field screening and/or analysis.

Tanks and Fill Stations. An additional shallow borehole will be drilled 10 ft downgradient from each contaminated borehole. These will be drilled to a nominal depth of 10 ft (for method see Sec. 11.5.3.1).

Drain Outfall. Additional surface soil samples (for method see Sec. 11.5.2.1) will be taken 10 ft in each of four directions from each contaminated sample.

For planning purposes, it is assumed that no additional sampling and analysis are required.

Table 14.5-V

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-029, DP TANK FARM.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
East Fill Station							X																											
Shallow Borehole	1	0.0 – 2.5 ft		X				X	X		X	X	X	X	X		X					E						E	E	E	E		E
		2.5 – 5.0 ft		X				X	X		X	X	X	X	X		X																
		5.0 – 7.5 ft		X				X	X		X	X	X	X	X		X					E						E	E	E	E		E
		7.5 – 10.0 ft		X				X	X		X	X	X	X	X		X																
	2	0.0 – 2.5 ft		X				X	X		X	X	X	X	X		X					E						E	E	E	E		E
Field Duplicate																																	
		2.5 – 5.0 ft		X				X	X		X	X	X	X	X		X																
		5.0 – 7.5 ft		X				X	X		X	X	X	X	X		X					E						E	E	E	E		E
		7.5 – 10.0 ft		X				X	X		X	X	X	X	X		X																
West Fill Station							X																										
Shallow Borehole	1	0.0 – 2.5 ft		X				X	X		X			X	X		X					E						E	E	E	E		E
Rinsate Blank																																	
Field Blank																																	
		2.5 – 5.0 ft		X				X	X		X	X	X	X	X		X					E						E	E	E	E		E
		5.0 – 7.5 ft		X				X	X		X	X	X	X	X		X																
		7.5 – 10.0 ft		X				X	X		X	X	X	X	X		X					E						E	E	E	E		E
	2	0.0 – 2.5 ft		X				X	X		X	X	X	X	X		X																
		2.5 – 5.0 ft		X				X	X		X	X	X	X	X		X					E						E	E	E	E		E
		5.0 – 7.5 ft		X				X	X		X	X	X	X	X		X																
		7.5 – 10.0 ft		X				X	X		X	X	X	X	X		X					E						E	E	E	E		E
Drain Outfall							X																										
Surface Soil Sample	1	0.0 – 6.0 in		X				X	X		X			X	X		X					E						E	E	E	E		E
	2	0.0 – 6.0 in		X				X	X		X			X	X		X																
Tank AFT-6							X																										

Table 14.5-V

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-029, DP TANK FARM.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
Shallow Borehole	1	0.0 - 2.5 ft						X	X	X	X	X	X	X	X		X					E	E					E	E	E		E	E	E
		2.5 - 5.0 ft						X	X	X	X	X	X	X	X		X					E	E					E	E	E		E	E	E
		5.0 - 7.5 ft						X	X	X	X	X	X	X	X		X					E	E					E	E	E		E	E	E
Field Duplicate		7.5 - 10.0 ft						X	X	X	X	X	X	X	X		X					E	E					E	E	E		E	E	E
	2	0.0 - 2.5 ft						X	X	X	X	X	X	X	X		X					E	E					E	E	E		E	E	E
Rinsate Blank																						X							X	X	X				
Field Blank		2.5 - 5.0 ft						X	X	X	X	X	X	X	X		X					E	E					E	E	E		E	E	E
		5.0 - 7.5 ft						X	X	X	X	X	X	X	X		X					E	E					E	E	E		E	E	E
		7.5 - 10.0 ft						X	X	X	X	X	X	X	X		X					E	E					E	E	E		E	E	E
Tank AFT-10				X																														
Shallow Borehole	1	0.0 - 2.5 ft						X	X	X	X	X	X	X	X		X					E	E					E	E	E		E	E	E
		2.5 - 5.0 ft						X	X	X	X	X	X	X	X		X					E	E					E	E	E		E	E	E
		5.0 - 7.5 ft						X	X	X	X	X	X	X	X		X					E	E					E	E	E		E	E	E
		7.5 - 10.0 ft						X	X	X	X	X	X	X	X		X					E	E					E	E	E		E	E	E
	2	0.0 - 2.5 ft						X	X	X	X	X	X	X	X		X					E	E					E	E	E		E	E	E
		2.5 - 5.0 ft						X	X	X	X	X	X	X	X		X					E	E					E	E	E		E	E	E
		5.0 - 7.5 ft						X	X	X	X	X	X	X	X		X					E	E					E	E	E		E	E	E
		7.5 - 10.0 ft						X	X	X	X	X	X	X	X		X					E	E					E	E	E		E	E	E
Tank AFT-12				X																														
Shallow Borehole	1	0.0 - 2.5 ft						X	X	X	X	X	X	X	X		X					E	E					E	E	E		E	E	E
Field Duplicate		2.5 - 5.0 ft						X	X	X	X	X	X	X	X		X					E	E					E	E	E		E	E	E
		5.0 - 7.5 ft						X	X	X	X	X	X	X	X		X					E	E					E	E	E		E	E	E
		7.5 - 10.0 ft						X	X	X	X	X	X	X	X		X					E	E					E	E	E		E	E	E

Table 14.5-V

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-029, DP TANK FARM.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
	2	0.0 – 2.5 ft						X	X		X	X	X	X	X		X					E						E	E	E		E		E
		2.5 – 5.0 ft						X	X		X	X	X	X	X		X												X	X		X		
		5.0 – 7.5 ft						X	X		X	X	X	X	X		X					E						E	X	X				
		7.5 – 10.0 ft						X	X		X	X	X									E	X					X	X	X		X		X
Rinsate Blank																																		
Field Blank																																		
Trip Blank																																		

14.6. Inactive Container Storage Areas

14.6.1. Site Description

This section describes the field investigations for an inactive container storage area located at TA-21 [SWMU 21-002(b)] (Fig. 14.6-1). SWMU 21-002(a) addresses sites that were used in the past for container storage but which no longer exist or are no longer used for that purpose. This SWMU is discussed in Chapter 18, SWMUs for Coordination with Building D&D Description and Sampling Plan.

14.6.1.1. Site History

SWMU 21-002(b) includes a former drum storage structure, TA-21-38, which was located southeast of Building TA-21-31 (LANL 1990). TA-21-38 was a 10-ft high, 15-ft by 36-ft wood frame structure built in August 1945 and decommissioned in February 1966 (LASL no date). No contaminated soil was removed nor was any clean backfill brought into the area of the building following D&D. TA-21-38 had a roof and was enclosed on three sides with tin siding and is believed to have had a concrete floor, although this has not been verified. The north side of the structure was open (Nyhan 1990). Upright 55-gal. drums were stored inside TA-21-38 and were also stored immediately to the southeast of the building on the ground (LANL 1990a). The contents of these drums are not known.

14.6.1.2. Existing Information

No data exist regarding contamination in the area of the former drum storage building, TA-21-38.

14.6.1.3. Source Term

The contaminant source term represented by the drums stored in and around TA-21-38 is not known.

14.6.2. Objectives and Data Needs

The objective of this investigation is to confirm the absence of contamination at SWMU 21-002(b). Specific data required to assess contamination at SWMU 21-002(b) include the following:

1. Determine the location of former building, TA-21-38.

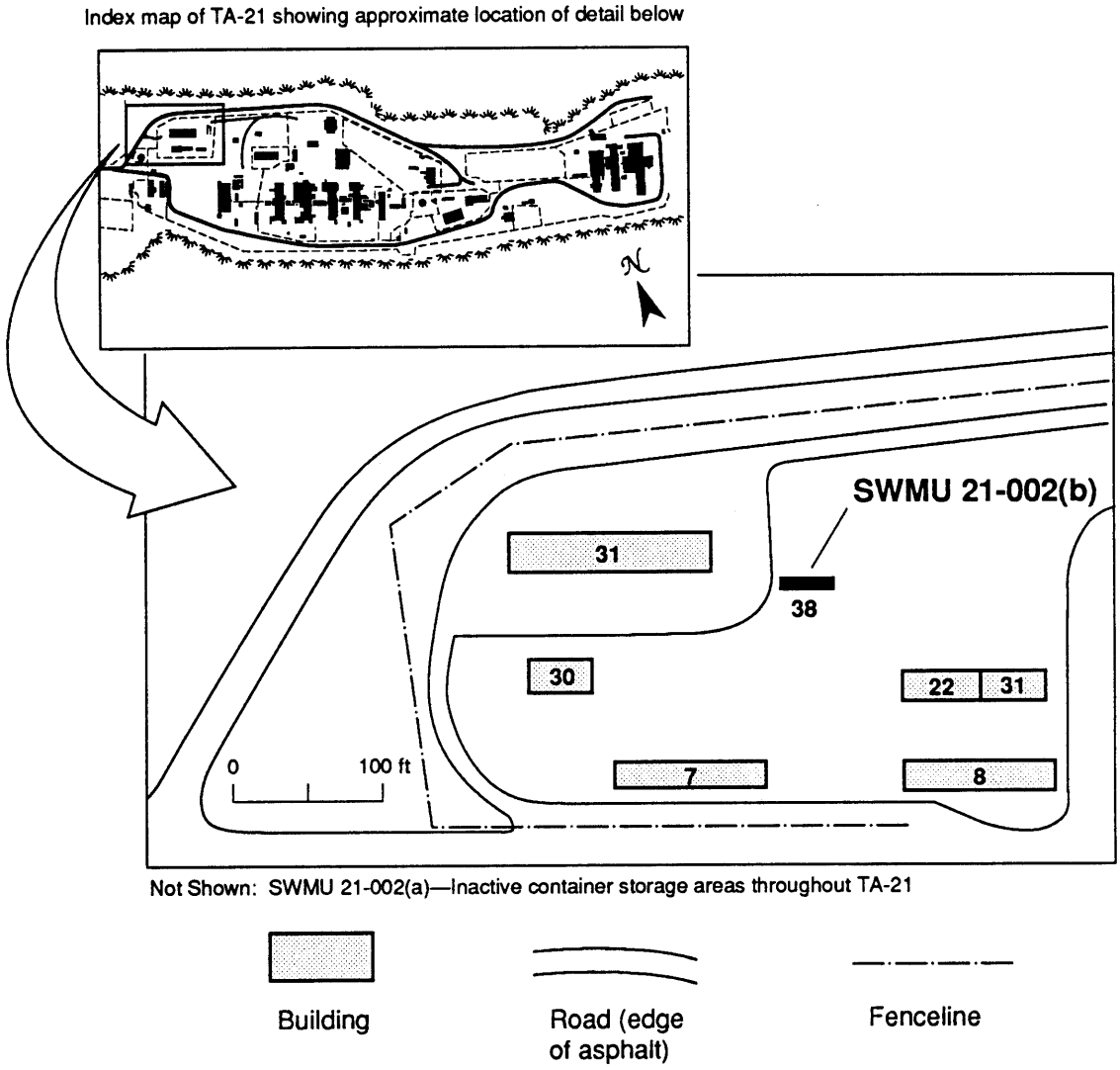

Fig. 14.6-1 Location of the inactive container storage area SWMU 21-002(b), TA-21-38. (LASL 1964a)

2. Identify the contaminants present using Level II and III data. Drums, gas cylinders, and other containers were stored throughout TA-21, and some were reported to have leaked.

3. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by additional surface and subsurface soil sampling and Level III analysis.

14.6.3. Sampling/investigation rationale

An initial and subsequent investigation is planned for SWMU 21-002(b). No information is available regarding actual spills from stored containers or their probable contaminants; therefore, the initial investigation is intended to identify the presence of contaminants in the most probable areas. Surface soil samples will be taken at eight locations covering the area of the former building and outside storage. Because specific contaminant species cannot be identified at this time, a full analytical suite will be specified for these samples.

If contaminants relating to the storage operations are identified in the initial samples, the sampling program will be expanded to include subsurface soils and surface sampling of a wider area. The analytical suite may be focused more closely to specific analytes in these subsequent investigations, based on results from initial samples.

14.6.4. Sampling Plan

14.6.4.1 Initial Investigation

The former location of TA-21-38 will be determined from a LANL engineering drawing (LASL 1964) and will be surveyed and marked in the field.

Five surface sampling locations will be placed in the area of the former TA-21-38 and three in the outside storage area (for method see Sec. 11.5.2.1, Surface Soil Samples). Fig. 14.6-2 shows the eight initial sampling locations. One is located in the center of the former location of TA-21-38. Additional locations are placed 10 ft north and south, and 20 ft east and west of the central location. These four locations, at roughly the edges of the former structure, will detect contamination that may have been washed onto the surrounding soil. Three sampling locations are planned southeast of the structure's former location to detect contamination that may have resulted from the storage of drums outside on the ground.

The field screening and sample analysis requirements for the initial phase of investigations at SWMU 21-002(b) are shown in Table 14.6-I. If no contamination is identified, no further action will be taken at SWMU 21-002(b).

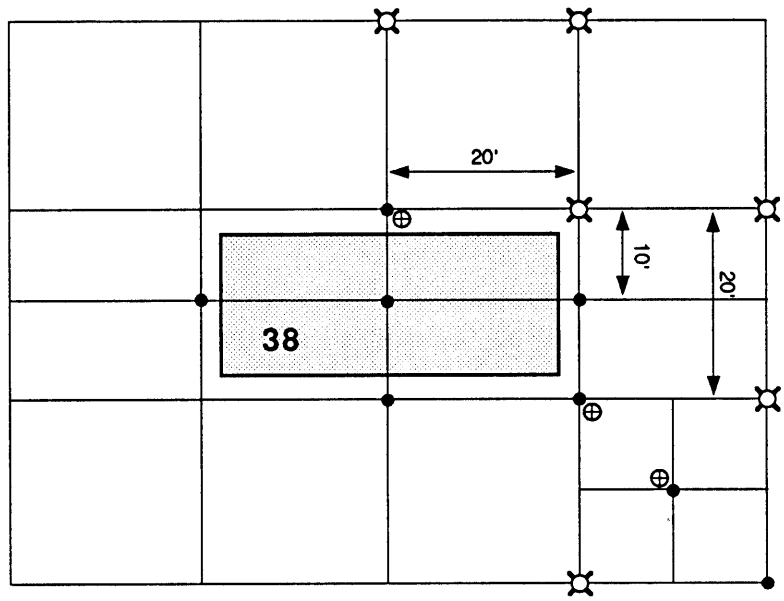

Fig. 14.6-2 Sampling locations at SWMU 21-002(b), TA-21-83.

14.6.4.2 Subsequent Investigations

If contaminants are identified in the initial samples, contaminants and their concentrations will be compared with results of the general surface sampling described for the TA-21 OU in Chapter 12. If the contaminants present and their concentrations are not significantly different, this contamination will be addressed with general OU-wide surface contamination. However, if contaminants at this SWMU are different, the subsequent investigation will include additional surface soil samples over a wider area to define the extent of contamination and shallow boreholes to assess the depth of contamination. Based on initial investigation results, analytical requirements for the subsequent investigation may be limited to a set of indicator contaminants. Additional surface soil samples will be taken at 20-ft spacings (for method see Sec. 11.5.2.1, Surface Soil Samples) until the extent of contamination is determined. Shallow boreholes will be sampled in close proximity to contaminated surface sampling locations to determine the depth of contaminant penetration (for method see Sec. 11.5.3.1, Shallow Boreholes). A nominal depth of 5 ft will be used for each of the boreholes.

For planning purposes, it is assumed that no more than three boreholes (resulting in six samples) and six additional surface soil samples will be required to define the vertical and lateral extent of contamination. Example locations for the additional surface soil samples and the boreholes are shown in Fig. 14.6-2. In the absence of any knowledge of potential contaminants, it is assumed for planning purposes that a full analytical suite will be specified for subsequent investigation samples, as shown in Table 14.6-II. Field screening will be used as appropriate in the subsequent investigation to minimize analytical laboratory analysis.

Table 14.6-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-002(B), DRUM STORAGE AREA.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Field Laboratory Measurements: Chlorides, Nitrates	Field Laboratory Measurements:	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals	Laboratory Analysis: Asbestos	Laboratory Analysis: Ethanol
TA-21-38																																		
Surface Soil Samples	1	0.0 - 6.0 in					X		X	X	X				X	X						X	X	X	X	X	X	X	X	X				
	2	0.0 - 6.0 in							X	X	X				X	X						X	X	X	X	X	X	X	X	X				
Field Duplicate																																		
	3	0.0 - 6.0 in							X	X	X				X	X						X	X	X	X	X	X	X	X	X				
	4	0.0 - 6.0 in							X	X	X				X	X						X	X	X	X	X	X	X	X	X				
	5	0.0 - 6.0 in							X	X	X				X	X						X	X	X	X	X	X	X	X	X				
Outside Storage Area																																		
	6	0.0 - 6.0 in							X	X	X				X	X						X	X	X	X	X	X	X	X	X				
	7	0.0 - 6.0 in							X	X	X				X	X						X	X	X	X	X	X	X	X	X				
	8	0.0 - 6.0 in							X	X	X				X	X						X	X	X	X	X	X	X	X	X				
Rinsate Blank																																		
Field Blank																												X	X	X				
Trip Blank																												X						

Table 14.6-II

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-002(B), DRUM STORAGE AREA.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
TA-21-38 and Outside Storage Location																																		
Shallow Boreholes	1	0.0 - 2.5 ft						X	X					X	X	X	X					X	X	X	X		X	X	X	X				
		2.5 - 5.0 ft									X	X	X																					
	2	0.0 - 2.5 ft						X	X					X	X	X	X					X	X	X	X		X	X	X	X				
		2.5 - 5.0 ft									X	X	X																					
	3	0.0 - 2.5 ft						X	X					X	X	X	X					X	X	X	X		X	X	X	X				
		2.5 - 5.0 ft									X	X	X																					
Surface Soil Samples	1	0.0 - 6.0 in						X	X					X	X	X	X					X	X	X	X		X	X	X	X				
	2	0.0 - 6.0 in						X	X					X	X	X	X					X	X	X	X		X	X	X	X				
Field Duplicate								X	X					X	X	X	X					X	X	X	X		X	X	X	X				
	3	0.0 - 6.0 in						X	X					X	X	X	X					X	X	X	X		X	X	X	X				
	4	0.0 - 6.0 in						X	X					X	X	X	X					X	X	X	X		X	X	X	X				
	5	0.0 - 6.0 in						X	X					X	X	X	X					X	X	X	X		X	X	X	X				
	6	0.0 - 6.0 in						X	X					X	X	X	X					X	X	X	X		X	X	X	X				
Rinsate Blank														X	X	X	X					X	X	X	X		X	X	X	X				
Field Blank														X	X	X	X					X	X	X	X		X	X	X	X				
Trip Blank														X	X	X	X					X	X	X	X		X	X	X	X				

14.7. SURFACE DISPOSAL AREAS

14.7.1. Site Description

This section describes the field investigations for six currently inactive surface disposal areas, SWMUs 21-013(b)–(g). This SWMU grouping addresses areas that were, or may have been, used in the past for surface disposal of various materials.

They are located predominantly in the western portion of TA-21 near MDAs B and V, and near Building TA-21-61. Figure 14.7-1 (LANL 1983a) shows the locations of SWMUs 21-013(b), (d), (e), and (g). Figure 14.7-2 (LANL 1983a) shows the locations of SWMUs 21-013(c) and (f).

A seventh surface disposal area, SWMU 21-013(a), is included in Sec. 14.8 as an aggregate to SWMU 21-026, sewage treatment plant.

14.7.1.1. Site History

SWMU 21-013(b) is located on the southern edge of DP Mesa, southwest of MDA V. This area contains concrete building debris, which was pushed into Los Alamos Canyon. This debris was from the 1965 demolition of Building TA-21-33 (L.O. 3196-21, W.O. 5-417-035) (LANL 1983c). Building TA-21-33 was a wooden structure, which was found to be contaminated with plutonium dust (Romero 1963) and possibly perchloric acid (Romero 1965). The wooden building was burned after being moved to MDA G, but all structural concrete was to be disposed of in Los Alamos Canyon (LASL 1965). It is not known if other materials were disposed of at SWMU 21-013(b).

SWMU 21-013(c) is located northeast of the High Temperature Chemistry Building, TA-21-209. The area is 85 ft from the DP East fence, where it makes right angles east of MDA U, and 122 ft from LASL Marker KI 1968, just south of the road to the sanitary treatment plant. This potential surface disposal area was found during the 1988 ER Program site visit. The area was disturbed and appeared to contain building debris (LANL 1990a). It is not known when materials were disposed of at SWMU 21-013(c).

SWMU 21-013(d) is a potential disposal area located north of the old Laundry Building TA-21-20 and north of DP Road. This area is also referred to as the "cold dump" and is believed to have been a disposal site for nonradioactive waste chemicals and/or materials. According to the LANL/Pan Am History Book (LASL no date), the Safety Training Building TA-21-45 was relocated

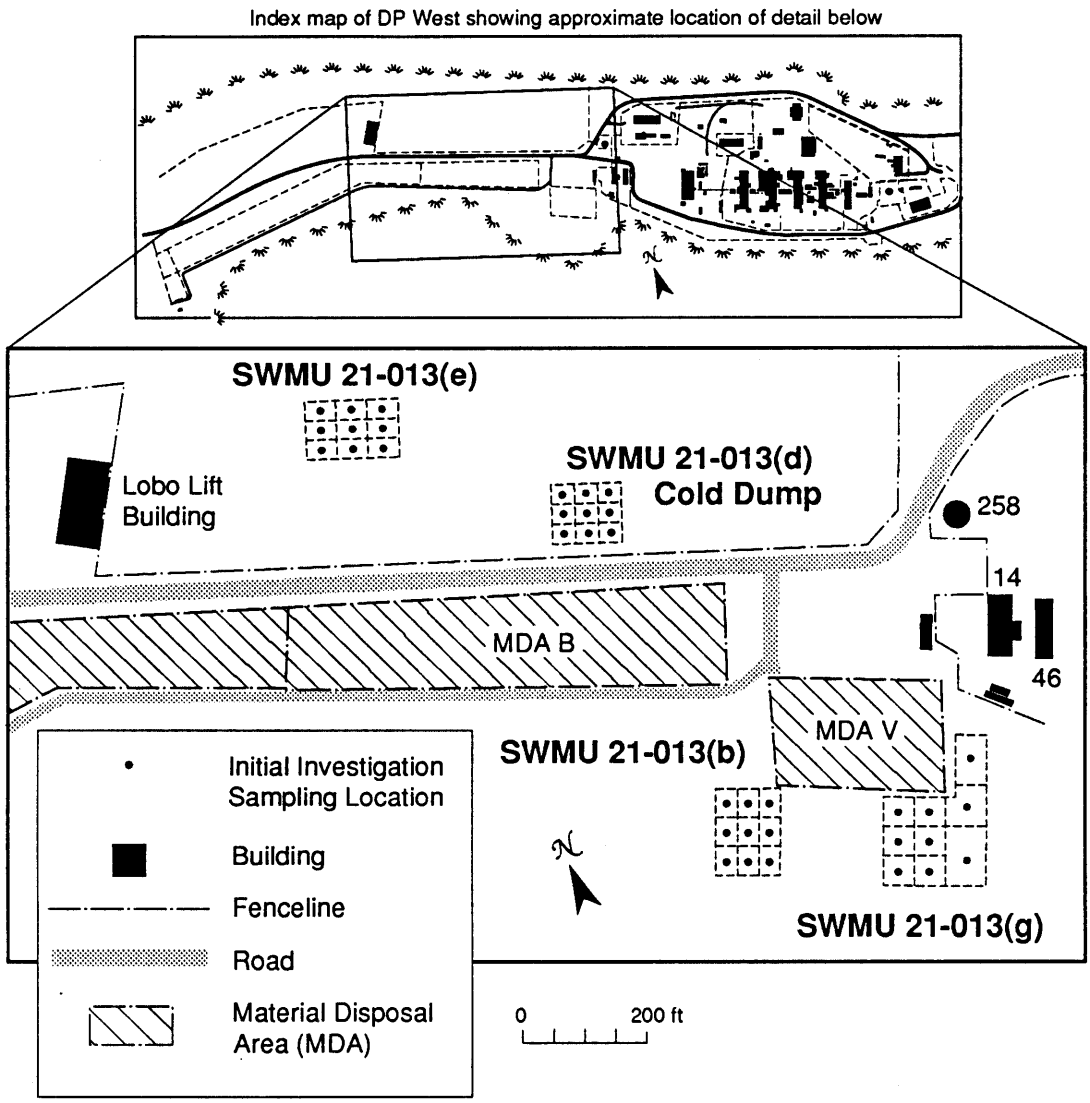

Fig. 14.7-1 Surface disposal areas SWMUs 21-013(b), (d), (e), and (g) locations and sampling grids. (LANL 1983a)

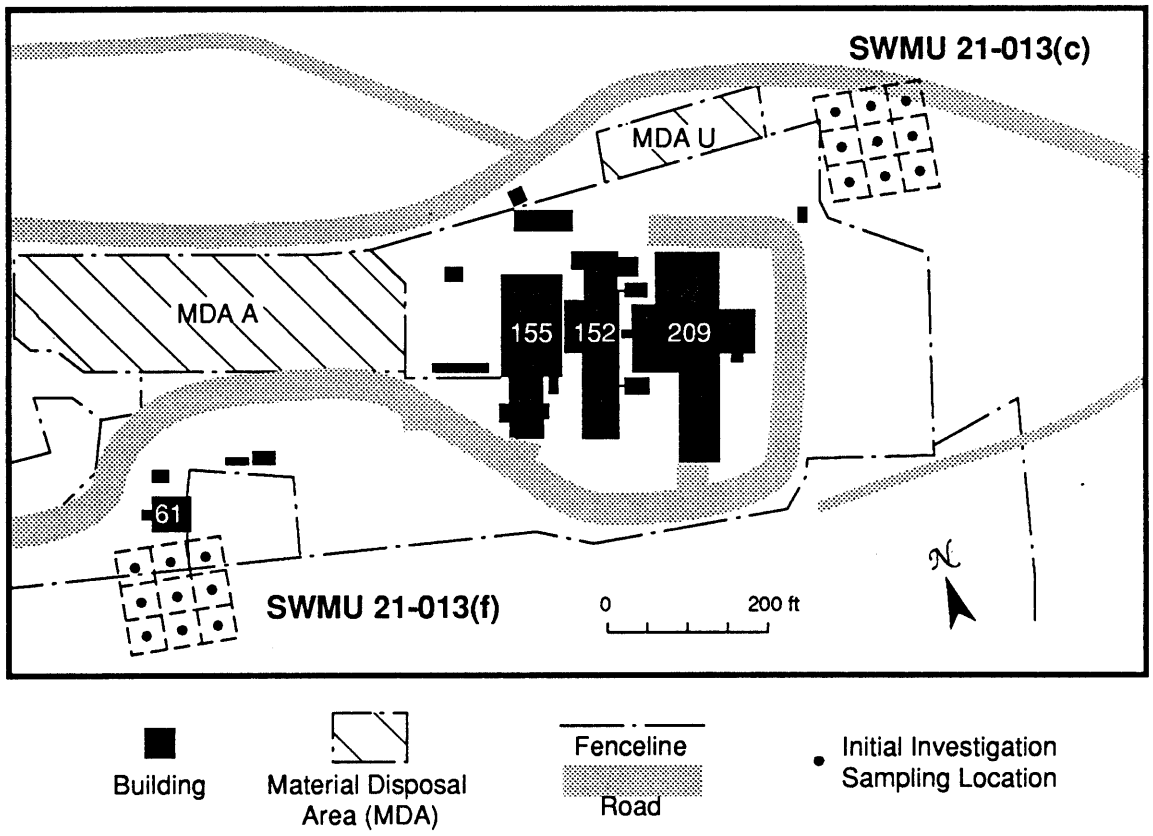

Fig. 14.7-2 Surface disposal areas SWMUs 21-013(c) and (f) locations and sampling grids. (LANL 1983a)

to this area in 1947 and subsequently removed in 1954. In September 1955, a fenced area existed in the approximate location of former Building TA-21-45 (LASL 1955), which could have enclosed a pit or trench. Currently, the only structure remaining near the SWMU 21-013(d) location is septic tank structure TA-21-124 (abandoned but not removed in 1966), which may be used to locate this surface disposal area. This area may have been scraped and the "cold dump" removed (LANL 1990a). There are no records available that indicate the types, quantities, or dates in which wastes may have been disposed of at SWMU 21-013(d).

SWMU 21-013(e) has been used to dispose of construction debris (LANL 1990a). Such debris, including soil piles and drain pipes were observed during the 1988 ER Program site visit at this location (Nyhan 1990a). Little is known about this site except that it is located northwest of the cold dump [SWMU 21-013(d)], 308 ft east of the fence adjacent to the Lobo Lift building and 175 ft north of the fence along DP Road. It is not known when materials were disposed of at SWMU 21-013(e).

SWMU 21-013(f) may not exist. Identification of this SWMU is based wholly on photographic evidence (LANL 1990a). A 1949 aerial photograph (LASL 1949, No. 12241) of the area currently occupied by Building TA-21-61, which is still in existence, showed a series of mounds on the mesa top. A photograph taken in 1950 (LASL 1950, No. 15925) shows that the mounds had been removed and replaced by Building TA-21-61. Because construction activities were not underway on TA-21-61 until July 11, 1950 (LANL no date a), these mounds cannot be explained by foundation preparation activities for this building. However, septic tank structure TA-21-56 and Laboratory Building TA-21-59, which are nearby, were constructed in May 1945 and July 1945, respectively; and construction activities on these two structures could have resulted in the "mounds" observed in the 1949 photo. It is not known if or when materials were disposed of at SWMU 21-013(f).

SWMU 21-013(g) consists of two drain lines (along with other building debris), which were observed during an ER Program site visit (Nyhan 1990). The area is located immediately south of MDA V. The two drain lines were originally believed to be associated with drainage from MDA V. A subsequent investigation determined that the two drain lines are only sections of discarded pipe and are not associated with MDA V as originally supposed (LANL 1990a). The origin of the two drain lines and other debris and date in which they were disposed of at SWMU 21-013(g) are not known.

14.7.1.2. Existing Information

SWMUs 21-013(c), (e), (f), and (g). No data exist regarding potential contaminants at these surface disposal areas.

SWMU 21-013(b) consists of concrete building debris from demolition of Building TA-21-33. A contamination survey of the building interior was conducted in 1963, and various surfaces were found to be contaminated with plutonium dust. Surface counts ranged from 1000 c/m (counts per minute) to 20,000 c/m alpha (Romero 1963). Another report (Romero 1965) states that perchloric acid contamination may have existed in the building interior exhaust hoods.

SWMU 21-013(d), the "cold dump," has been investigated by a geophysical survey and a biased subsurface soil gas sampling program. Interpretation of the geophysical data indicated that there was no geophysical evidence indicating the presence of trenches or buried waste (LANL 1989). Judgmental subsurface soil gas sampling (for volatile organic compounds only) was performed at eight locations at 1.7- to 4-ft depths. LANL (1989) states that 1,1,1-trichloroethane was identified in one sample, as does the SWMU Report (LANL 1990). However, a re-evaluation of the soil gas data collected by the U.S. DOE (LANL 1989) from this area has determined that the presence of 1,1,1-trichloroethane is the result of its residual contamination within the sampling equipment. Therefore, whether 1,1,1-trichloroethane is present is questionable.

The ground surface at SWMU 21-013(d) was also screened for radioactivity and for organic vapors. No radioactivity in excess of natural background radiation (cited as approximately 26-36 μR/h) was detected. Organic vapors were screened with a photoionization detector. Organic vapor concentrations ranged from 1-7 units (LANL 1989).

14.7.1.3. Source Term

SWMUs 21-013(c), (e), (f), and (g). No previous sampling data exist regarding potential contaminants at these surface disposal areas. Therefore, the contaminant source term is not known.

SWMU 21-013(d). Re-evaluation of the subsurface soil gas sampling data has eliminated concern for 1,1,1-trichloroethane. Field screening at SWMU 21-013(d) did not indicate the presence of radioactive or organic vapor contaminants. Therefore, the contaminant source term for SWMU is also not known.

SWMU 21-013(b). The concrete building debris from Building TA-21-33 may be contaminated with plutonium and possible perchloric acid. Contamination of the area could have occurred as a

consequence of operations, leakage from either of the two underground waste lines, or during the operation of cutting the building into two sections prior to its offsite burning and disposal.

14.7.2. Objectives and Data Needs

The objective of this investigation is to confirm the absence of contamination at SWMUs 21-013(b-g). Specific data required to assess contamination at SWMUs 21-013(b)–(g) include the following:

1. Identify the contaminants present using Level II and III data. The contamination of surface disposal areas is unknown, with the possible exception of concrete debris from Building TA-21-33. The debris may be contaminated with plutonium and perchloric acid.

2. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by additional surface and subsurface soil and debris sampling and Level III analysis.

14.7.3. Sampling/Investigation Rationale

14.7.3.1. Initial Investigation

SWMUs 21-013(c), (d), and (e). These SWMUs are accessible to investigation using vehicle-mounted equipment. The initial investigation is intended to identify the presence of contamination in the soil and to determine the depth of the soil and debris. Field radiation surveys (at all three SWMUs) and organic vapor surveys [at SWMU 21-013(d) only] will be used to identify areas of gross contamination. Surface soil samples and shallow borehole core samples will be collected at grid locations and at locations identified by the field surveys. The thickness of the soil layer overlying the tuff will be determined from the borehole cores.

Field screening of the ground surface for organic vapors will initially be performed only at SWMU 21-013(d). This area is presently the only one in which historical information indicates potential disposal of waste chemicals. Other surface disposal areas may be screened for organic vapors if stained areas are visible and if field screening samples detect above-background level concentrations.

SWMUs 21-013(b), (f), and (g). These SWMUs are inaccessible to motorized equipment because they are physically located over, or on the edge of, Los Alamos Canyon. Investigation of these areas will be accomplished with hand-operated sampling equipment. The initial investigation is intended to identify the presence of contamination within the soil and to determine the

thickness of the soil layer overlying the tuff. If contamination is identified within the soil layer sampled, it will be assumed that the entire soil column at specific locations might be contaminated.

A field survey will be conducted at each surface disposal area to screen the surface for radioactivity to define any locations of gross contamination. Surface and manually collected shallow subsurface soil samples will be collected at grid locations and at locations exhibiting above-background level radioactivity.

14.7.3.2. Subsequent Investigation

The need for a subsequent sampling program will be based upon analysis of data from the initial investigation. If implemented, a subsequent sampling program would focus on collection of additional surface and subsurface samples to determine the vertical and lateral extent of contamination. The analytical suite for a subsequent investigation may be focused to specific analytes based on results from the initial investigation.

14.7.4. Sampling Plan

14.7.4.1. Initial Investigation

General Requirements: The SWMU locations will be determined using Fig. 14.7-1 [SWMUs 21-013(b), (d), (e), and (g)], and Fig. 14.7-2 [SWMUs 21-013(c) and (f)], and visual identification in the field. The visual boundaries of each area will be staked and then gridded into nine approximately equal-sized segments. The center of each grid will also be staked as indicated in Figs. 14.6-1 and 14.7-2.

A field survey will be conducted at each area to define locations of gross radioactive contamination (for method see Sec. 11.4.1.2). Organic vapor surface screening will also be performed at SWMU 21-013(d) (for method see Secs. 11.6.2.1 and Sec. 11.6.2.2). It is anticipated that above-background level radioactivity or organic vapor concentrations will identify no more than three additional sampling locations at any of the surface disposal areas.

The center of nine grid segments, in addition to any locations identified during the field survey, will be sampled as indicated in Figs. 14.7-1 and 14.7-2 (LANL 1983a). A surface soil sample (for method see Sec. 11.5.2.1.) will be taken at each location. This will result in a maximum of 12 samples per SWMU (72 total, 18 to analytical laboratory).

All samples will be field-screened and processed in the field laboratory. Twenty-five percent of the samples will be submitted to an analytical laboratory for additional analyses. Because the purpose of this investigation is largely to identify the presence of contaminantns, the 25% selected should include all that have an indication of contamination based on field laboratory measurements. Because no firm information is available to define the contaminants that may be present, the samples will be subjected to a full analytical suite. The field survey, field screening, and sample analysis requirements for the initial investigation are shown in Table 14.7-I. If contaminants are identified, samples may be reanalyzed for asbestos, because some of these surface disposal areas may contain building rubble. If no contamination is identified, no further action will be taken at SWMUs 21-013(b-g).

SWMUs 21-013(c), (d), and (e). Shallow boreholes will be used to sample subsurface soil at all grid locations and locations identified by the field surveys (for method see Sec. 11.5.3.1). The nominal borehole depth is 7.5 ft but may be stopped shallower once native tuff has been penetrated to 2 to 3 ft. It is assumed that no more than three subsurface samples will be collected at any location, for 36 samples per SWMU (108 total, 27 to analytical laboratory). This investigation will determine the depth of soil and debris in the disposal area and will allow evaluation of the presence of contaminants in the underlying tuff.

SWMUs 21-013(b), (f), and (g) Near-surface soil samples will be collected at all grid locations and locations identified by the field surveys (for method see Sec. 11.5.2.4). This sampling will be accomplished by modifying the method, so that near surface samples will be collected only from the 12- to 18-in. and 24- to 30-in. intervals. Certain sampling intervals can be omitted because wastes should be mixed and dispersed if this was a disposal area. This will minimize the number of samples taken for analysis. This modification will result in two near-surface samples collected at each location, for 18 per SWMU (54 total, 14 to analytical laboratory). Again, 25% of the samples will be sent to the analytical laboratory for analysis.

The maximum depth sampled will be approximately 2.5 ft and may be shallower if native tuff is encountered. If the tuff has not been encountered at the maximum depth sampled at any or all locations, its depth will be measure using a narrow steel rod driven downward until significant resistance is encountered. The indication that tuff has been encountered will be based on field judgement. The total depth from the surface to the tuff will be measured. This depth will allow calculation of the volume of potentially contaminated material. If contamination is found in the initial investigation, this information will be useful for planning subsequent investigations. This investigation will not provide information on any contamination of the underlying tuff.

Table 14.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Field Laboratory Measurements: Chlorides, Nitrates	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals	Laboratory Analysis: Asbestos	Laboratory Analysis: Ethanol
21-013(c)				X			X																								
Radiological Survey					X															E											
Surface Soil Sample (bias)	1	0.0 - 6.0 in						X	X	X		X			E	X				E	E	E	E	E	E	E	E	E			
Shallow Borehole (bias)	1	0.0 - 2.5 ft						X	X	X	X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E			
		2.5 - 5.0 ft						X	X	X	X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E			
		5.0 - 7.5 ft						X	X	X	X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E			
Surface Soil Sample (bias)	2	0.0 - 6.0 in						X	X	X	X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E			
Rinsate Blank																															
Field Blank																															
Shallow Borehole (bias)	2	0.0 - 2.5 ft						X	X	X	X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E			
		2.5 - 5.0 ft						X	X	X	X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E			
		5.0 - 7.5 ft						X	X	X	X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E			
Surface Soil Sample (bias)	3	0.0 - 6.0 in						X	X	X	X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E			
Shallow Borehole (bias)	3	0.0 - 2.5 ft						X	X	X	X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E			
		2.5 - 5.0 ft						X	X	X	X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E			
		5.0 - 7.5 ft						X	X	X	X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E			
Surface Soil Sample	1	0.0 - 6.0 in						X	X	X	X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E			
Shallow Borehole	1	0.0 - 2.5 ft						X	X	X	X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E			
		2.5 - 5.0 ft						X	X	X	X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E			
		5.0 - 7.5 ft						X	X	X	X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E			
Surface Soil Sample	2	0.0 - 6.0 in						X	X	X	X	X	X	X	X	X	X			E	E	E	E	E	E	E	E	E			
Field Duplicate																				E	E	E	E	E	E	E	E	E			
Shallow Borehole	2	0.0 - 2.5 ft						X	X	X	X	X	X	X	X	X	X															
		2.5 - 5.0 ft						X	X	X	X	X	X	X	X	X	X															
		5.0 - 7.5 ft						X	X	X	X	X	X	X	X	X	X															
Surface Soil Sample	3	0.0 - 6.0 in						X	X	X	X	X	X	X	X	X	X															

Table 14.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Survey: Gross Gamma	Field Survey: Low-Energy Gamma	Field Survey: Electromagnetic	Field Survey: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Field Laboratory Measurements: Chlorides, Nitrates	Field Laboratory Measurements:	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals	Laboratory Analysis: Asbestos	Laboratory Analysis: Ethanol
Shallow Borehole	3	0.0 - 2.5 ft						X	X		X		X	X			X					E	E	E	E		E	E	E	E				
		2.5 - 5.0 ft						X	X		X	X	X	X			X					E	E	E	E		E	E	E	E				
		5.0 - 7.5 ft						X	X		X	X	X	X			X					E	E	E	E		E	E	E	E				
Surface Soil Sample	4	0.0 - 6.0 in						X	X		X		X	X			X					E	E	E	E		E	E	E	E				
Shallow Borehole	4	0.0 - 2.5 ft						X	X		X	X	X	X			X					E	E	E	E		E	E	E	E				
		2.5 - 5.0 ft						X	X		X	X	X	X			X					E	E	E	E		E	E	E	E				
		5.0 - 7.5 ft						X	X		X	X	X	X			X					E	E	E	E		E	E	E	E				
Surface Soil Sample	5	0.0 - 6.0 in						X	X		X		X	X			X					E	E	E	E		E	E	E	E				
Shallow Borehole	5	0.0 - 2.5 ft						X	X		X	X	X	X			X					E	E	E	E		E	E	E	E				
		2.5 - 5.0 ft						X	X		X	X	X	X			X					E	E	E	E		E	E	E	E				
		5.0 - 7.5 ft						X	X		X	X	X	X			X					E	E	E	E		E	E	E	E				
Surface Soil Sample	6	0.0 - 6.0 in						X	X		X		X	X			X					E	E	E	E		E	E	E	E				
Shallow Borehole	6	0.0 - 2.5 ft						X	X		X	X	X	X			X					E	E	E	E		E	E	E	E				
		2.5 - 5.0 ft						X	X		X	X	X	X			X					E	E	E	E		E	E	E	E				
		5.0 - 7.5 ft						X	X		X	X	X	X			X					E	E	E	E		E	E	E	E				
Surface Soil Sample	7	0.0 - 6.0 in						X	X		X		X	X			X					E	E	E	E		E	E	E	E				
Shallow Borehole	7	0.0 - 2.5 ft						X	X		X	X	X	X			X					E	E	E	E		E	E	E	E				
		2.5 - 5.0 ft						X	X		X	X	X	X			X					E	E	E	E		E	E	E	E				
		5.0 - 7.5 ft						X	X		X	X	X	X			X					E	E	E	E		E	E	E	E				
Surface Soil Sample	8	0.0 - 6.0 in						X	X		X		X	X			X					E	E	E	E		E	E	E	E				
Shallow Borehole	8	0.0 - 2.5 ft						X	X			X	X	X			X					E	E	E	E		E	E	E	E				
		2.5 - 5.0 ft						X	X		X	X	X	X			X					E	E	E	E		E	E	E	E				
		5.0 - 7.5 ft						X	X		X	X	X	X			X					E	E	E	E		E	E	E	E				
Surface Soil Sample	9	0.0 - 6.0 in						X	X		X	X	X	X			X					E	E	E	E		E	E	E	E				

Table 14.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening					Field Laboratory Measurements								Laboratory Analysis														
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
Shallow Borehole	9	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																	
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E					
21-013(d)							X																											
Radiological Survey				X	X																													
Surface Soil Sample (bias)	1	0.0 - 6.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E					
Rinsate Blank																						X	X	X	X		X	X	X	X					
Field Blank																												X	X	X					
Shallow Borehole (bias)	1	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																	
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
Surface Soil Sample (bias)	2	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
Shallow Borehole (bias)	2	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E					
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
Surface Soil Sample (bias)	3	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
Shallow Borehole (bias)	3	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																	
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E					
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
Trip Blank																												X						
Surface Soil Sample	1	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
Shallow Borehole	1	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																	
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E					
Surface Soil Sample	2	0.0 - 6.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E					
Shallow Borehole	2	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																	

Table 14.7-1

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
		2.5 - 5.0 ft																																
		5.0 - 7.5 ft						X	X	X																								
Surface Soil Sample	3	0.0 - 6.0 in						X	X	X	X	X	X	X	X	X	X					X												
Rinsate Blank																																		
Field Blank																																		
Shallow Borehole	3	0.0 - 2.5 ft						X	X	X	X	X	X	X	X	X	X					E												
		2.5 - 5.0 ft						X	X	X	X	X	X	X	X	X	X					E												
		5.0 - 7.5 ft						X	X	X	X	X	X	X	X	X	X					E												
Surface Soil Sample	4	0.0 - 6.0 in						X	X	X	X	X	X	X	X	X	X					E												
Shallow Borehole	4	0.0 - 2.5 ft						X	X	X	X	X	X	X	X	X	X					E												
		2.5 - 5.0 ft						X	X	X	X	X	X	X	X	X	X					E												
		5.0 - 7.5 ft						X	X	X	X	X	X	X	X	X	X					E												
Surface Soil Sample	5	0.0 - 6.0 in						X	X	X	X	X	X	X	X	X	X					E												
Shallow Borehole	5	0.0 - 2.5 ft						X	X	X	X	X	X	X	X	X	X					E												
		2.5 - 5.0 ft						X	X	X	X	X	X	X	X	X	X					E												
		5.0 - 7.5 ft						X	X	X	X	X	X	X	X	X	X					E												
Surface Soil Sample	6	0.0 - 6.0 in						X	X	X	X	X	X	X	X	X	X					E												
Shallow Borehole	6	0.0 - 2.5 ft						X	X	X	X	X	X	X	X	X	X					E												
		2.5 - 5.0 ft						X	X	X	X	X	X	X	X	X	X					E												
		5.0 - 7.5 ft						X	X	X	X	X	X	X	X	X	X					E												
Surface Soil Sample	7	0.0 - 6.0 in						X	X	X	X	X	X	X	X	X	X					E												
Shallow Borehole	7	0.0 - 2.5 ft						X	X	X	X	X	X	X	X	X	X					E												
		2.5 - 5.0 ft						X	X	X	X	X	X	X	X	X	X					E												
		5.0 - 7.5 ft						X	X	X	X	X	X	X	X	X	X					E												
Surface Soil Sample	8	0.0 - 6.0 in						X	X	X	X	X	X	X	X	X	X					E												
Rinsate Blank																																		

Table 14.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements									Laboratory Analysis														
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
Field Blank																												X	X	X					
Shallow Borehole	8	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
Surface Soil Sample	9	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
Shallow Borehole	9	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																	
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
21-013(e)							X																												
Radiological Survey				X	X																														
Surface Soil Sample (bias)	1	0.0 - 6.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
Field Duplicate																						E	E	E	E		E	E	E	E				
Shallow Borehole (bias)	1	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
Surface Soil Sample (bias)	2	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
Shallow Borehole (bias)	2	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
Surface Soil Sample (bias)	3	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
Shallow Borehole (bias)	3	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
Surface Soil Sample	1	0.0 - 6.0 in						X	X		X		X	X	X	X	X																	
Shallow Borehole	1	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																	
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	

Table 14.7-1

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates	Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
Rinsate Blank		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X				X	X	X	X	X	X	X	X				
Field Blank																																	
Trip Blank																																	
Surface Soil Sample	2	0.0 - 6.0 in						X	X		X	X	X	X	X	X	X				X	X	X	X	X	X	X	X				
Shallow Borehole	2	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X				X	X	X	X	X	X	X	X				
		2.5 - 5.0 ft						X	X		X		X	X	X	X	X				X	X	X	X	X	X	X	X				
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X				X	X	X	X	X	X	X	X				
Surface Soil Sample	3	0.0 - 6.0 in						X	X		X	X	X	X	X	X	X				X	X	X	X	X	X	X	X				
Shallow Borehole	3	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X				X	X	X	X	X	X	X	X				
Field Duplicate																																	
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X				X	X	X	X	X	X	X	X				
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X				X	X	X	X	X	X	X	X				
Surface Soil Sample	4	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X				X	X	X	X	X	X	X	X				
Shallow Borehole	4	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X				X	X	X	X	X	X	X	X				
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X				X	X	X	X	X	X	X	X				
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X				X	X	X	X	X	X	X	X				
Surface Soil Sample	5	0.0 - 6.0 in						X	X		X	X	X	X	X	X	X				X	X	X	X	X	X	X	X				
Shallow Borehole	5	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X				X	X	X	X	X	X	X	X				
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X				X	X	X	X	X	X	X	X				
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X				X	X	X	X	X	X	X	X				
Surface Soil Sample	6	0.0 - 6.0 in						X	X		X	X	X	X	X	X	X				X	X	X	X	X	X	X	X				
Shallow Borehole	6	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X				X	X	X	X	X	X	X	X				
		2.5 - 5.0 ft						X	X		X		X	X	X	X	X				X	X	X	X	X	X	X	X				
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X				X	X	X	X	X	X	X	X				
Surface Soil Sample	7	0.0 - 6.0 in						X	X		X	X	X	X	X	X	X				X	X	X	X	X	X	X	X				

Table 14.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements									Laboratory Analysis														
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol		
Rinsate Blank																						X	X	X	X		X	X	X	X						
Field Blank																												X	X	X						
Shallow Borehole	7	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E						
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																			
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																			
Surface Soil Sample	8	0.0 - 6.0 in						X	X		X		X	X	X	X	X																			
Shallow Borehole	8	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																			
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E						
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																			
Surface Soil Sample	9	0.0 - 6.0 in						X	X		X		X	X	X	X	X																			
Shallow Borehole	9	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																			
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																			
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E						
21-013(b)							X																													
Radiological Survey				X	X																															
Near Surface Soil (bias)	1	0.0 - 6.0 in						X	X		X		X	X	X	X	X																			
		6.0 - 12.0 in						X	X		X		X																								
		12.0 - 18.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E						
		18.0 - 24.0 in						X	X		X		X																								
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																			
Near Surface Soil (bias)	2	0.0 - 6.0 in						X	X		X		X	X	X	X	X																			
		6.0 - 12.0 in						X	X		X		X																								
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																			
		18.0 - 24.0 in						X	X		X		X																								
		24.0 - 30.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E						
Near Surface Soil (bias)	3	0.0 - 6.0 in						X	X		X		X	X	X	X	X																			

Table 14.7-1

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
		6.0 - 12.0 in						X	X	X	X	X	X	X																				
		12.0 - 18.0 in						X	X	X	X	X	X																					
		18.0 - 24.0 in						X	X	X	X	X	X																					
		24.0 - 30.0 in						X	X	X	X	X	X																					
Near Surface Soil	1	0.0 - 6.0 in						X	X		X	X	X																					
		6.0 - 12.0 in						X	X		X	X	X		X		X																	
		12.0 - 18.0 in						X	X		X	X	X		X		X																	
		18.0 - 24.0 in						X	X		X	X	X		X		X																	
		24.0 - 30.0 in						X	X		X	X	X		X		X																	
Near Surface Soil	2	0.0 - 6.0 in						X	X		X	X	X		X		X																	
		6.0 - 12.0 in						X	X		X	X	X		X		X						E											
		12.0 - 18.0 in						X	X		X	X	X		X		X						E											
		18.0 - 24.0 in						X	X		X	X	X		X		X						E											
		24.0 - 30.0 in						X	X		X	X	X		X		X						E											
Near Surface Soil	3	0.0 - 6.0 in						X	X		X	X	X		X		X						E											
		6.0 - 12.0 in						X	X		X	X	X		X		X						E											
		12.0 - 18.0 in						X	X		X	X	X		X		X						E											
		18.0 - 24.0 in						X	X		X	X	X		X		X						E											
		24.0 - 30.0 in						X	X		X	X	X		X		X						E											
Near Surface Soil	4	0.0 - 6.0 in						X	X		X	X	X		X		X						E											
		6.0 - 12.0 in																																
		12.0 - 18.0 in																																
		18.0 - 24.0 in																																
		24.0 - 30.0 in																																
Rinsate Blank																					X												
Field Blank																					X												

Table 14.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates	Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
Near Surface Soil	5	0.0 - 6.0 in						X	X		X		X	X	X	X	X				E	E	E										
		6.0 - 12.0 in						X	X		X		X	X	X	X	X																
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																
		18.0 - 24.0 in						X	X		X		X	X	X	X	X																
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																
Near Surface Soil	6	0.0 - 6.0 in						X	X		X		X																				
		6.0 - 12.0 in						X	X		X		X																				
		12.0 - 18.0 in						X	X		X		X	X	X	X	X				E	E	E										
		18.0 - 24.0 in						X	X		X		X	X	X	X	X																
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																
Near Surface Soil	7	0.0 - 6.0 in						X	X		X		X	X	X	X	X																
		6.0 - 12.0 in						X	X		X		X	X	X	X	X																
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																
		18.0 - 24.0 in						X	X		X		X	X	X	X	X																
		24.0 - 30.0 in						X	X		X		X	X	X	X	X				E	E	E										
Near Surface Soil	8	0.0 - 6.0 in						X	X		X		X																				
		6.0 - 12.0 in						X	X		X		X																				
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																
		18.0 - 24.0 in						X	X		X		X	X	X	X	X																
		24.0 - 30.0 in						X	X		X		X	X	X	X	X				E	E	E										
Near Surface Soil	9	0.0 - 6.0 in						X	X		X		X								E	E	E										
Field Duplicate		6.0 - 12.0 in						X	X		X		X	X	X	X	X																
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																
		18.0 - 24.0 in						X	X		X		X	X	X	X	X																
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																

Table 14.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

	Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
21-013(f)																																			
Near Surface Soil (bias)		1	0.0 - 6.0 in					X	X	X		X	X	X	X			X					E												
			6.0 - 12.0 in						X	X		X	X	X				X					E	E											
			12.0 - 18.0 in						X	X		X	X	X				X					E	E											
			18.0 - 24.0 in						X	X		X	X	X				X					E	E											
			24.0 - 30.0 in						X	X		X	X	X				X					E	E											
Near Surface Soil (bias)		2	0.0 - 6.0 in						X	X		X	X	X	X			X					E												
			6.0 - 12.0 in						X	X		X	X	X				X					E	E											
			12.0 - 18.0 in						X	X		X	X	X				X					E	E											
			18.0 - 24.0 in						X	X		X	X	X				X					E	E											
			24.0 - 30.0 in						X	X		X	X	X				X					E	E											
Near Surface Soil (bias)		3	0.0 - 6.0 in						X	X		X	X	X	X			X					E												
			6.0 - 12.0 in						X	X		X	X	X				X					E	E											
			12.0 - 18.0 in						X	X		X	X	X				X					E	E											
			18.0 - 24.0 in						X	X		X	X	X				X					E	E											
			24.0 - 30.0 in						X	X		X	X	X				X					E	E											
Near Surface Soil		1	0.0 - 6.0 in						X	X		X	X	X	X			X					E												
			6.0 - 12.0 in						X	X		X	X	X				X					E	E											
			12.0 - 18.0 in						X	X		X	X	X				X					E	E											
			18.0 - 24.0 in						X	X		X	X	X				X					E	E											
			24.0 - 30.0 in						X	X		X	X	X				X					E	E											
Near Surface Soil		2	0.0 - 6.0 in						X	X		X	X	X	X			X					E												
			6.0 - 12.0 in						X	X		X	X	X				X					E	E											
			12.0 - 18.0 in						X	X		X	X	X				X					E	E											
			18.0 - 24.0 in						X	X		X	X	X				X					E	E											
			24.0 - 30.0 in						X	X		X	X	X				X					E	E											

Table 14.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis													
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
Near Surface Soil	3	0.0 - 6.0 in						X	X		X		X	X	X	X	X																
		6.0 - 12.0 in						X	X		X		X																				
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																
		18.0 - 24.0 in						X	X		X		X																				
		24.0 - 30.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
Near Surface Soil	4	0.0 - 6.0 in						X	X		X		X	X	X	X	X																
Rinsate Blank																						X	X	X	X		X	X	X	X			
Field Blank																												X	X	X			
		6.0 - 12.0 in						X	X		X		X																				
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																
		18.0 - 24.0 in						X	X		X		X																				
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																
Near Surface Soil	5	0.0 - 6.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
		6.0 - 12.0 in						X	X		X		X																				
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																
		18.0 - 24.0 in						X	X		X		X																				
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																
Near Surface Soil	6	0.0 - 6.0 in						X	X		X		X	X	X	X	X																
		6.0 - 12.0 in						X	X		X		X																				
		12.0 - 18.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
		18.0 - 24.0 in						X	X		X		X																				
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																
Near Surface Soil	7	0.0 - 6.0 in						X	X		X		X	X	X	X	X																
		6.0 - 12.0 in						X	X		X		X																				
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																
		18.0 - 24.0 in						X	X		X		X																				

Table 14.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
Near Surface Soil		24.0 - 30.0 in												X	X																			
	8	0.0 - 6.0 in						X	X		X		X	X	X																			
		6.0 - 12.0 in						X	X		X		X	X	X																			
		12.0 - 18.0 in						X	X		X		X	X	X																			
		18.0 - 24.0 in						X	X		X		X	X	X																			
		24.0 - 30.0 in						X	X		X		X	X	X																			
Near Surface Soil		0.0 - 6.0 in						X	X		X		X	X	X								E	E	E	E		E	E	E	E				
	9	6.0 - 12.0 in						X	X		X		X	X	X								E	E	E	E		E	E	E	E				
Field Duplicate		6.0 - 12.0 in						X	X		X		X	X	X								E	E	E	E		E	E	E	E				
		12.0 - 18.0 in						X	X		X		X	X	X								E	E	E	E		E	E	E	E				
		18.0 - 24.0 in						X	X		X		X	X	X								E	E	E	E		E	E	E	E				
		24.0 - 30.0 in						X	X		X		X	X	X								E	E	E	E		E	E	E	E				
Trip Blank						X																												
21-013(g)																																		
Radiological Survey				X	X																													
Near Surface Soil (bias)	1	0.0 - 6.0 in						X	X		X		X	X	X								E	E	E	E		E	E	E	E				
		6.0 - 12.0 in						X	X		X		X	X	X								E	E	E	E		E	E	E	E				
		12.0 - 18.0 in						X	X		X		X	X	X								E	E	E	E		E	E	E	E				
		18.0 - 24.0 in						X	X		X		X	X	X								E	E	E	E		E	E	E	E				
		24.0 - 30.0 in						X	X		X		X	X	X								E	E	E	E		E	E	E	E				
Near Surface Soil (bias)	2	0.0 - 6.0 in						X	X		X		X	X	X								E	E	E	E		E	E	E	E				
		6.0 - 12.0 in						X	X		X		X	X	X								E	E	E	E		E	E	E	E				
		12.0 - 18.0 in						X	X		X		X	X	X								E	E	E	E		E	E	E	E				
		18.0 - 24.0 in						X	X		X		X	X	X								E	E	E	E		E	E	E	E				
		24.0 - 30.0 in						X	X		X		X	X	X								E	E	E	E		E	E	E	E				
Near Surface Soil (bias)	3	0.0 - 6.0 in						X	X		X		X	X	X								E	E	E	E		E	E	E	E				

Table 14.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

				Field Surveys				Field Screening						Field Laboratory Measurements									Laboratory Analysis													
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol	
		6.0 - 12.0 in						X	X		X		X																						
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																		
		18.0 - 24.0 in						X	X		X		X																						
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																		
Near Surface Soil	1	0.0 - 6.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E					
		6.0 - 12.0 in						X	X		X		X																						
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																		
		18.0 - 24.0 in						X	X		X		X																						
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																		
Near Surface Soil	2	0.0 - 6.0 in						X	X		X		X	X	X	X	X																		
Rinsate Blank																						X	X	X	X		X	X	X	X					
Field Blank																													X	X					
		6.0 - 12.0 in						X	X		X		X																						
		12.0 - 18.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E					
		18.0 - 24.0 in						X	X		X		X																						
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																		
Near Surface Soil	3	0.0 - 6.0 in						X	X		X		X	X	X	X	X																		
		6.0 - 12.0 in						X	X		X		X																						
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																		
		18.0 - 24.0 in						X	X		X		X																						
		24.0 - 30.0 in						X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E					
Near Surface Soil	4	0.0 - 6.0 in						X	X		X		X	X	X	X	X																		
		6.0 - 12.0 in						X	X		X		X																						
		12.0 - 18.0 in						X	X		X		X	X	X	X	X																		
		18.0 - 24.0 in						X	X		X		X																						
		24.0 - 30.0 in						X	X		X		X	X	X	X	X																		

Table 14.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
Near Surface Soil	5	0.0 - 6.0 in					X	X			X		X	X	X	X	X					E	E	E	E		E	E	E	E				
		6.0 - 12.0 in					X	X			X		X									E	E	E	E		E	E	E	E				
		12.0 - 18.0 in					X	X			X		X									E	E	E	E		E	E	E	E				
		18.0 - 24.0 in					X	X			X		X									E	E	E	E		E	E	E	E				
		24.0 - 30.0 in					X	X			X		X	X	X	X	X					E	E	E	E		E	E	E	E				
Near Surface Soil	6	0.0 - 6.0 in					X	X			X		X	X	X	X	X					E	E	E	E		E	E	E	E				
		6.0 - 12.0 in					X	X			X		X									E	E	E	E		E	E	E	E				
		12.0 - 18.0 in					X	X			X		X									E	E	E	E		E	E	E	E				
		18.0 - 24.0 in					X	X			X		X									E	E	E	E		E	E	E	E				
		24.0 - 30.0 in					X	X			X		X	X	X	X	X					E	E	E	E		E	E	E	E				
Near Surface Soil	7	0.0 - 6.0 in					X	X			X		X	X	X	X	X					E	E	E	E		E	E	E	E				
		6.0 - 12.0 in					X	X			X		X									E	E	E	E		E	E	E	E				
		12.0 - 18.0 in					X	X			X		X									E	E	E	E		E	E	E	E				
		18.0 - 24.0 in					X	X			X		X									E	E	E	E		E	E	E	E				
		24.0 - 30.0 in					X	X			X		X	X	X	X	X					E	E	E	E		E	E	E	E				
Near Surface Soil	8	0.0 - 6.0 in					X	X			X		X	X	X	X	X					E	E	E	E		E	E	E	E				
		6.0 - 12.0 in					X	X			X		X									E	E	E	E		E	E	E	E				
		12.0 - 18.0 in					X	X			X		X									E	E	E	E		E	E	E	E				
		18.0 - 24.0 in					X	X			X		X									E	E	E	E		E	E	E	E				
		24.0 - 30.0 in					X	X			X		X	X	X	X	X					E	E	E	E		E	E	E	E				
Near Surface Soil	9	0.0 - 6.0 in					X	X			X		X	X	X	X	X					E	E	E	E		E	E	E	E				
Field Duplicate								X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E				
Rinsate Blank																						E	E	E	E		E	E	E	E				
Field Blank								X	X		X		X									E	E	E	E		E	E	E	E				
		6.0 - 12.0 in						X	X		X		X									E	E	E	E		E	E	E	E				
		12.0 - 18.0 in						X	X		X		X									E	E	E	E		E	E	E	E				

Table 14.7-1

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-013(B) - (G), SURFACE DISPOSAL AREAS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
		18.0 - 24.0 in						X	X		X		X		X	X	X											X						
		24.0 - 30.0 in						X	X		X		X		X	X	X																	
Trip Blank																												X					

14.7.4.2. Subsequent Investigation

If contaminants are identified from the initial investigation, subsequent sampling programs at any of these SWMUs would focus on collection of surface and subsurface samples to determine the vertical and lateral extent of contamination. Additional sampling locations will be established at 20-ft spacings in the direction data are required. Surface and shallow subsurface sampling will be conducted according to the methods identified above, until the extent of contamination is determined.

For planning purposes, it is assumed that no more than four additional locations will be sampled and that this is required at only two of the SWMUs. Based on results from the initial investigation, analytical requirements may be limited to a specific set of indicator contaminants. Additionally, initial samples may be analyzed for asbestos if other contamination is found. For planning purposes it is assumed that the same analytical scheme used in the initial investigation with the addition of asbestos will be used here. A maximum of four additional samples at four locations at each of two SWMUs is assumed for this investigation. (28 samples, 7 to analytical laboratory).

Table 14.7-II

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-013(B) - (G) SURFACE DISPOSAL AREAS.

				Field Surveys					Field Screening						Field Laboratory Measurements										Laboratory Analysis															
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey		Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol			
SWMU 21-013(c),(d), and (e)																																							
Surface Soil Sample	1	0.0 - 6.0 in							X	X		X		X	X	X	X	X																E				
Shallow Borehole	1	0.0 - 2.5 ft							X	X		X	X	X	X	X	X	X																E				
		2.5 - 5.0 ft							X	X		X	X	X	X	X	X	X																E				
		5.0 - 7.5 ft							X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			E				
Surface Soil Sample	2	0.0 - 6.0 in							X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E			E				
Field Duplicate																							E	E	E	E		E	E	E	E			E				
Field Triplicate																							E	E	E	E		E	E	E	E			E				
Shallow Borehole	2	0.0 - 2.5 ft							X	X		X	X	X	X	X	X	X																				
		2.5 - 5.0 ft							X	X		X	X	X	X	X	X	X																				
		5.0 - 7.5 ft							X	X		X	X	X	X	X	X	X																				
Surface Soil Sample	3	0.0 - 6.0 in							X	X		X		X	X	X	X	X																				
Shallow Borehole	3	0.0 - 2.5 ft							X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			E				
		2.5 - 5.0 ft							X	X		X	X	X	X	X	X	X																				
Rinsate Blank																							X	X	X	X		X	X	X	X			X				
Field Blank																													X	X	X							
		5.0 - 7.5 ft							X	X		X	X	X	X	X	X	X																				
Surface Soil Sample	4	0.0 - 6.0 in							X	X		X		X	X	X	X	X																				
Shallow Borehole	4	0.0 - 2.5 ft							X	X		X	X	X	X	X	X	X																				
		2.5 - 5.0 ft							X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			E				
		5.0 - 7.5 ft							X	X		X	X	X	X	X	X	X																				
SWMU 21-013(b),(f), and (g)																																							
Near Surface Soil	1	0.0 - 6.0 in							X	X		X		X	X	X	X	X					E	E	E	E		E	E	E	E			E				
		6.0 - 12.0 in							X	X		X		X																								
		12.0 - 18.0 in							X	X		X		X	X	X	X	X																				

Table 14.7-II

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-013(B) - (G) SURFACE DISPOSAL AREAS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
		18.0 - 24.0 in						X	X		X		X																					
		24.0 - 30.0 in						X	X		X		X																					
Near Surface Soil	2	0.0 - 6.0 in						X	X		X		X		X	X	X																	
Rinsate Blank																																		
Field Blank																																		
		6.0 - 12.0 in						X	X		X		X																					
		12.0 - 18.0 in						X	X		X		X																					
		18.0 - 24.0 in						X	X		X		X																					
		24.0 - 30.0 in						X	X		X		X																					
Near Surface Soil	3	0.0 - 6.0 in						X	X		X		X																					
		6.0 - 12.0 in						X	X		X		X																					
		12.0 - 18.0 in						X	X		X		X																					
		18.0 - 24.0 in						X	X		X		X																					
		24.0 - 30.0 in						X	X		X		X																					
Field Duplicate																						E	E	E	E		E	E	E	E	E	E		
Field Triplicate																						E	E	E	E		E	E	E	E	E	E		
Near Surface Soil	4	0.0 - 6.0 in						X	X		X		X																					
		6.0 - 12.0 in						X	X		X		X																					
		12.0 - 18.0 in						X	X		X		X																					
		18.0 - 24.0 in						X	X		X		X																					
		24.0 - 30.0 in						X	X		X		X																					
Trip Blank																																		X

14.8 SEWAGE TREATMENT PLANT

14.8.1 Site Description

This chapter describes the field activities for the sewage treatment plant [SWMU 21-026(a)-(c)] and a surface disposal area [SWMU 21-013(a)], both located at the eastern end of DP Mesa at TA-21 (Fig. 14.8-1). This grouping of SWMUs addresses sites that are still in use and a site that is inactive and may have previously treated wastewater from TA-21 containing radiological and inorganic contamination.

14.8.1.1 Site History

SWMU 21-026(a)–(c) includes TA-21-227 sewage treatment plant, TA-21-230 sand filter/sludge drying beds, and TA-21-348 dosing siphon chamber (Fig. 14.8-2).

This sewage treatment plant replaced septic tank/filter field and septic tank/surface discharge systems throughout TA-21 including those which served TA-21-1, TA-21-3, TA-21-4, TA-21-5, TA-21-14, TA-21-30, TA-21-31, TA-21-61, TA-21-152, TA-21-155, TA-21-209, TA-21-210, TA-21-257, TA-21-357, and TA-21-361 (LASL 1964b; LASL 1965a). Some of the floor drains in these buildings may be connected to the sanitary sewer line, as well. Construction began on the sewage treatment plant and four sludge drying beds on July 13, 1965, and was completed by February 18, 1966 (LASL no date). Sanitary liquid wastes were then diverted to one major sanitary waste line along the southern edge of DP Mesa (LASL 1966c; Nyhan 1990) (Fig. 14.8-3 and 14.8-4). The sewage treatment plant treats sanitary wastes and cooling water from TA-21 facilities (LANL 1990a). The plant has also received water from decontamination activities, janitor's scrub water, and waste from other operations at TA-21 (LANL 1990a; Nyhan 1990).

SWMU 21-026(a), the sewage treatment plant (TA-21-227), is an extended aeration sanitary waste treatment plant consisting of a grit chamber, comminuter, digester, aeration tank, and clarifier (Emelity et. al. 1972; Zia Company 1986). Originally, effluent leaving TA-21-227 after treatment was released at a concrete spillpad located on the southern edge of DP Canyon (LASL 1966b). Presently, the effluent is sent from TA-21-227 to the dosing siphon chamber (TA-21-348), then to two sand filter beds, and finally to the original outfall in DP canyon (LANL 1990b; Barnett 1990).

Since 1966, several modifications have been made to the sewage treatment plant. In 1976, a concrete box and flume, as well as a flow meter, were installed at the inlet to facilitate influent

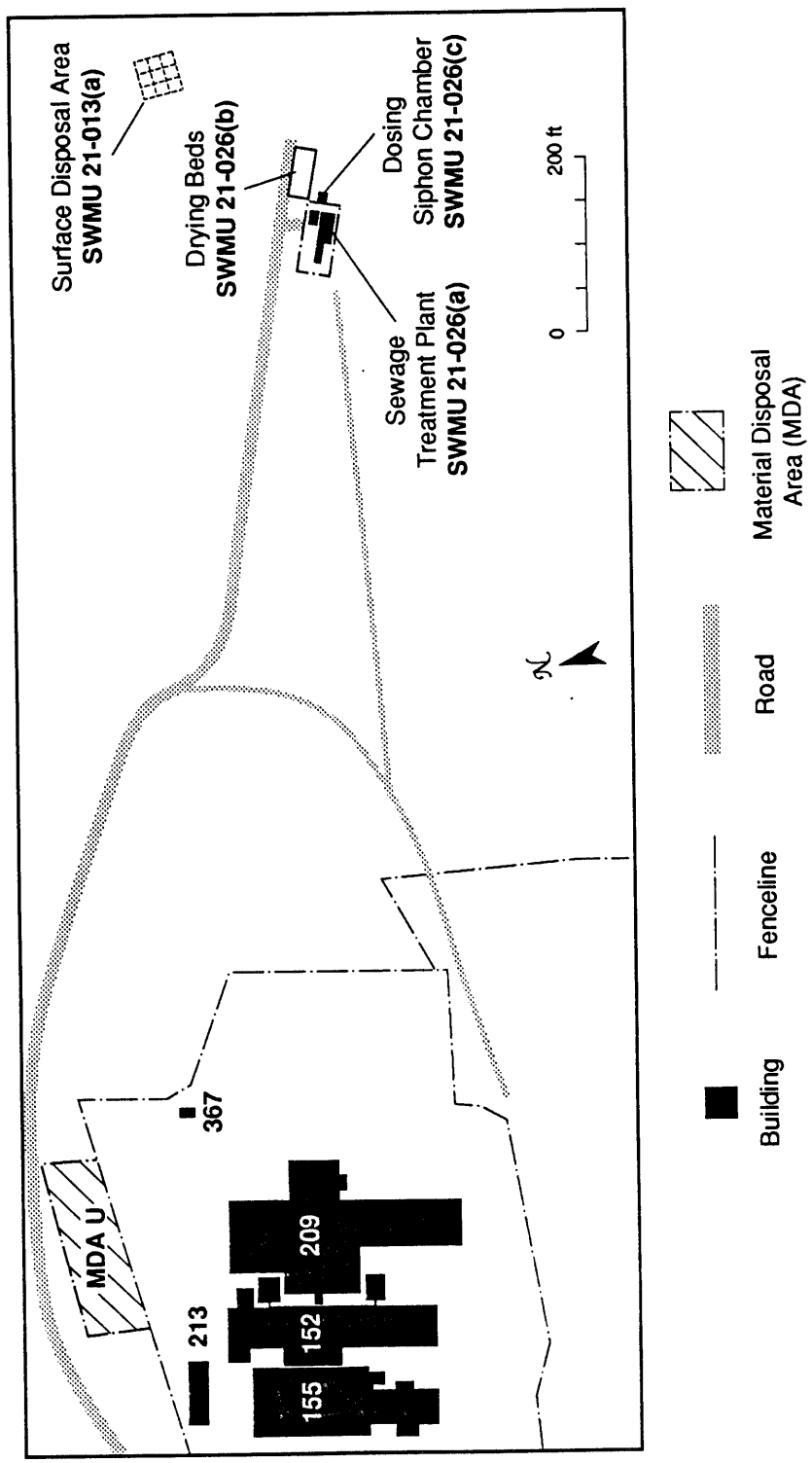

Fig. 14.8-1 Location of the TA-21 sewage treatment plant. (LASL 1966a)

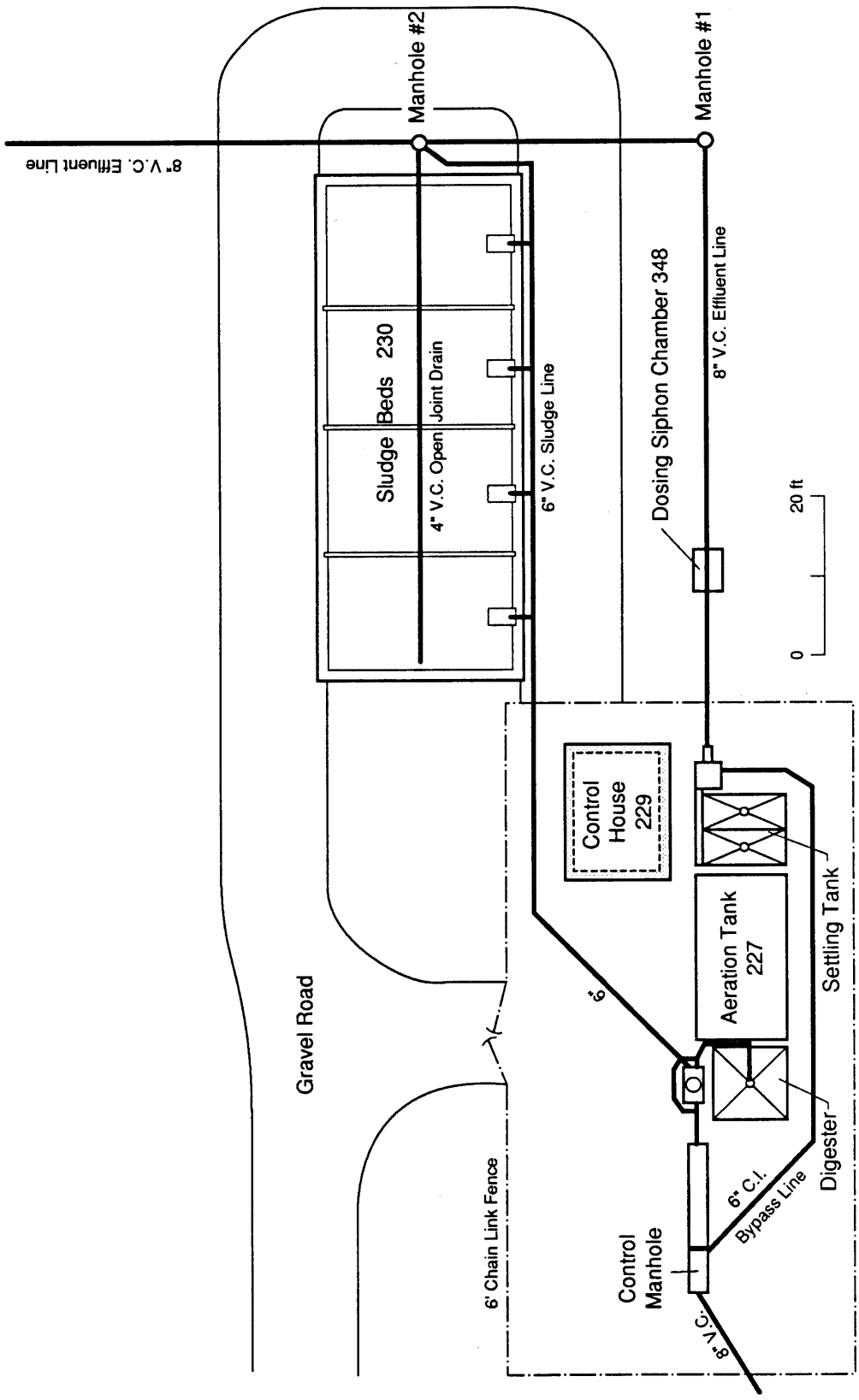

Fig. 14.8-2 Schematic of the TA-21 sewage treatment plant layout. (LASL 1966b)

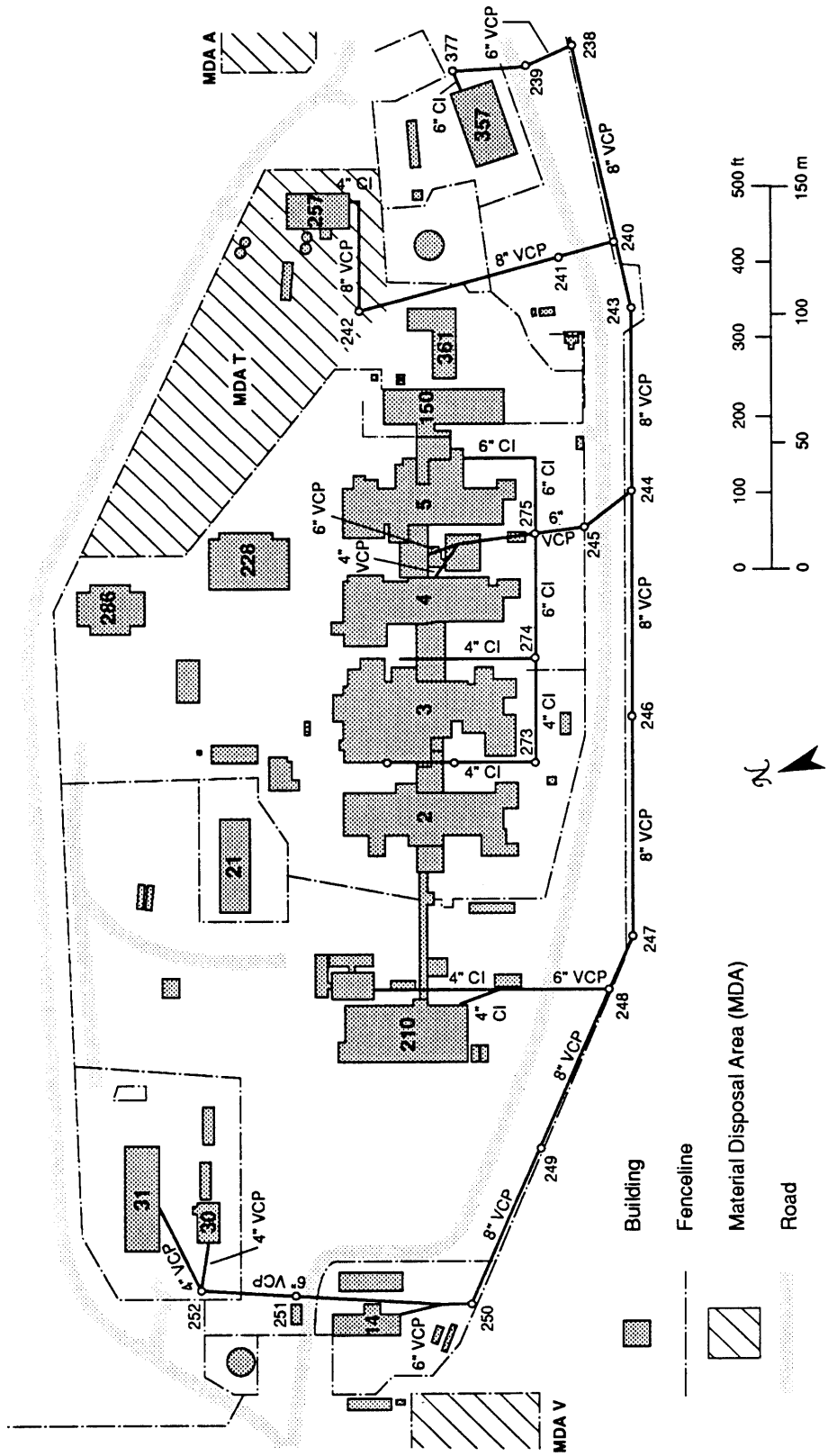

Fig. 14.8-3 Map of DP West showing the location of the main sanitary waste line. (Zia Company 1975)

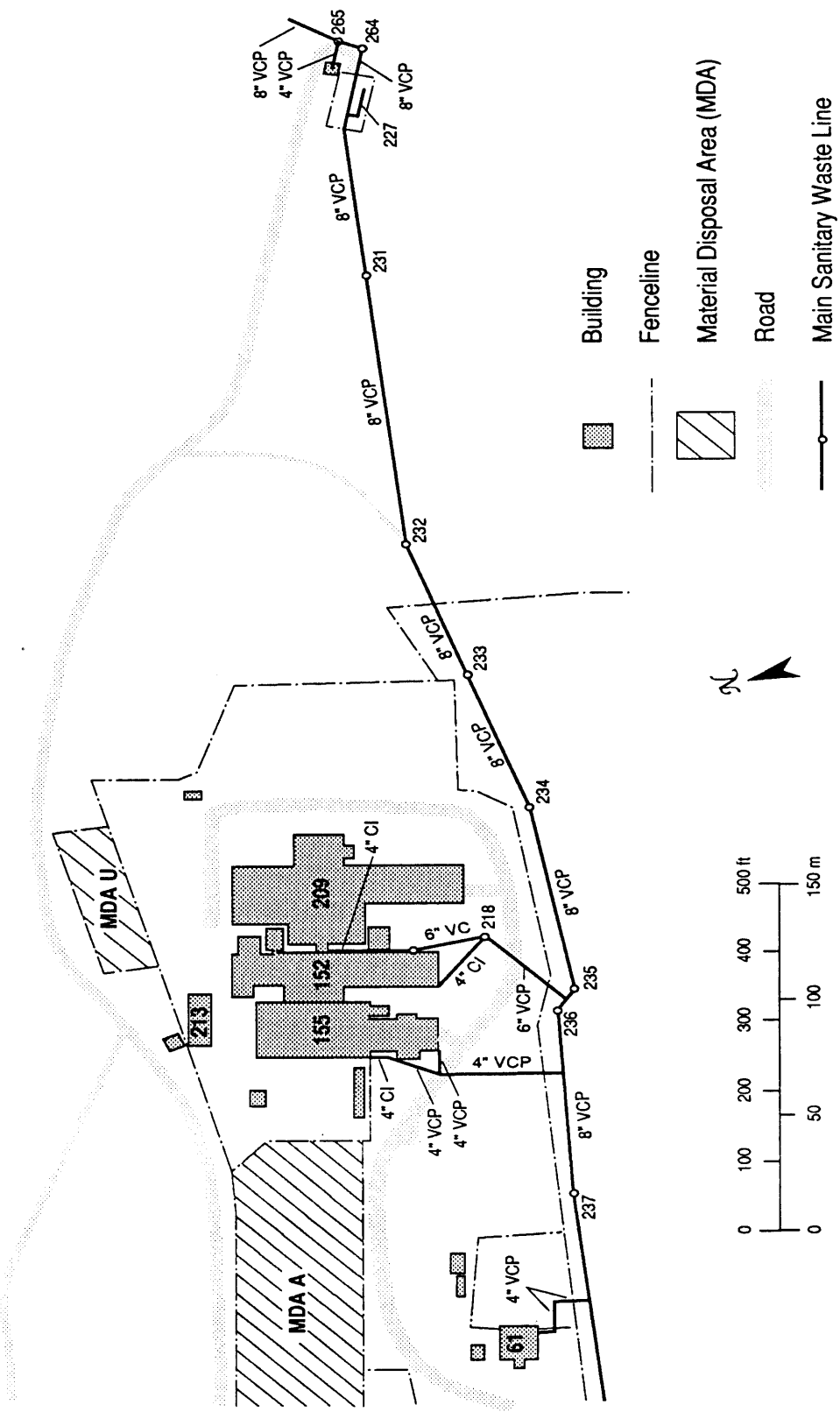

Fig. 14.8-4 Map of DP East showing the location of the main sanitary waste line. (Zia Company 1975)

flow measurements (Zia Company 1976). In May of 1990, a gauging station wet well was constructed about 85 ft north of the eastern-most sludge drying bed and about 36 ft from the existing concrete spillpad. The effluent flow meter was moved to this location, and this station now monitors the effluents discharged to DP Canyon through NPDES outfall 05S (LANL 1990d).

SWMU 21-026(b) was modified in May 1990. At this time, two of the original four sludge drying beds (TA-21-230) were converted into sand filters (LANL 1990b; Barnett 1990). These received effluent from the chlorine contact chamber and filtered the wastewater in its final stage of treatment. Four new, 4-in. PVC lines were installed in the two western-most sand filter beds and the two remaining eastern-most sludge drying beds. These lines carry effluent from the beds to the gauging station and on to the outfall in DP Canyon (LANL 1990b). The old 4-in. drain tile line was removed, and old connections were plugged with concrete (LANL 1990b).

Each sand filter/sludge drying bed is 14.5 by 23 ft with 4-ft-deep concrete walls. The sand in each bed is located about 2 ft from the top of the bed walls and is about 1-ft thick on the west side of each bed, grading to about 2-ft thick on the east side. The plant is currently overdesigned for the amount of waste being treated. Presently, only the two western-most sand filter beds are regularly used to filter treated wastewater before it is discharged to DP Canyon (Barnett 1990).

SWMU 21-026(c), the chlorine contact chamber (TA-21-348), was converted in the late spring or early summer of 1990 to a dosing siphon chamber (LANL 1990c; Barnett 1990). The structure is a 5-ft by 7-ft by 8-ft deep concrete tank located outside of the chain link fence, on the eastern side of TA-21-227. The chlorine contact chamber was used to treat wastewater with chlorine disinfectant but was taken out of operation because of the reduced flow through the plant and decreased fecal coliform counts (Barnett 1990). Effluent now enters the dosing siphon chamber from the plant until the chamber is full, when it is then pumped to the two western sand filter beds. The line that connects the dosing siphon chamber to manhole TA-21-264 and the outfall in the canyon was plugged with concrete when the chamber was converted (LANL 1990c).

SWMU 21-013(a) includes an inactive surface disposal area near TA-21-227 (Fig. 14.8-1). The top layer of sand from the two sand filter beds and two sludge drying beds has previously been disposed at this location near the sewage treatment plant (LANL 1990a). This disposal site is located north of the sewage treatment plant, on the southern edge of DP Canyon, just east of the new gauging station, and is thought to be identified by a pile of sand (LANL 1990a). The area is listed under SWMU 21-013(a), surface disposal areas, but will be addressed in this sampling plan in conjunction with SWMU 21-026, sewage treatment plant, because it appears to be part of the operations at the sewage treatment plant, as well as its close proximity. At present, sand is no

longer disposed of at SWMU 21-026; the upper layer of sand contained in the two eastern sludge drying beds is scraped off periodically and taken to TA-54 for disposal (Barnett 1990).

14.8.1.2 Existing Information

No data exist regarding contamination in the area of the sewage treatment plant or the inactive surface disposal area nearby. However, wastewater flow has been measured, and contaminant assays have been performed on sanitary wastewater as well as sewage sludge from the plant.

Flow data were collected for the sewage treatment plant at TA-21 from October 1978 through June 1990. A reduction in the wastewater flow rate occurred during this period and may correlate to the reduction in personnel at TA-21 (Nyhan 1990).

Radionuclide assays were performed on liquid effluents from June 1976 through 1989, including gross alpha, gross beta, gamma, and tritium (Nyhan 1990). Table 14.8-I presents a summary of those data; the average values for gross alpha, gross beta, gamma, and tritium for this period were 6.5 pCi/L, 12 pCi/L, 270 pCi/L, and 2,600 pCi/L, respectively. High values of 120 pCi/L gross alpha were recorded August 10, 17, and 26, 1976; the high value of 92 pCi/L gross beta was recorded on May 27, 1976; the high value of 1,600 pCi/L gamma was recorded in May 1988; and the high value of 34,800 pCi/L tritium was recorded for November 26 through December 10, 1979. There does not appear to be any temporal pattern to the presence of radionuclides in wastewater. Background data for water are not available; therefore, comparisons to background level cannot be made.

TABLE 14.8-I
RADIONUCLIDE ASSAYS FOR TA-21 SEWAGE TREATMENT PLANT LIQUID EFFLUENT
(1976—1989)

	Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Gross Gamma (pCi/L)	Tritium (pCi/L)
Average	6.5	12	-68	2600
Standard Deviation	11	11	430	3800
Minimum	0.005	0.007	-1100	0
Maximum	120	92	1600	35000
Number of Assays	157	157	50	146

Radionuclide assays were performed on sludge collected in the sludge drying beds between March 1979 through December 1985 (Nyhan 1990). Table 14.8-II presents a summary of those data; the average values for gross alpha, gross beta, and gamma for this period were 1,600 pCi/g, 71 pCi/g, and 240 pCi/g, respectively. The high value of 21,000 pCi/g gross alpha was recorded on March 8, 1982; the high value of 430 pCi/g gross beta was recorded on March 8, 1982; and the high value of 2,050 cpm/g gross gamma was recorded on June 2, 1979. No tritium assays were performed. There does not appear to be any temporal pattern to the presence of radionuclides in sludge. The average value for gamma in sewage sludge is significantly higher than concentrations of gross gamma considered to be background level in area soils (Sec. 2.4.2). No other comparisons to background data can be made.

TABLE 14.8-II
RADIONUCLIDE ASSAYS FOR TA-21 SEWAGE TREATMENT PLANT SLUDGE(1979—1985)

	Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Gross Gamma (cpm/g)
Average	1600	62	240
Standard Deviation	5400	110	570
Minimum	18	4	8.2
Maximum	21000	4300	2100
Number of Assays	14	14	22

Inorganic assays were also performed on sludge in the period between June 1976 and December 1985 (Table 14.8-III) (Nyhan 1990). Background values have not been established for sewage effluent and sludge. However, results of inorganic analyses show that in the majority of individual samples, boron, chromium, nickel, copper, zinc, arsenic, mercury, and lead concentrations in sewage sludge were significantly higher than concentrations considered to be background level in area soils (Sec. 2.4.2).

14.8.1.3 Source Term

SWMU 21-026(a)–(c). No data exist regarding contamination in and around the sewage treatment plant. Wastes treated at the sewage treatment plant are primarily domestic; however, there may be other contaminants that have entered the main sanitary waste line. Water from

TABLE 14.8-III

RESULTS OF NONRADIOACTIVE ASSAYS (HEAVY METALS) PERFORMED ON SLUDGE FROM THE TA-21 SEWAGE TREATMENT PLANT[a]

Date	CMB-1 Sample Number	mg/kg B	V	Cr	Mn	% Fe	µg/g Ni	Cu	Zn	As	Se	Mo	Ag	Cd	Sn	Ba	Hg	Pb
6/25/76[b]	3265	500	150	400	200	.3-3.0	100	1500	2000	<1000	<1000	200	1500	30	300	1000	<100	600
5/5/77	TA-21-STP	100	100	100	80	.4	150	1000	800	<1000	–	60	300	<60	–	1000	<600	400
6/30/77	TA-21-STP	30	80	200	100	1	40	800	2000	<200	–	20	400	10	–	1000	<20	300
9/26/77	9594	10	150	100	50	2	30	800	1000	<100	–	50	100	<10	–	200	<10	300
12/16/77	10972	40	80	300	200	2	100	800	3000	<200	–	8	60	<20	–	1500	<60	400
2/21/78	10972	30	50	200	150	2	80	1000	3000	<200	–	8	80	<20	–	1500	<60	400
5/1/78	11454	20	40	250	100	1	20	400	3000	<200	–	10	60	<20	–	800	<60	300
7/19/78	11880	8	30	80	150	1	30	600	1200	<200	–	6	50	<20	–	600	<60	200
9/27/78	12145	20	15	100	60	1	30	800	3000	<200	–	6	20	<20	–	400	<60	300
3/21/79	12936	15	20	80	100	1.5	20	400	2000	<200	–	6	40	<20	–	600	<20	500
6/15/79	13499	20	60	100	200	2	30	1000	1500	<200	–	15	40	<20	–	400	<60	400
7/2/79	13499	20	50	80	200	2	40	1000	1500	<200	–	15	60	<20	–	400	<60	500
10/1/79	13972	20	50	80	50	6	40	1000	3000	<100	–	10	40	<20	–	400	<60	400
3/7/80	14764	20	40	200	200	3	50	2000	2500	<100	–	60	150	<20	–	800	<60	500
5/26/80	15471	30	50	120	150	2	50	800	3000	<100	–	10	60	<20	–	300	<20	400
7/10/80	15832	40	80	300	60	1	100	1200	3000	<100	–	20	40	<20	–	500	<20	300
10/10/80	16590	30	50	300	120	2	80	1000	2500	<100	–	15	100	<20	–	2500	<20	400
1/28/81	17550	30	150	400	160	1.5	100	1000	1500	<100	–	20	80	<20	–	1200	<20	500
5/18/81	18907	20	40	300	200	2.0	100	600	3000	<100	–	40	80	20	–	1500	<20	400
11/3/81	21177	40	60	100	150	1.8	10	100	1000	<200	–	6	4	<20	–	200	<20	100
3/8/82	22383	30	30	250	200	1	40	1000	3000	<200	–	10	40	<20	–	4000	<20	200
6/15/82	23364	40	50	400	300	2	60	1000	2000	<100	–	30	50	<20	–	5000	<20	400
7/29/82	23859	30	140	400	400	1.4	80	1600	2500	<200	–	15	40	<20	–	4000	<20	200
10/14/82	24724	80	40	500	300	3	60	1000	3000	<200	–	30	30	<20	–	5000	<20	300
3/18/83	83321	–	–	275 (9)	237 (4.2)	1.0 (0.1)	97 (8.4)	935 (1)	1470 (280)	3.4	–	–	9.7 (1.1)	15.3 (1)	–	540 (74)	36 (2)	180 (20)
5/26/83	–	–	–	121 (6)	268 (42)	4.6 (0.5)	61 (14)	745 (420)	2220 (640)	3.3 (0.74)	–	–	26 (5.6)	14 (3)	–	87 (6.6)	39 (1)	278 (55)
3/15/84	85080	–	–	329 (27)	418 (2.9)	1.7 (0.1)	63.4 (2)	1570 (43)	2640 (471)	<0.0001	–	–	–	26.8 (2.5)	–	669 (269)	21.4 (2.5)	21.3 (.75)
6/8/84	85.77018	–	–	212	503	2.1	106	1040	1840	9.7	–	–	29.2	13.8	–	1440	16.6	239
8/20/84	85.77056	–	–	224	469	1.85	77.5	1010	1840	4.63	–	–	17.3	6.75	–	4590	15.0	233
11/26/84	85.77064	–	–	172	425	1.75	55.5	924	1708	34.9	–	–	34.9	7.58	–	1574	22.9	7.58
6/5/85	85.77121	–	–	130 (26)	300 (60)	.79 (.16)	58 (12)	930 (190)	1400 (280)	5.4 (1.8)	–	–	4 (0.8)	12 (2.4)	–	1700 (340)	250 (50)	230 (46)
11/18/85	85.77072	–	–	245 (49)	339 (68)	1.2 (.24)	43 (8.6)	1000 (912)	400 (364)	7.0 (1.4)	–	–	8 (1.6)	18 (4.0)	–	2100 (420)	20 (21)	316 (34)
12/20/85	85.78421	–	–	100 (73)	50 (57)	.10 (.11)	40 (37)	500 (416)	400 (364)	23 (5.0)	–	–	21 (4.0)	10 (2.0)	–	360 (100)	22 (4.0)	50 (47)
1986	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1987	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1988	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
1989	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

[a]Source: Nyhan 1990.
[b]Data from 6/25/76 through and including 10/14/82 was submitted by HSE-7.

decontamination activities, from janitor's scrub water, and from wastes (chemical, radioactive, or mixed) produced in specific operations may have resulted in small amounts of plutonium, uranium, americium, tritium, cesium, strontium, organic constituents, and inorganic constituents in the plant sludge (Nyhan 1990). The quantity of contaminated waste that has entered the sewage treatment plant by way of sanitary drains and/or floor drains is not known.

SWMU 21-013(a). No data exist regarding contamination in and around the sand disposal area. Assays for gross alpha, gross beta, gamma, and inorganic constituents were performed by HSE-8 on sludge from the sewage treatment plant. These assays showed the presence of radionuclides and heavy metals (Nyhan 1990). Because sand was used to filter solids from the sludge, it may be assumed that sand placed in the surface disposal area may be contaminated with radionuclides and inorganic constituents.

14.8.2 Objectives and Data Needs

The objective of this investigation is to confirm the presence or absence, and determine the extent of contamination, at SWMU 21-026(a)–(c) and SWMU 21-013(a).

Specific data required to assess contamination at SWMU 21-026(a)–(c) include the areas around the sewage treatment plant TA-21-227, around the sand filter/sludge drying beds TA-21-230, and around the dosing siphon chamber TA-21-348 as follows:

1. Identify the contaminants present using Level II and III data due to leakage beneath the sewage treatment plant (Building TA-21-227), to leakage beneath the sand filter/sludge drying beds (TA-21-230), and to leakage beneath the dosing siphon chamber (TA-21-348). In the course of processing contaminated wastewater, the potential exists, however small, that leakage occurred from one or more operations at the sewage treatment plant.

2. If contaminants are identified at the sewage treatment plant, the sand filter/sludge drying beds, or the dosing siphon chamber, determine the lateral and vertical extent of contaminant migration by additional surface and subsurface sampling and Level III analyses.

Specific data required to prove absence of contamination at SWMU 21-013(a) include the following:

1. Determine the location of the surface disposal area.

2. Confirm absence of contaminants using Level II and III data. The processing of contaminated wastewater produced contaminated residual sand and sewage sludge, which may also have contaminated the environment when it was disposed.

3. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by surface and subsurface soil sampling and Level III analyses.

4. Identify contaminants present using Level II and Level III data from drainages in the area of SWMU 21-013(a). Surface soil contamination in the area, if known to exist, may have the potential for transport of contamination by water erosion in surface drainages.

14.8.3 Sampling/Investigation Rationale

SWMU 21-026(a)–(c). The initial investigation consists of angled drilling and subsurface soil sampling to determine if contamination is present under TA-21-227 [SWMU 21-026(a)], TA-21-230 [SWMU 21-026(b)], and TA-21-348 [SWMU 21-026(c)]. Contaminant assessment under these buildings cannot otherwise be performed by vertical drilling. These samples will be analyzed for nitrates and chlorides because both are associated with human domestic waste (Sawyer and McCarty 1978). The samples will also be submitted for soil moisture determinations because relatively high moisture content in native soils may indicate leakage from the wastewater treatment plant. If indications of leakage are found at any of the three SWMUs under investigation, then additional sample analyses will be performed by the analytical laboratory.

If required, a subsequent investigation at some or all of the three SWMUs to define the nature and extent of contamination will be conducted by vertical drilling. Samples will be submitted to the analytical laboratory for a full suite of analyses unless sample results from the initial investigation allow specification of a more focused analytical suite.

SWMU 21-013(a). The initial investigation will include field radiological surveys on a rectangular grid. Surface and near-surface soil sampling will be performed within each grid cell. Based on results from field laboratory analyses, further surface and near-surface sampling along the original or a more closely spaced grid may be required. Thirty percent of the samples will be submitted to an analytical laboratory for confirmatory analyses.

Based on the results from the initial investigations, a subsequent investigation may include additional surface and near-surface soil sampling and may also include any drainages that collect run-off from the surface disposal site. Subsequent sampling will be used to determine the extent or depth of contamination in and around the surface disposal area. These samples will be submitted for a full analytical suite of analyses unless sample results from the initial investigation allow specification of a more focused analytical suite.

14.8.4 Sampling Plan

14.8.4.1. Initial Investigations

The sampling and analysis requirements are shown in Table 14.8-IV. Soil moisture determinations will be performed for borehole samples from the sewage treatment plant area because relatively high moisture content in native soils may indicate leakage from the wastewater treatment plant. Nitrates and chlorides will also be analyzed because both are associated with human domestic waste (Sawyer and McCarty 1978). If contamination is not identified, no further action will be taken at SWMUs 21-0026(a)–(c).

SWMU 21-026(a). An angled borehole will be placed on the north side of TA-21-227, 5 ft from the building in the area between the building and the 6-in. cast iron sludge line to the drying beds (see Fig. 14.8-5). A drilling angle of 24 degrees from vertical will be used (for method see Sec. 11.5.3.3). Figure 14.8-6 provides a graphic representation of the drilling to be performed at TA-21-227. The borehole will pass under the northern edge of the building at an initial depth of 11 ft. The length of the borehole will be extended 20 ft beyond the center of the aeration tank for a total length of 47 ft, a total depth of 43 ft, and provide 10 samples.

Determinations for soil moisture will also be performed in the field laboratory (for methods see Sec. 11.7). All samples that exhibit relatively high soil moisture content will be sent to the analytical laboratory for a full suite of analyses (Table 14.8-IV), and 30% of uncontaminated or questionable samples (based on field laboratory analyses) will also be sent to the analytical laboratory. The results from the analytical laboratory will determine the need for subsequent investigations.

This should identify any contamination that may have migrated outward and downward from the tank. Although the borehole is to be drilled directly below the aeration tank, any contamination resulting from potential leaks in the digester and settling tanks located in the building should be detected as well because of the small size of the building.

SWMU 21-026(b). Two angled boreholes will be drilled beneath the sludge drying/sand filter beds. The locations of these boreholes are shown in Fig. 14.8-5. One borehole will be placed 3 ft from the north wall of the sand filters. This borehole will be drilled under the sand filters at an angle of 27 degrees from vertical. The second borehole will be placed 3 ft from the south wall of the sludge drying beds at an angle of 27 degrees from vertical (for method see Sec. 11.5.3.3). Figure 14.8-7 is a graphic representation of the drilling to be performed at TA-21-230. Both boreholes will pass under the beds at an initial depth of 6 ft. The boreholes will be extended for

Table 14.8-IV

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMUS 21-026(A) – (C) AND 21-013(A), SEWAGE TREATMENT PLANT.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
21-026(a)																																		
Angled Borehole	1	0.0 – 5.0 ft							X		X	X	X	X	X	X			X	X														
		5.0 – 10.0 ft							X		X	X	X	X	X	X			X	X		E	E	E	E	E	E						
		10.0 – 15.0 ft							X		X	X	X	X	X	X			X	X														
		15.0 – 20.0 ft							X		X	X	X	X	X	X			X	X		E	E	E	E	E	E						
		20.0 – 25.0 ft							X		X	X	X	X	X	X			X	X														
Rinsate Blank																						X	X	X	X	X	X	X	X	X	X	X	X	X
Field Blank																																		
		25.0 – 30.0 ft							X		X	X	X	X	X	X			X	X		E	E	E	E	E	E						
		30.0 – 35.0 ft							X		X	X	X	X	X	X			X	X														
		35.0 – 40.0 ft							X		X	X	X	X	X	X			X	X		E	E	E	E	E	E						
		40.0 – 45.0 ft							X		X	X	X	X	X	X			X	X														
		45.0 – 47.0 ft							X		X	X	X	X	X	X			X	X														
Trip Blank																													X					
21-026(b)																																		
Angled Borehole	1	0.0 – 5.0 ft							X		X	X	X	X	X	X			X	X														
		5.0 – 10.0 ft							X		X	X	X	X	X	X			X	X		E	E	E	E	E	E						
		10.0 – 15.0 ft							X		X	X	X	X	X	X			X	X														
		15.0 – 20.0 ft							X		X	X	X	X	X	X			X	X														
		20.0 – 25.0 ft							X		X	X	X	X	X	X			X	X		E	E	E	E	E	E						
		25.0 – 30.0 ft							X		X	X	X	X	X	X			X	X														
		30.0 – 35.0 ft							X		X	X	X	X	X	X			X	X														
		35.0 – 40.0 ft							X		X	X	X	X	X	X			X	X		E	E	E	E	E	E						
		40.0 – 45.0 ft							X		X	X	X	X	X	X			X	X														
		45.0 – 50.0 ft							X		X	X	X	X	X	X			X	X														

Table 14.8-IV

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMUS 21-026(A) - (C) AND 21-013(A), SEWAGE TREATMENT PLANT.

Sample Type	Sampling Location	Interval	Sample Identification	Field Survey: Gross Gamma	Field Survey: Low-Energy Gamma	Field Survey: Electromagnetic	Field Survey: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Measurements: Gross Alpha	Field Measurements: Gamma Spectrometry	Field Measurements: Tritium	Field Measurements: Volatile Organics	Field Measurements: PCB	Field Measurements: Soil Moisture	Field Measurements: Chlorides, Nitrates	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals	Laboratory Analysis: Asbestos	Laboratory Analysis: Ethanol
Trip Blank									X											E	E	E	E									
Angled Borehole	2	0.0 - 5.0 ft							X	X	X	X	X	E	E	E	E															
		5.0 - 10.0 ft												X	E	E	E															
Rinsate Blank																				E	E	E	E									
Field Blank																				E	E	E	E									
		10.0 - 15.0 ft							X					X	E	E	E															
		15.0 - 20.0 ft							X	X	X	X	X	X	E	E	E															
		20.0 - 25.0 ft							X	X	X	X	X	X	E	E	E															
		25.0 - 30.0 ft							X	X	X	X	X	X	E	E	E															
		30.0 - 35.0 ft							X	X	X	X	X	X	E	E	E															
		35.0 - 40.0 ft							X	X	X	X	X	X	E	E	E															
		40.0 - 45.0 ft							X	X	X	X	X	X	E	E	E															
		45.0 - 50.0 ft							X	X	X	X	X	X	E	E	E															
		50.0 - 52.0 ft																									X					
Trip Blank									X											E	E	E	E									
21-026(c)																																
Vertical Borehole	1	0.0 - 5.0 ft							X	X	X	X	X	X	E	E	E															
		5.0 - 10.0 ft							X	X	X	X	X	X	E	E	E															
		10.0 - 15.0 ft							X	X	X	X	X	X	E	E	E															
		15.0 - 20.0 ft							X	X	X	X	X	X	E	E	E															
		20.0 - 25.0 ft							X	X	X	X	X	X	E	E	E															
		25.0 - 30.0 ft							X	X	X	X	X	X	E	E	E															
21-013(a)																																
Radiological Survey			X																													
Surface Soil Sample	1	0.0 - 6.0 in	X																													

Table 14.8-IV

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMUS 21-026(A) - (C) AND 21-013(A), SEWAGE TREATMENT PLANT.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Chlorides, Nitrates		Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Asbestos	Ethanol
	2	0.0 - 6.0 in																																
Rinsate Blank																																		
Field Blank																																		
	3	0.0 - 6.0 in						X	X		X	X		X	X							E	E	E	E	E	E	E	E	E				
	4	0.0 - 6.0 in						X	X		X	X		X	X							E	E	E	E	E	E	E	E	E				
	5	0.0 - 6.0 in						X	X		X	X		X	X							E	E	E	E	E	E	E	E	E				
Field Duplicate																						E	E	E	E	E	E	E	E	E				
	6	0.0 - 6.0 in						X	X		X	X		X	X							E	E	E	E	E	E	E	E	E				
	7	0.0 - 6.0 in						X	X		X	X		X	X							E	E	E	E	E	E	E	E	E				
	8	0.0 - 6.0 in						X	X		X	X		X	X							E	E	E	E	E	E	E	E	E				
	9	0.0 - 6.0 in						X	X		X	X		X	X							E	E	E	E	E	E	E	E	E				
Surface Soil Sample (bias)	1	0.0 - 6.0 in						X	X		X	X		X	X							E	E	E	E	E	E	E	E	E				
	2	0.0 - 6.0 in						X	X		X	X		X	X							E	E	E	E	E	E	E	E	E				
	3	0.0 - 6.0 in						X	X		X	X		X	X							E	E	E	E	E	E	E	E	E				
Near Surface Soil	1	6.0 - 12.0 in						X	X		X	X		X	X							E	E	E	E	E	E	E	E	E				
		12.0 - 18.0 in						X	X		X	X		X	X							E	E	E	E	E	E	E	E	E				
		18.0 - 24.0 in						X	X		X	X		X	X							E	E	E	E	E	E	E	E	E				
	2	6.0 - 12.0 in						X	X		X	X		X	X							E	E	E	E	E	E	E	E	E				
		12.0 - 18.0 in						X	X		X	X		X	X							E	E	E	E	E	E	E	E	E				
		18.0 - 24.0 in						X	X		X	X		X	X							E	E	E	E	E	E	E	E	E				
	3	6.0 - 12.0 in						X	X		X	X		X	X							E	E	E	E	E	E	E	E	E				
		12.0 - 18.0 in						X	X		X	X		X	X							E	E	E	E	E	E	E	E	E				
		18.0 - 24.0 in						X	X		X	X		X	X							E	E	E	E	E	E	E	E	E				
Rinsate Blank																						X	X	X	X	X	X	X	X	X				
Field Blank																													X	X				
Trip Blank																														X				

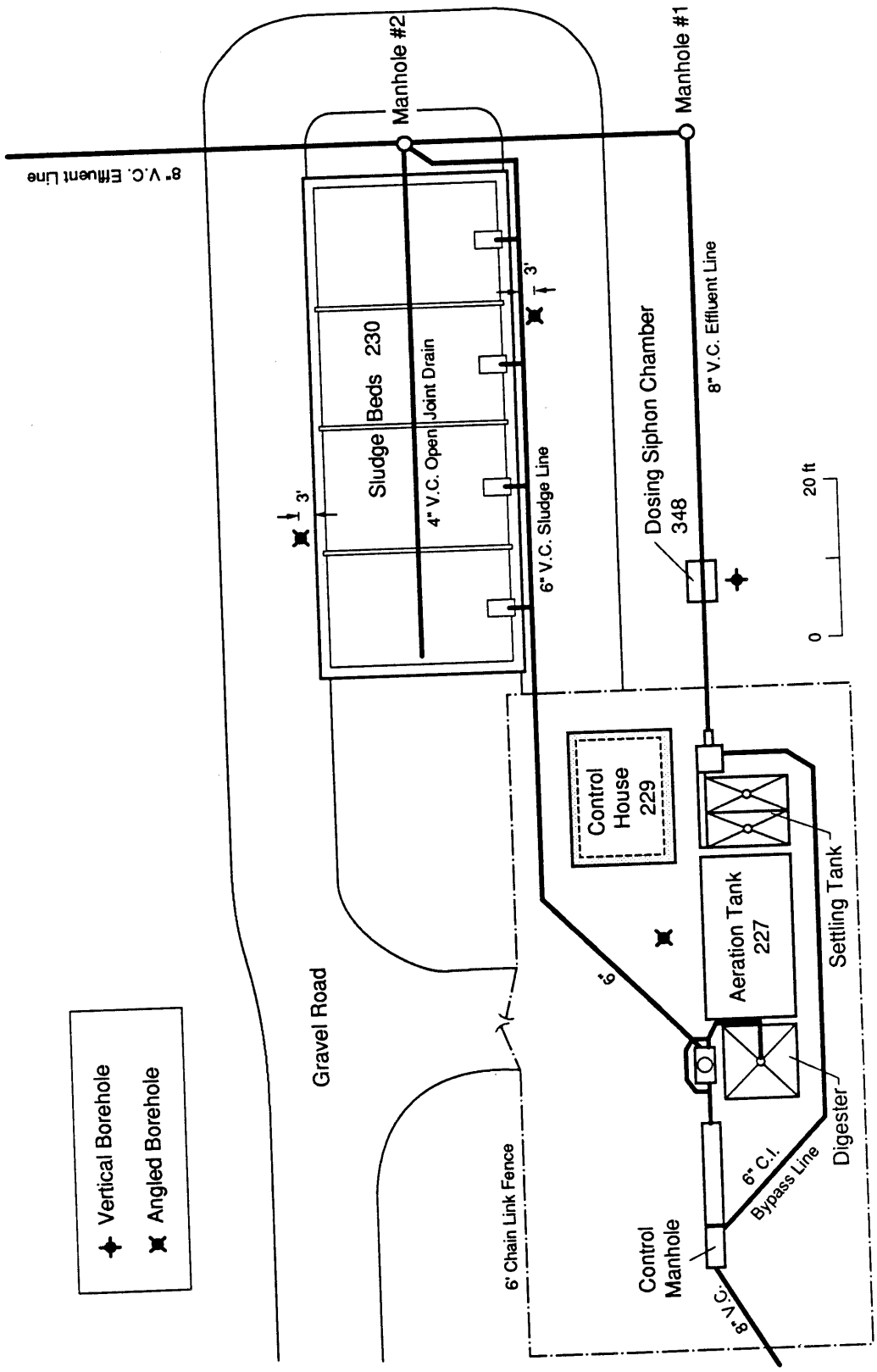

Fig. 14.8-5 Initial borehole locations for the initial investigation of SWMUs 21-026(a), (b), and (c) at the sewage treatment plant. (LASL 1966b)

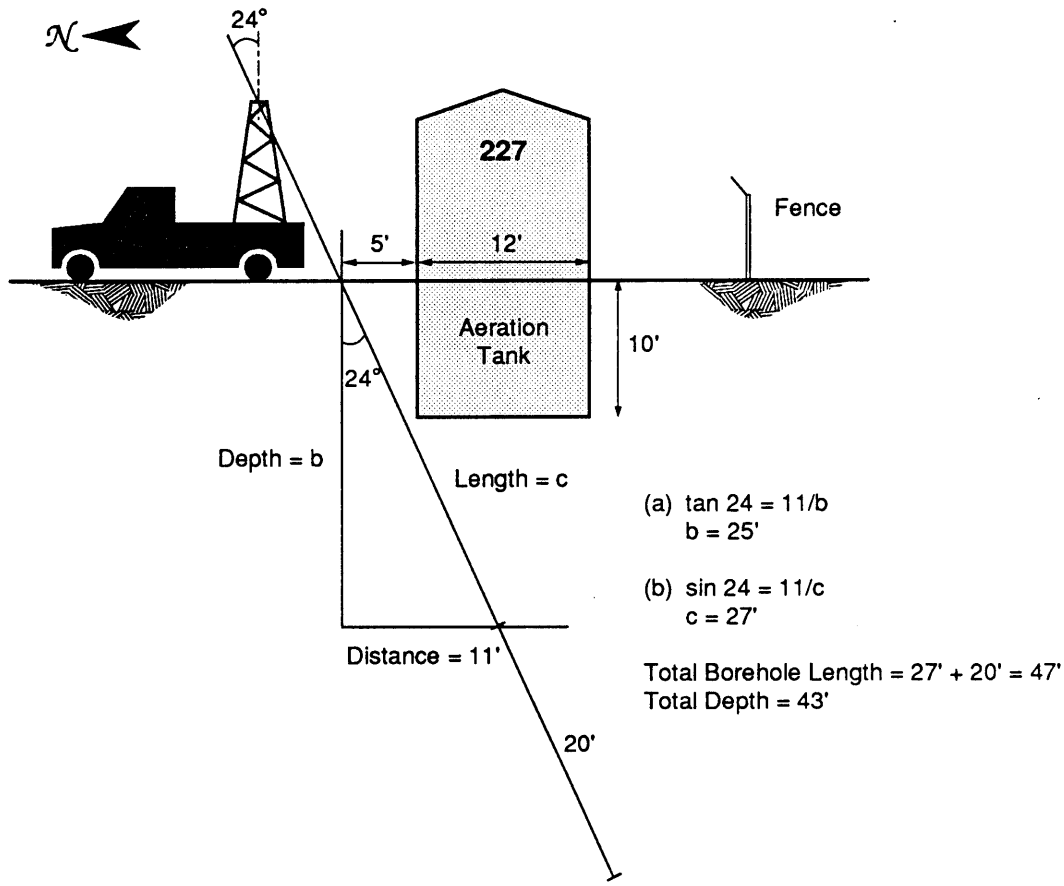

Fig. 14.8-6 Graphic representation of drilling to be performed under the initial investigation at TA-21-227 [SWMU 21-026(a)].

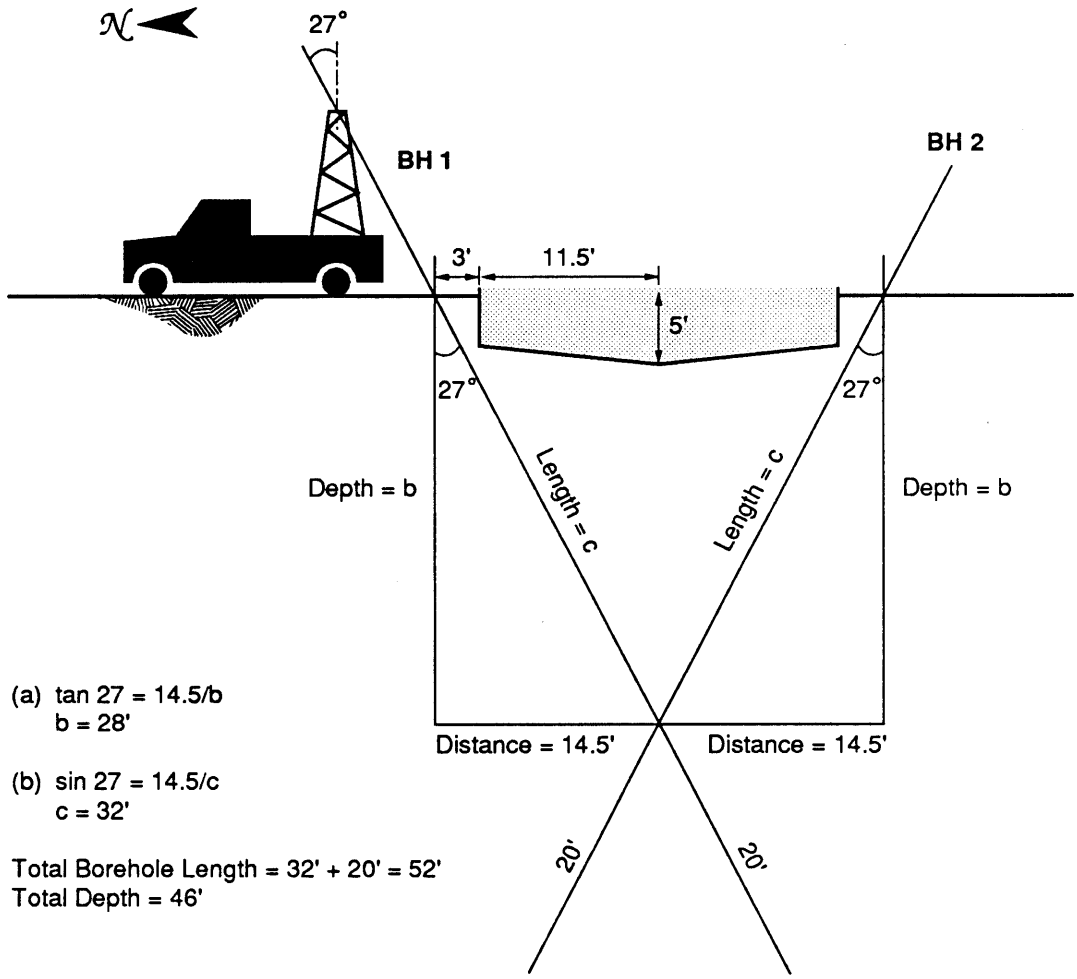

Fig. 14.8-7 Graphic representation of drilling to be performed under the initial investigation at TA-21-230 [SWMU 21-026(b)].

20 ft beyond the center of the sand filter and sludge drying beds to locate any contamination that may have migrated outward and downward from the beds. Each borehole will be 52 ft in length, reach a total depth of 46 ft, and result in 11 samples.

Determinations for soil moisture, chlorides, and nitrates will be performed in the field laboratory. The selection of samples for analysis will follow the same protocol as for SWMU 21-026(a) above. This should identify any contamination that may have migrated outward and downward.

SWMU 21-026(c). One vertical borehole will be drilled on the south side of the dosing siphon chamber (Fig. 14.8-5). The borehole will be placed close to the outside of the barrier that surrounds the structure. The nominal depth for this borehole is 30 ft (for method see Sec. 11.5.3.2). A total of seven samples will result.

Determinations for soil moisture, chlorides, and nitrates will also be performed in the field laboratory. The selection of samples for analysis will follow the same protocol as for SWMU 21-026(a) above. This should identify any contamination that may have migrated outward and downward.

SWMU 21-013(a). Visual reconnaissance of the surface disposal area will be accomplished in the company of the sewage treatment plant operator. The approximate "center," and the approximate extent, or boundary, of the surface disposal area will be flagged. This area is approximately 45 by 45 ft and will be divided into nine 15- by 15-ft grid cells. The entire area will be field-surveyed for radiological contaminants (for methods see Sec. 11.4.1).

Surface soil sampling locations will be at the center of each grid cell, resulting in nine potential sampling locations (for method see Sec. 11.5.2.1) (Fig. 14.8-8) Surface soil samples will be collected in grid cells determined to lie within the sand disposal area, based on the radiological surveys or visual observations. In addition, judgmental surface soil samples will be taken at a maximum of three "hot spots" identified in the field survey. Based on field screening and field laboratory analyses, the surface sampling grid may be extended. At a maximum of three areas of surface contamination, near-surface soil samples will be taken to a maximum depth of 24-in. (for method see Sec. 11.5.2.4).

For planning purposes, it is assumed that nine grid locations plus three "hot spot" locations will be surface sampled, and at three of these locations, three additional samples will be taken to reach a 24-in. depth. This totals 21 samples to be processed in the field laboratory. Thirty percent of the samples from this investigation will be submitted for a full analytical suite of analyses (six samples).

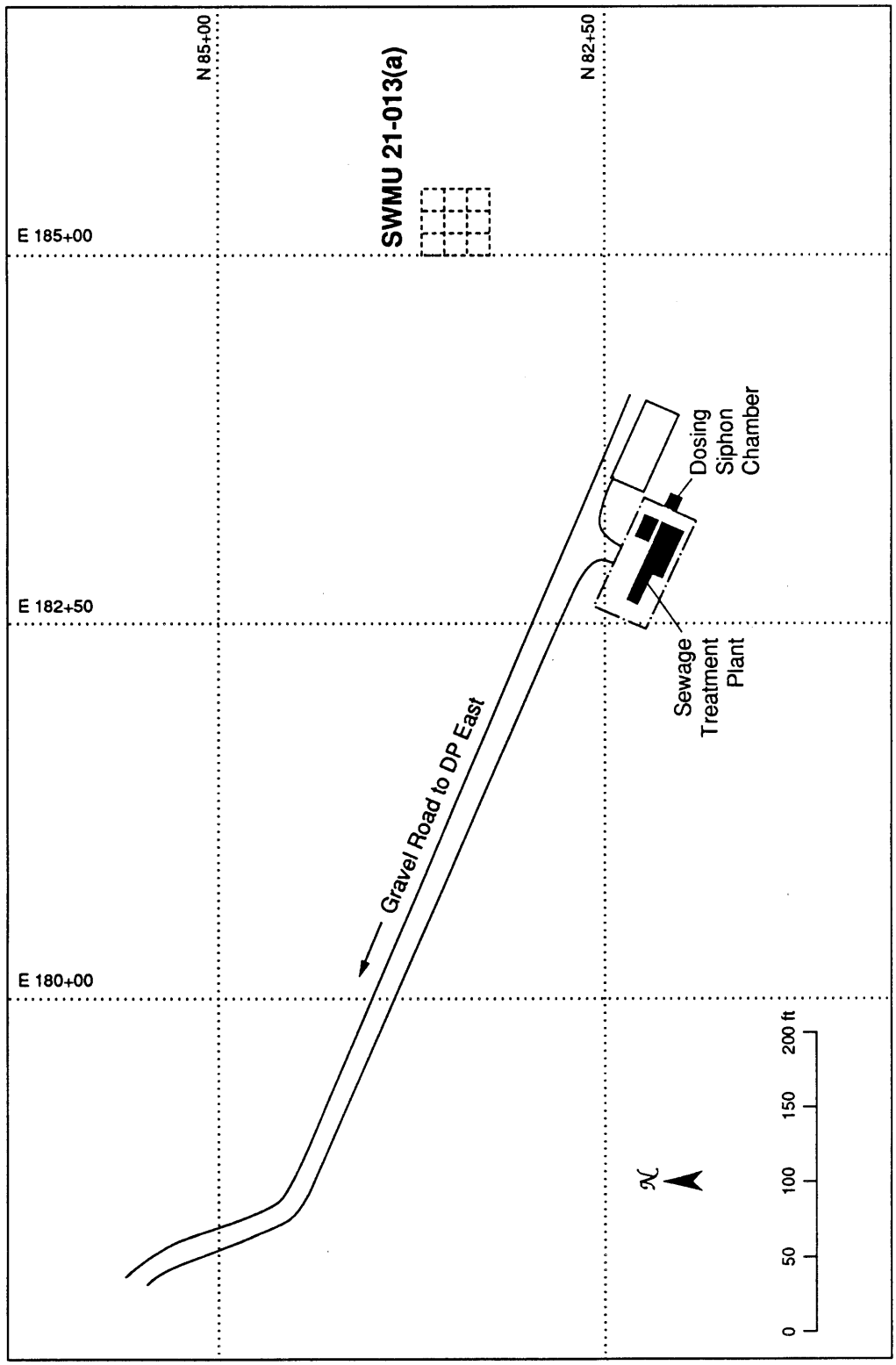

Fig. 14.8-8 Schematic of the sampling grid for the surface disposal area at the sewage treatment plant, TA-21. (LANL 1983d)

14.8.4.2. Subsequent Investigations

SWMU 21-026(a)–(c). From the initial boreholes at each of the three SWMUs, it will be possible to determine whether contamination exists and if the contaminant plume extends laterally. If the contaminant plume is identified under each facility, then vertical boreholes will be drilled at these facilities (for method see Sec. 11.5.3.2).

The first vertical borehole will be placed 20 ft south of the sewage treatment plant, TA-21-227, and the second will be placed 20 ft north, in line with the initial borehole (Fig. 14.8-9). The nominal depth is assumed to be 50 ft but will be based on analysis of results from initial investigations.

If contamination is found around the sand filters/sludge drying beds, TA-21-230, three vertical boreholes will be drilled (Fig. 14.8-10). These will be located 20 ft from the north wall of the two sludge drying beds in line with the angled borehole; 20 ft east of the sludge drying beds, in line with manhole 21-265; and 20 ft from the west end of the sand filter beds in line with manhole 21-265. The nominal depth of these three boreholes is assumed to be 50 ft but will be based on results from the initial investigation.

If contamination is found at the dosing siphon chamber, TA-21-348, one additional borehole will be drilled (Fig. 14.8-910. This borehole will be located 20 ft southeast of the southeast corner of the dosing chamber.

It is anticipated that no more than four additional boreholes will be required to define the lateral and vertical extent of contamination from any one of the three SWMUs. For planning purposes, however, it is assumed that no additional boreholes are required and that no additional sample analyses will be needed.

SWMU 21-013(a). From the initial surface and near surface soil samples, it will be possible to determine whether contamination exists, the primary direction of the contaminant dispersal, and whether the contaminant depth is greater than 2 ft. Surface sampling in a wider area may be employed to define the extent of the area. If a contaminant plume is identified, then shallow boreholes will be employed to define the subsurface extent. A nominal depth of 10 ft is appropriate.

For planning purposes, it is assumed that no additional sampling will be required.

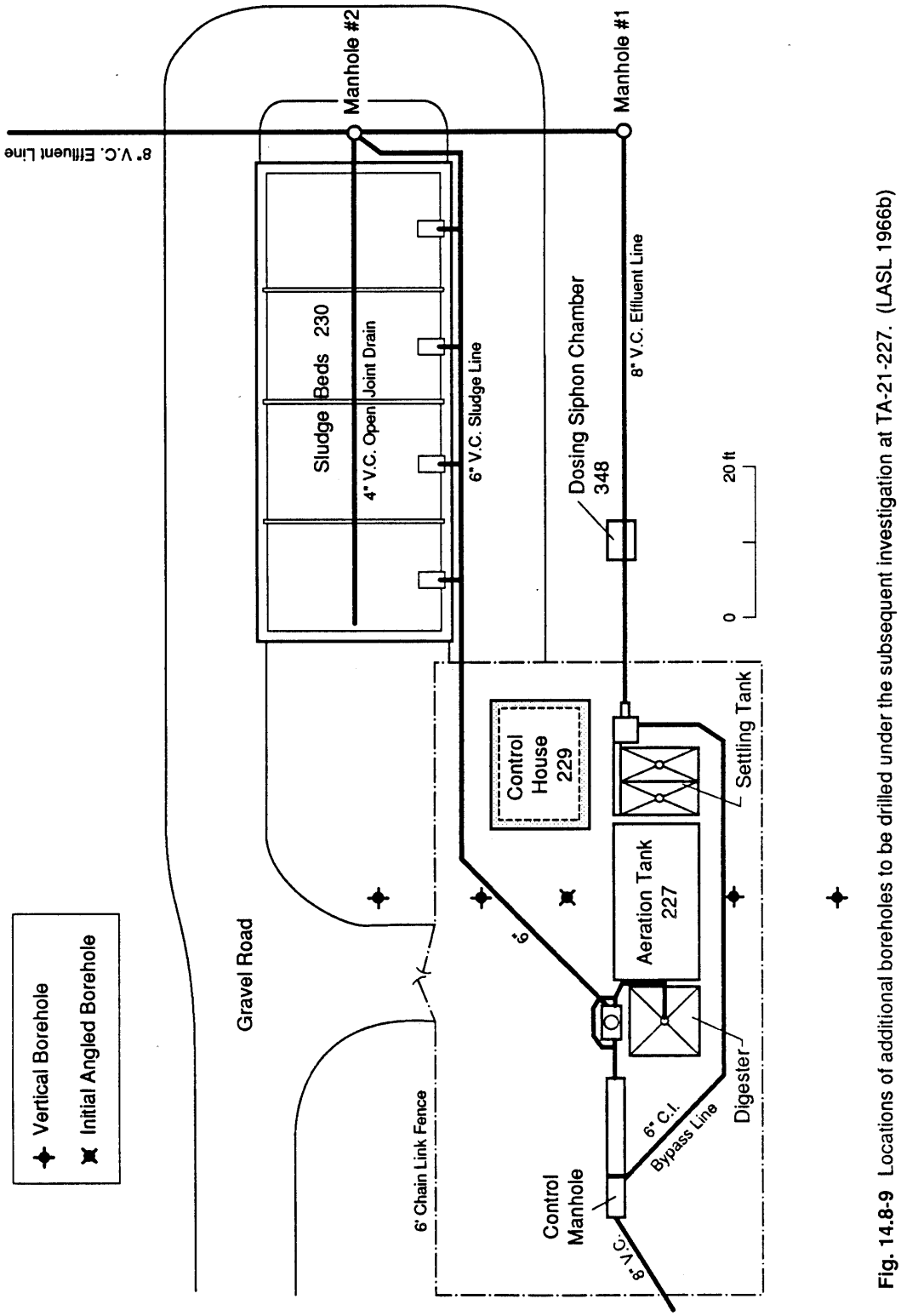

Fig. 14.8-9 Locations of additional boreholes to be drilled under the subsequent investigation at TA-21-227. (LASL 1966b)

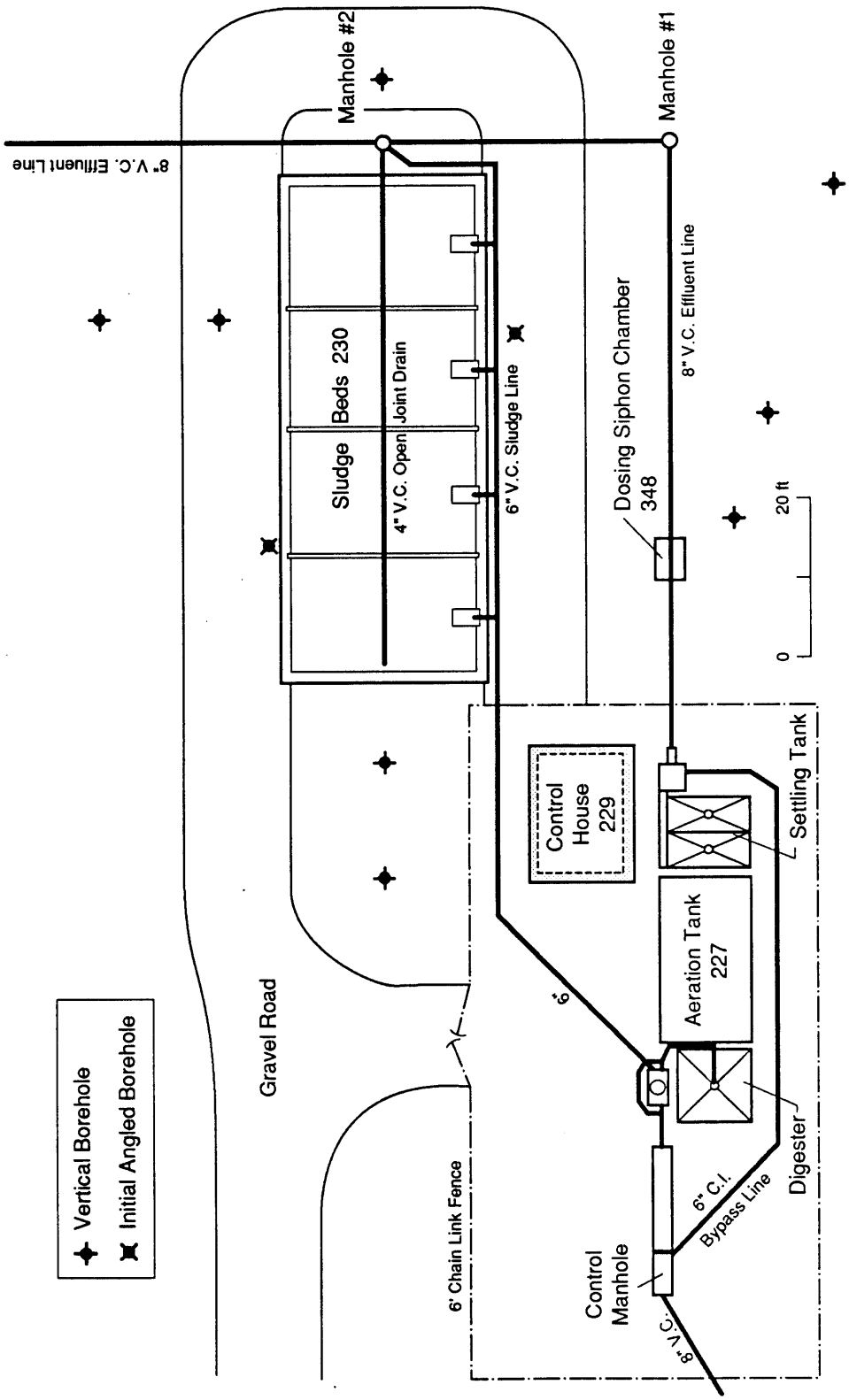

Fig. 14.8-10 Locations of additional boreholes to be drilled under the subsequent investigation at TA-21-230. (LASL 1966b)

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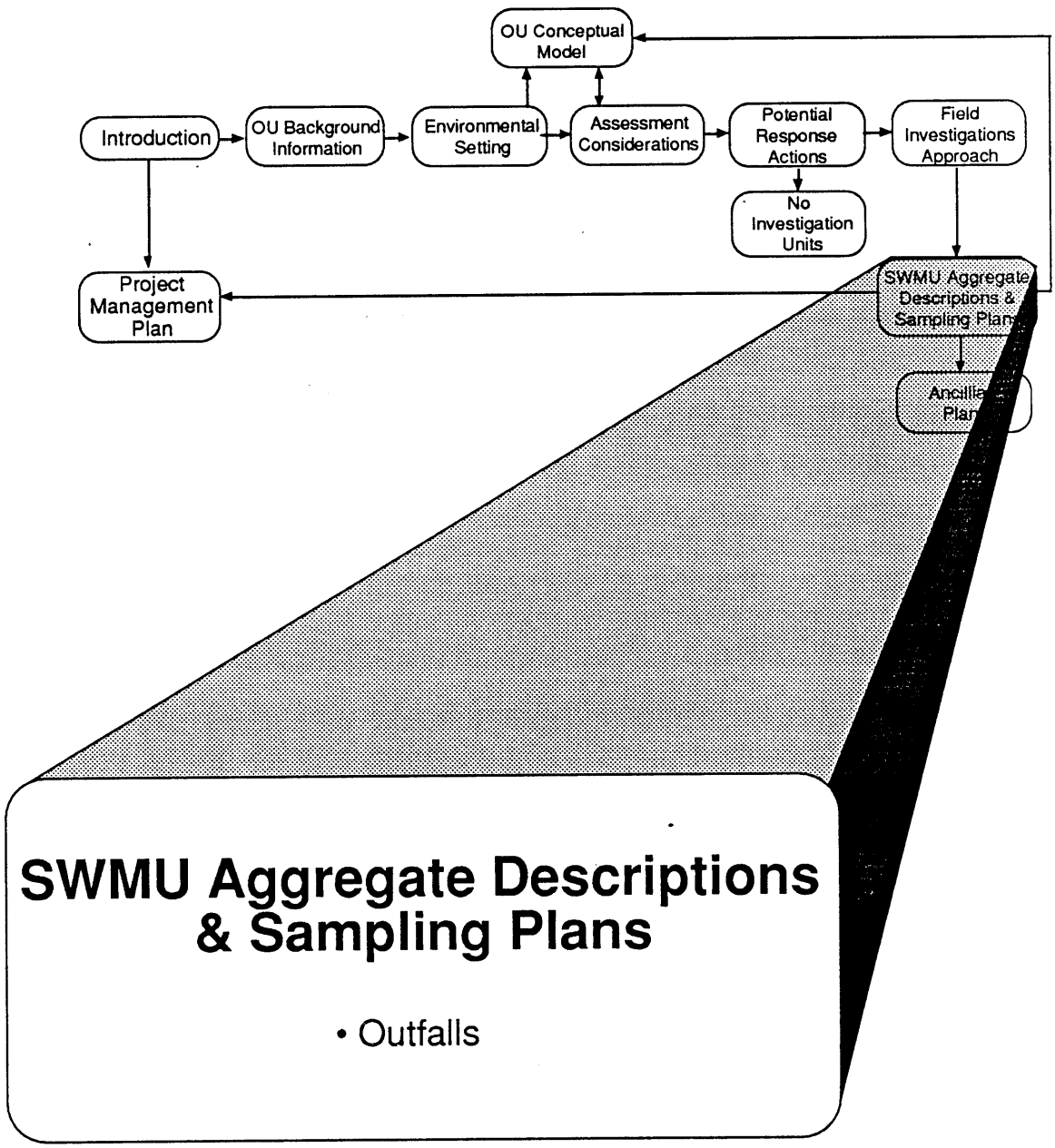
CHAPTER 15


OU Conceptual Model
Introduction
OU Background Information
Environmental Setting
Assessment Considerations
Potential Response Actions
Field Investigations Approach
No Investigation Units
Project Management Plan
SWMU Aggregate Descriptions & Sampling Plan
Ancillary Plan
SWMU Aggregate Descriptions & Sampling Plans
• Outfalls

15. OUTFALLS DESCRIPTION AND SAMPLING PLAN

15.1 Introduction

This chapter addresses outfalls from liquid waste systems listed as SWMUs in several SWMU groups that include the following:

- SWMU 21-004, Aboveground Tanks and Drain Lines
- SWMU 21-006, Underground Seepage Pits
- SWMU 21-011, New Industrial Waste Treatment Plant
- SWMU 21-013, Surface Disposal Areas
- SWMU 21-022, Acid Waste Lines and Sumps and
- SWMU 21-023, Decommissioned Septic Systems
- SWMU 21-024, Inactive Septic Systems/Outfalls
- SWMU 21-026, Wastewater Treatment Plant and
- SWMU 21-027, Surface Discharge

The majority of the outfalls covered under these SWMUs were previously identified as part of the CEARP investigation (LANL 1987). Table 15.1-I lists outfalls by SWMU number and cross references the CEARP identifier. In addition, some outfalls that have not been classified as SWMUs are also addressed. These are identified by EPA NPDES numbers and are considered in this work plan because of uncertainties in the history of releases predating NPDES permitting. Figures 15.1-1 and 15.1-2 show the general location of each outfall.

Two outfalls identified as part of SWMU 21-013(g) (CEARP identifiers 3ac and 3ad) were both erroneously identified as outfalls. They are discarded sections of pipe, which project from the upper portion of a slope descending into Los Alamos Canyon from the south perimeter of MDA V. This location corresponds to a surface disposal area, SWMU 21-013(g), where debris from the demolition of buildings was pushed over the edge of the mesa. These will no longer be considered outfalls, but investigations are planned under the more appropriate category of Surface Disposal Areas, Sec. 14.7.

TABLE 15.1-I
DISCHARGE SYSTEMS

SWMU Number	CEARP Identifier	Associated Facilities	Previously Sampled
21-004(d)	TA-21-3n	Sump 223	*
21-006(b)	TA-21-3u	Pit 118/Bldg 2	*
21-011(k)	TA-21-3o, NPDES EPA 050050	Bldg 257	*
21-022(h)	TA-21-3a, NPDES EPA 03A032	Bldg 150	
21-023(c)	TA-21-3y	Tank 62/Bldg 33	*
21-024(a)	TA-21-3m	Tank 53/Bldg 9	
21-024(b)	TA-21-3g	Tank 55/Bldg 17	*
21-024(c)	TA-21-3h	Tank 56/Bldg 54	*
21-024(d)	TA-21-3f	Tank 106/Bldg 1	*
21-024(e)	TA-21-3e	Tank 123/Bldg 20	*
21-024(f)	TA-21-3k	Tank 124/Bldg 45	*
21-024(g)	TA-21-3l	Tank 125/Bldgs 7 & 31	*
21-024(h)	TA-21-3i	Tank 56/Bldg 54	*
21-024(i)	TA-21-3j	Tank 181/Bldg 152	*
21-024(j)	No CEARP Identifier	Tank 194/Bldg 155	
21-024(k)	No CEARP Identifier	Tank 219/Bldg 209	
21-024(l)	TA-21-3x	Bldg 21	*
21-024(m)	TA-21-3z	Bldg 209	
21-024(n)	TA-21-3aa	Bldg 155	*
21-024(o)	TA-21-3ab	Bldg 46	*
21-026(d)	TA-21-3w, NPDES EPA SSS05S	Bldg 227	
21-027(a)	TA-21-3d	Bldg 3	*
	TA-21-3p, NPDES EPA 03A031	Cooling Tower 143	*
	TA-21-3ae	Bldg 3	*
	TA-21-3af	Bldg 3/Cooling Tower 143	
21-027(b)	TA-21-3q	Bldg 152	
	TA-21-3r, NPDES EPA 03A034	Cooling Towers 166 & 167	
21-027(c)	TA-21-3c	Bldg 6	
21-027(d)	No CEARP Identifier	Tank 47	
—	TA-21-3b, NPDES EPA 03A037	Bldg 314	
—	TA-21-3s, NPDES EPA 03A036	Cooling Tower 220	
—	TA-21-3t, NPDES EPA 03A035	Cooling Tower 210	
—	TA-21-3v, NPDES EPA 03A037	Bldg 314	
Not an outfall	TA-21-3ac	MDA V	*
Not an outfall	TA-21-3ad	MDA V	
—	TA-21-3ag, NPDES EPA 02A129	Bldg 357	*
—	No CEARP Identifier, NPDES EPA 04A142	Cooling Tower 149	

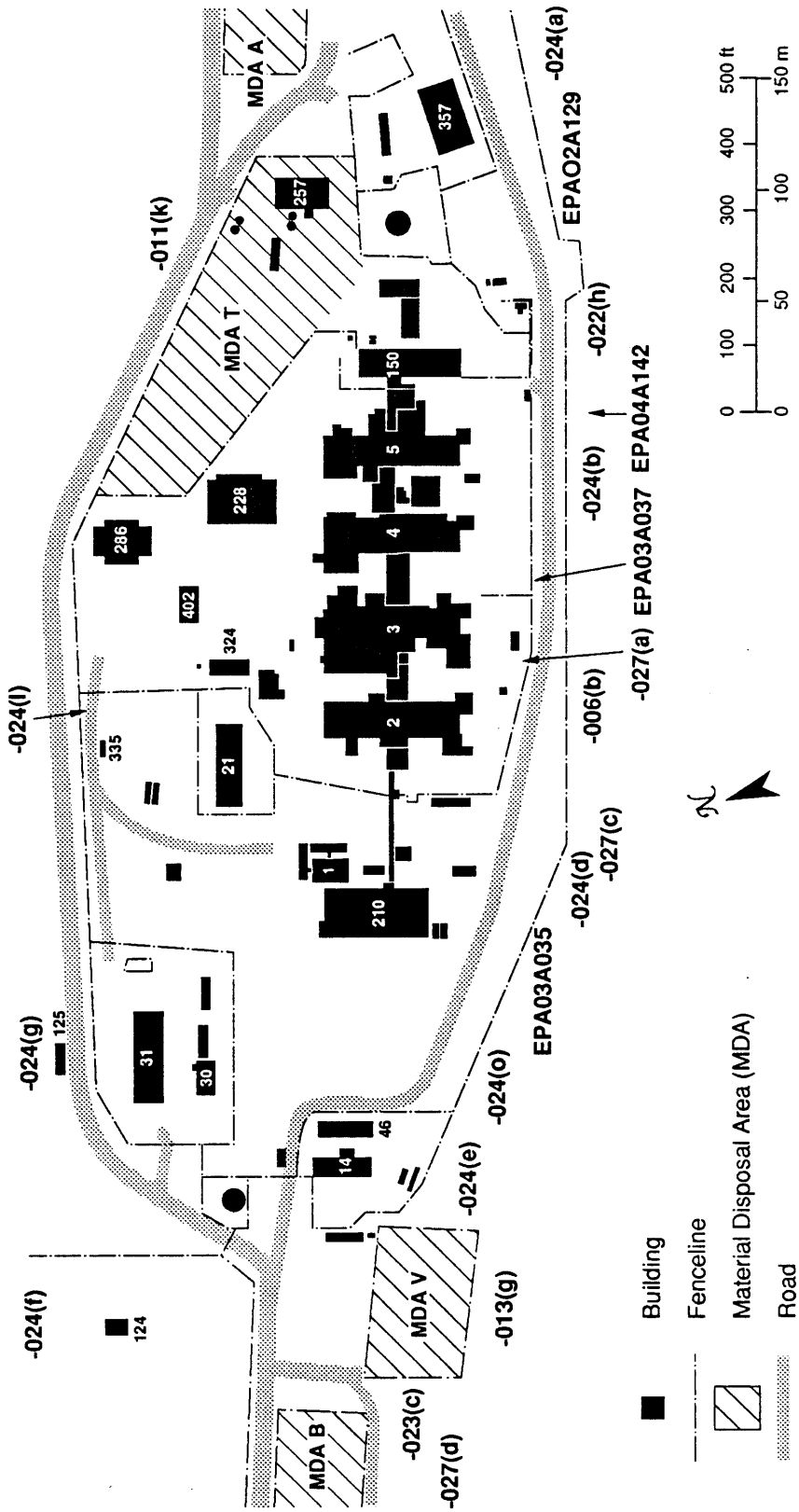


Fig. 15.1-1 Locations of outfalls at DP West.

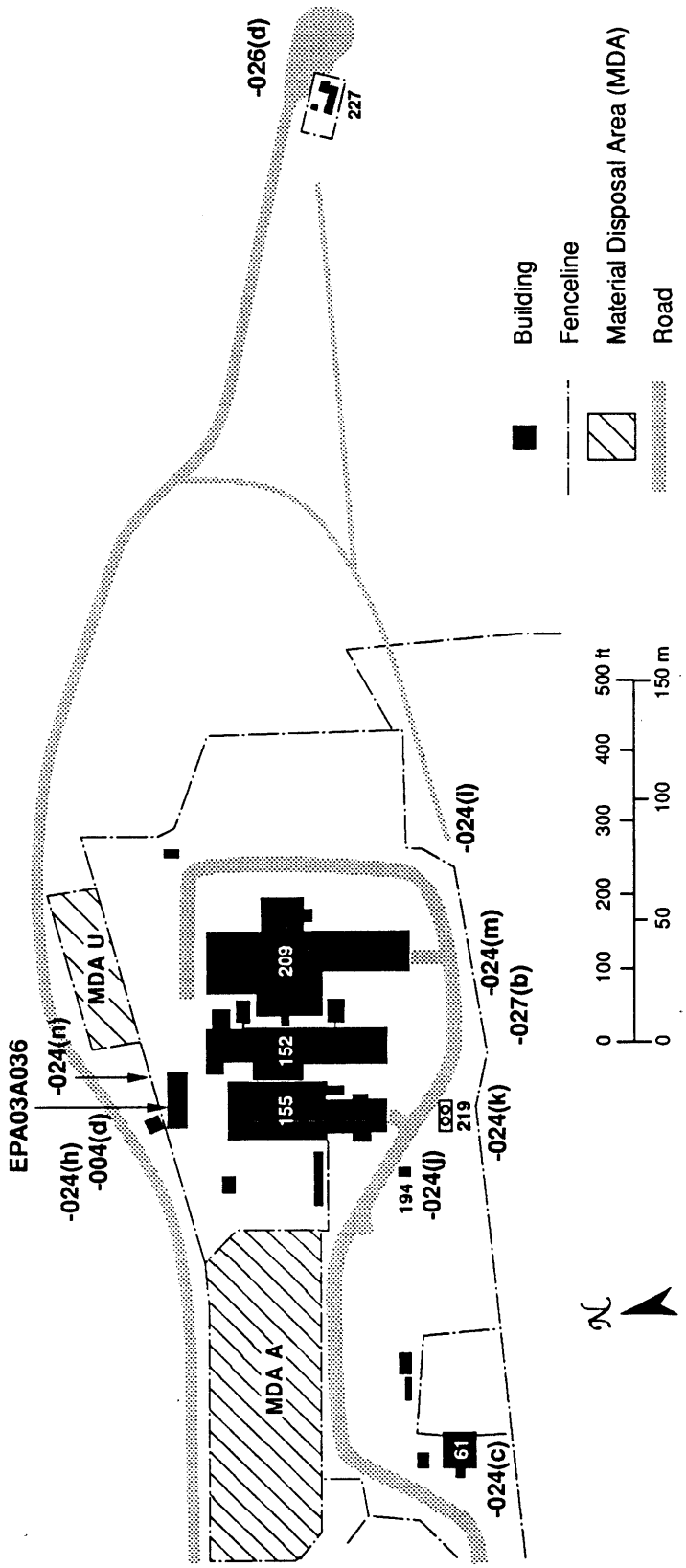


Fig. 15.1-2 Locations of outfalls at DP East.

15.1.1 Outfall Groups

There are 30 individual outfalls covered in this chapter; they are organized into nine sections, as follows:

- 15.2 Outfalls with Undetermined Locations
  - SWMU 21-023(c)
  - SWMU 21-024(a)
  - SWMU 21-024(g)
  - SWMU 21-024(l)
  - SWMU 21-027(c)
  - SWMU 21-027(d)
- 15.3 Outfalls with Septic Tanks
  - SWMU 21-024(b)
  - SWMU 21-024(c)
  - SWMU 21-024(d)
  - SWMU 21-024(e)
  - SWMU 21-024(i)
- 15.4 Direct Discharge Outfalls
  - SWMU 21-011(k)
  - SWMU 21-022(h)
  - SWMU 21-024(n)
  - SWMU 21-024(o)
  - SWMU 21-026(d)
- 15.5 Surface Drainage South of TA-21-3
  - SWMU 21-027(a)
- 15.6 Septic Tanks
  - SWMU 21-024(j)
  - SWMU 21-024(k)
- 15.7 Surface Drainage South of TA-21-155
  - SWMU 21-024(m)
  - SWMU 21-027(b)
- 15.8 Surface Drainage North of TA-21-155
  - SWMU 21-004(d)
  - SWMU 21-024(h)
- 15.9 Special Cases
  - SWMU 21-006(b)
  - SWMU 21-024(f)
- 15.10 NPDES Discharge Systems
  - EPA 02A129
  - EPA 03A035
  - EPA 03A036
  - EPA 03A037
  - EPA 04A142

A summary of the investigations planned in this chapter is given in Sec. 15.1.6.

15.1.2 Previous TA-21 Outfall Sampling

Surface soil samples of 18 outfalls at TA-21 were taken between October 25, 1988, and October 21, 1988 (DOE 1989). This was a subset of the 32 known outfalls at that time. NPDES-permitted outfalls and outfalls directly over the abrupt north face of Los Alamos Canyon were not sampled.

Outfall sample locations were screened with three instruments: Micro R meter, FIDLER, and Geiger-Mueller detector. Surface soil samples were analyzed at an EPA-certified laboratory for radioactive constituents, metals, volatiles, BNAs, pesticides, and oil and grease. The following radionuclides were analyzed: ^{241}Am, ^{137}Cs, ^{238}Pu and $^{239/240}Pu$ (isotopic), ^{226}Ra, ^{90}Sr, ^{232}Th, $2^{34}U$, and $^{235/238}U$ (isotopic).

Because only one sample was taken at each outfall, this data will only be used to indicate what contaminants may be present at a given outfall. Generally, analytical results showed metals and radionuclides in numerous samples. All samples with elevated inorganic contaminants (metals) also had radioactive constituents present.

DOE Headquarters conducted environmental sampling at Los Alamos, April 25 through June 23, 1988 (DOE 1989b). DOE environmental survey problem numbers 6 and 19 contained sampling locations at TA-21. Soils near NPDES Outfall 50 suspected to be contaminated with heavy metals and radionuclides by waste water discharged from TA-21-257 [see Sec. 15.4 SWMU 21-01(k)] were sampled as part of DOE environmental survey problem number 6. Soil adjacent to waste freon drums southwest of the TA-21-3 drainage ditch was sampled under DOE environmental survey problem number 19. These analytical results are discussed in conjunction with Outfalls under SWMU 21-027(a) in Sec. 15.5.

15.1.3 Approach to Outfalls Characterization

Two concepts are inherent in the plans developed for characterizing the outfalls. First, based on a review of reconnaissance sampling data of 19 samples from 18 outfalls (DOE 1989a), it has been found in every case that if there were no radioactive contaminants, there also were no nonradioactive contaminants present. (Note: the reconnaissance sampling results are presented in the following sections.) In some cases, radioactivity was detected in the absence of other contamination, but the reverse was not observed. This observation leads to the use of radioactivity as an indicator of the presence of contamination as a field tool.

Second, based on the results of the reconnaissance sampling, it is believed that minimal contamination is present in the outfall drainages of TA-21. An objective of the characterization of the outfalls is to supplement the small number of available sample analysis results by providing additional data from locations having a high probability of being contaminated, if contaminants are present. To ensure that the sample analyses provide a defensible basis for planning further actions, a full analytical suite will be used for most samples. This approach will provide additional information on contaminants that have been measured in the past; and confirmation of the absence of other contaminant species.

These data will be used to assess necessary actions at each outfall. It is expected that many will not require further action, and those for which some action may be needed may best be addressed in the context of a removal action rather than further characterization.

15.1.4 Outfall Drainage Sampling Strategy

The concept of using the presence of radioactivity as a field tool is an important part of the characterization strategy in several of the outfall drainages. In a number of cases, either the outfall location or the exact drainage path from an outfall is uncertain. Where possible, field radiation surveys will be employed to identify those locations or paths, so they may be sampled explicitly. This is referred to as Strategy A and is used in several of the sampling plans presented in this chapter. When field radiation surveys are not successful in defining the locations or paths, the alternative approach will be to bound the possible locations with sampling points. This is referred to as Strategy B and is used in vague drainages when Strategy A is unsuccessful. A third strategy, Strategy C, will be used for clearly defined drainage paths where there is little uncertainty in the flow path of a discharge. Such drainages will be sampled in the channel, preferably from ponding or pooling areas.

Formal statements of Strategies A, B, and C are provided below. These will be referenced as needed by the sampling plans presented in this chapter.

1. **Strategy A.** If a drainage pattern is identified by the field radiological survey, surface soil samples (0–6 in. or at differing depths as detailed in the field sampling plans) will be taken from the contaminated areas that define the pattern. Surface soil contaminant levels determined as part of OU-wide characterization (see Chapter 12) will be used for comparison. Fig. 15.1-3 is a graphic representation of this sampling scheme.

2. **Strategy B.** If no pattern of contamination is found using Strategy A, a series of surface soil samples (0–6 in. or at differing depths as detailed in the field sampling plans) will be taken from the slope below the best identified location of the outfall discharge. Three sampling points will be

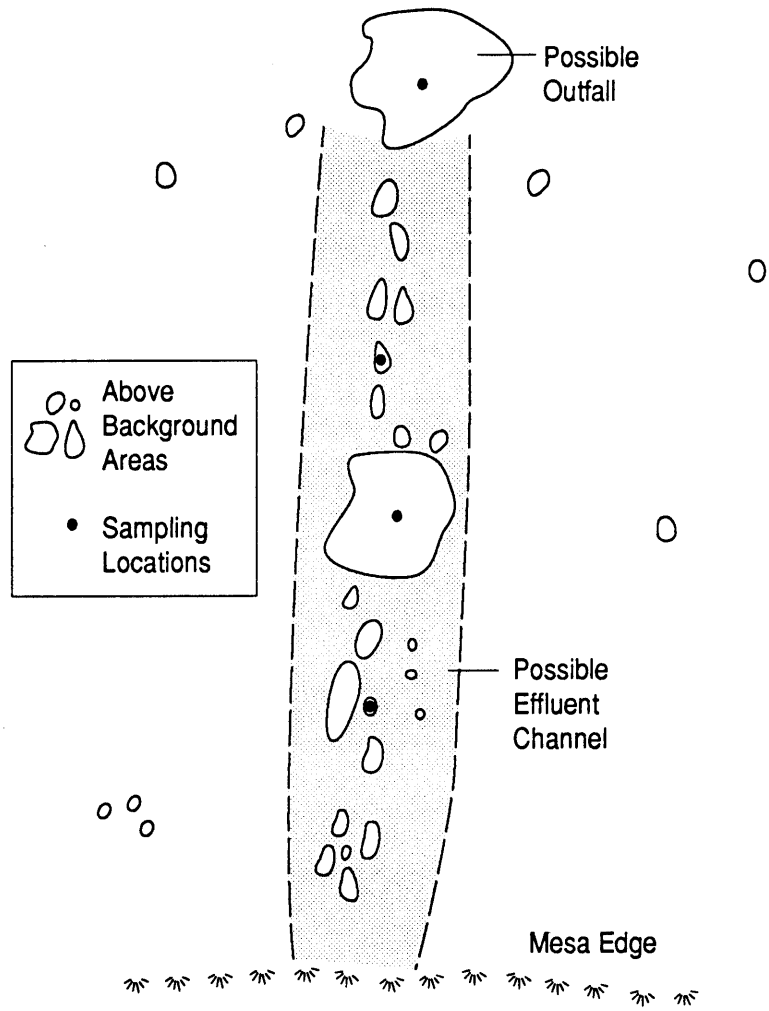


Fig. 15.1-3 Sampling strategy A.

spaced at nominal 5-ft intervals in a line across the probable drainage path. These three sample groups will be placed at roughly 15-ft intervals down the flow path between the outfall and the mesa edge. This method is expected to give a reasonable probability of bounding the effluent channel, recognizing the potential for errors in determining the location of the outfall. The spacing between the three sample groups may vary depending on the proximity to the mesa edge, the need to sample a bench below the mesa edge, and other factors. Figure 15.1-4 is a graphic representation of this sampling scheme. As for Strategy A, surface soil contaminant levels determined as part of OU-wide characterization (see Chapter 12) will be used for comparison.

3. **Strategy C.** If no pattern of contamination is found using Strategy A for drainages with well-defined channels (assumed to be stable channels), surface soil sampling (0–6 in. or differing depths as detailed in the field

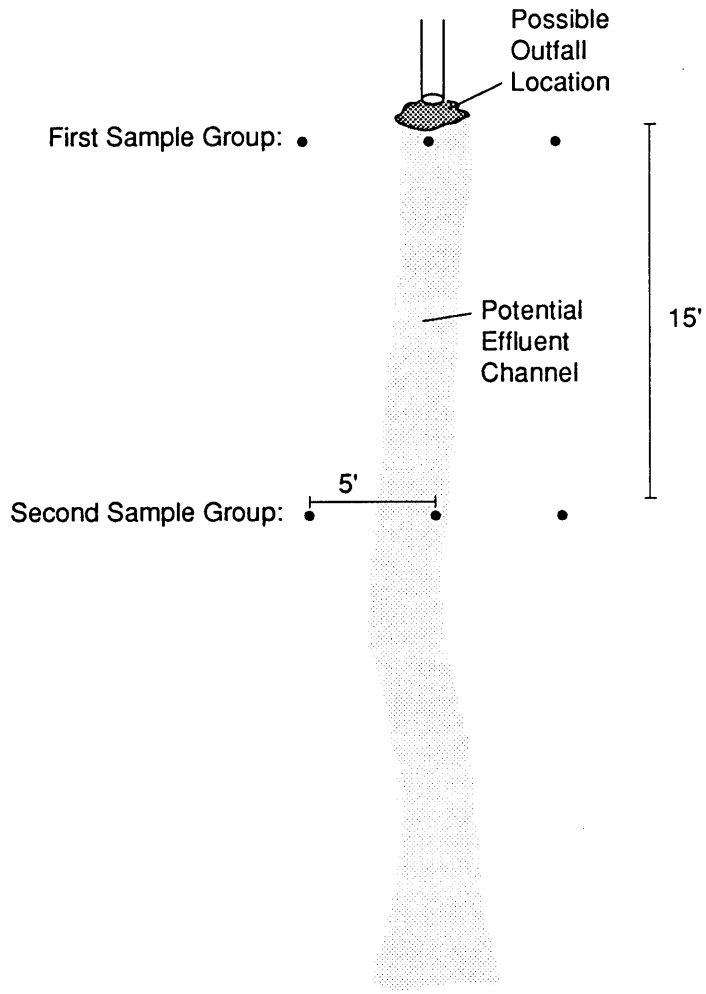


Fig. 15.1-4 Sampling strategy B.

sampling plans) will be done in the channel. In general, one sample location will be at the point of discharge, and at least one additional location will be sampled in a pooling area or likely sedimentation point 15 to 50 ft from the discharge. Surface soil contaminant levels determined as part of OU-wide characterization (see Chapter 12) will be used for comparison. Figure 15.1-5 illustrates this strategy.

For all three strategies, the number of sampling locations, the type of sampling method, and the depth to be sampled may vary from investigation to investigation. In addition, the number of points sampled down the course of each drainage may differ based on the specific characteristics of the drainage channel. As stated above, OU-wide surface soil contaminant levels determined

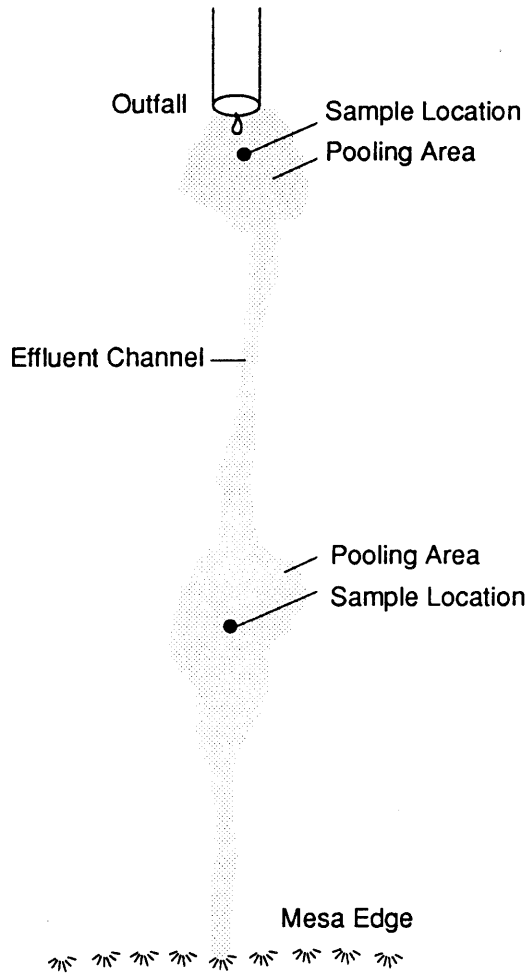


Fig. 15.1-5 Sampling strategy C.

as part of OU-wide characterization will aid in distinguishing contaminant levels because of site-wide releases or other influences not related to discharges from contaminated outfalls.

15.1.5 Septic Tank Sampling Strategy

A single borehole will be drilled and sampled at existing septic tanks at the point where leakage is most likely (beside the center of the tank or near tank inlet or outlet line), to define the presence and depth of contamination. This information will provide input to the CMS for planning septic tank removal. No further RFI septic tank characterization will be conducted.

15.1.6 Summary of Chapter 15 Outfall Sampling

For outfalls, the pathways of concern identified in Chapter 5 include surface run-off, infiltration, and vapor-phase movements. The no-action alternative was identified in Chapter 10 as a potential appropriate remedial alternative for all of the SWMUs listed in this chapter. The review of available information has determined that the field investigations at seven of the SWMUs [21-006(b), -024(f), (h), (g), (k), and (m), and -027(b)] and at the NPDES systems may determine that environmental releases have not occurred at these sites. After this determination, the site will be proposed for no further investigation. Other preliminary remedial alternatives identified for this chapter's SWMUs include treatment, removal and disposal, and removal and treatment. The analysis of preliminary remedial alternatives for each SWMU is tabulated in Table 10-I. The strategy for the field investigations to characterize the SWMUs in this chapter is presented in Fig. 15.1-6. The field survey measurements and field screening measurements are defined in Chapter 11. Tables 15.1-II and 15.1-III summarize measurements and analyses for subsurface soil samples to be taken during the initial investigation at all outfalls addressed in this chapter.

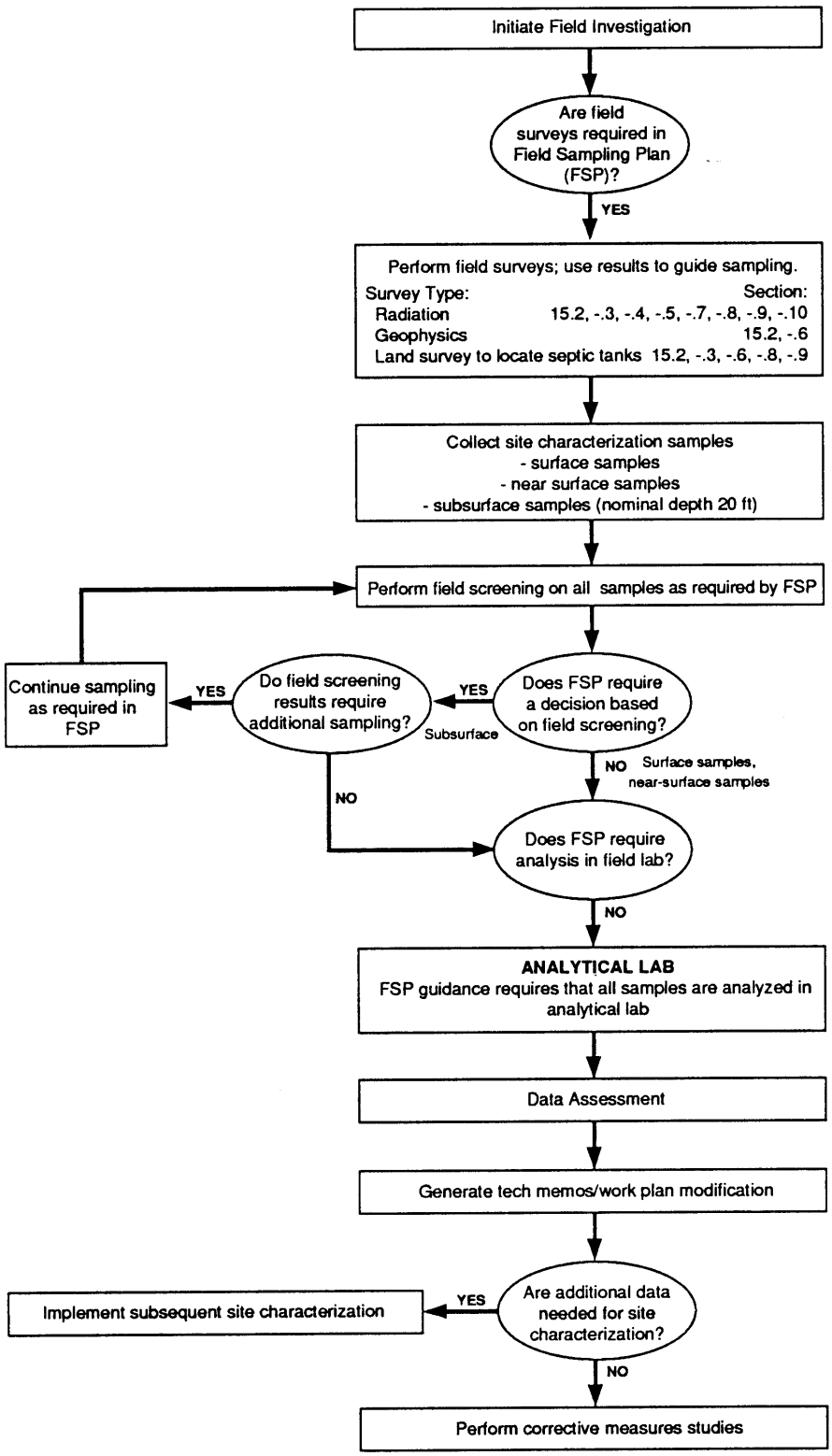


Fig. 15.1-6 Logic flow for field investigations to characterize outfalls.

15.1-II SUMMARY OF INITIAL INVESTIGATIONS BY SECTION FOR CHAPTER 15.

Section	Description	Survey Areas			Surface	Near Surface Soil Samples		Trench	
		Land	Radiological	Geophysical	Soil Samples	No. of Locations	No. of Samples	No. of Locations	No. of Samples
15.2	Undetermined Locations	9	12	1	24	12	30	1	
15.3	Outfalls with Septic Tanks	7	10		1	11	26	4	
15.4	Direct Discharge Outfalls		8		4	11	31		
15.5	Drainage South TA-21-3		2		14				
15.6	Septic Tanks	2	2	2					
15.7	Drainage South of TA-21-155		2			2	6		
15.8	Drainage North of TA-21-155	1	4			9	27	1	
15.9	Special Cases		4		6	3	9		
15.10	NPDES Discharge Systems		10			10	30		
	Total	19	54	3	49	58	159	6	

Section	Description	Boreholes						Q A
		Shallow			Vertical			
		Number	Total Footage	No. of Samples	Number	Total Footage	No. of Samples	
15.2	Undetermined Locations				3	60	12	15
15.3	Outfalls with Septic Tanks				5	100	20	11
15.4	Direct Discharge Outfalls							7
15.5	Drainage South TA-21-3				2	40	8	4
15.6	Septic Tanks				4	80	16	5
15.7	Drainage South of TA-21-155							4
15.8	Drainage North of TA-21-155				1	20	4	7
15.9	Special Cases	1	10	4	1	20	4	7
15.10	NPDES Discharge Systems							7
	Total	1	10	4	16	320	64	67

15.1-III SUMMARY OF SAMPLE AND ANALYSIS FOR INITIAL INVESTIGATIONS BY SECTION FOR CHAPTER 15

	15.2	15.3	15.4	15.5	15.6	15.7	15.8	15.9	15.10		Total
Field Sample Screening											
Gross Gamma	66	47	35	22	16	6	31	23	30		276
Gross Alpha	66	47	35	22	16	6	31	23	30		276
Organic Vapor	67	51	35	22	16	6	32	23	30		282
Combustible Gas/Oxygen	13	20		8	16		5	8			70
Lithological Logging	12	21		8	16		4	8			69
Field Laboratory Measurements											
Gross Alpha											
Gamma Spectrometry											
Tritium											
Volatile Organics											
PCB											
Soil Moisture											
Laboratory Analysis											
Gamma Spectrometry	75	54	39	24	18	8	35	27	34		314
Tritium	75	54	39	24	18	8	35	27	34		314
Total Uranium	75	54	39	24	18	8	35	27	34		314
Isotopic Plutonium	75	54	39	24	18	8	35	27	34		314
Isotopic Uranium											
Strontium 90	75	54	39	24	18	8	35	27	34		314
VOA (SW 8240)	81	58	42	26	21	10	38	30	37		343
Semivolatiles (SW 8270)	80	57	41	25	19	9	37	29	36		333
Metals (SW 6010)	80	57	41	25	19	9	37	29	36		333
PCB (SW 8080)		11									11
TCLP Metals											
Isotopic Thorium		54	39	24	18	8	35	27			205

15.2 Outfalls with Undetermined Locations

15.2.1 Site Description

The six outfalls described in this section have no physical evidence to indicate their location. They have been grouped together because similar investigations are planned to determine locations and identify the presence of contamination.

15.2.1.1 History

SWMU 21-023(c) was a septic system (CEARP identifier 3y) that routed sewage from Building TA-21-33 through septic tank TA-21-62 to the surface on the south rim of DP Mesa above Los Alamos Canyon (Fig. 15.2-1). TA-21-33 was the old waste treatment laboratory where research into recovery of plutonium from liquid process wastes was performed. TA-21-33 (SWMU 21-009) and associated drain lines are addressed in Sec. 17.3.

The septic system included a concrete tank, 3-ft 6-in. wide by 7-ft long and 5-ft 10-in. deep, and the associated 4-in.-diameter vitrified clay pipe (VCP). The septic tank was probably built in the first half of 1948 (LASL 1948) and was removed on April 12, 1965, when it was taken to the "contaminated dump" (MDA G), as was Building TA-21-33 (Jenike 1965).

No evidence of either the outfall or the septic tank has been identified in the field. The flow pattern for the area below the septic tank may have been altered as a result of the 1965 removal of the building and the tank because some rubble is known to have been bulldozed over the mesa edge (see Sec. 14.7, Surface Disposal Areas). It is also unknown whether the drain line from the sump discharged onto the mesa or at the mesa edge. The end of the outfall line was reported to be 40 ft from the septic tank (LASL 1958).

SWMU 21-027(d) (no CEARP identifier) consisted of a 4-in. steel drain line that extended from the catch basin around a fuel tank (TA-21-47) south toward Los Alamos Canyon (Fig. 15.2-1). The line drained storm run-off from the bermed area around TA-21-47. Originally this line discharged where building TA-21-33 (see above) was built but was extended toward the south rim of DP Mesa as a result of the construction of that building. The drain line was removed in March 1965 (LASL 1965).

SWMU 21-024(a) was a septic system (CEARP identifier 3m) that routed sewage from Building TA-21-9 through septic tank TA-21-53 (abandoned in place in 1966) to the surface on the south

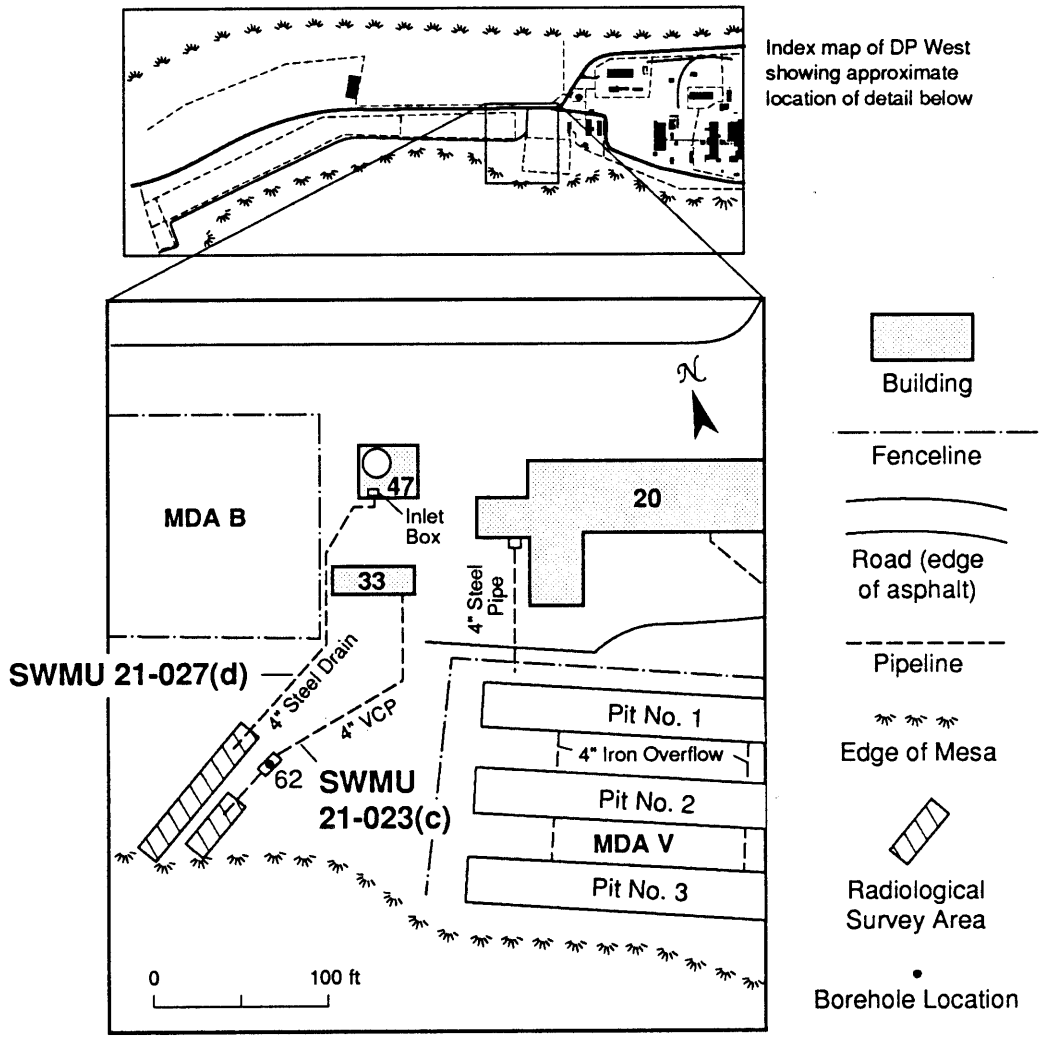


Fig. 15.2-1 Location of SWMUs 21-023(c) and 21-027(d), and radiological survey areas. (LASL 1958b, 1961)

rim of DP Mesa above Los Alamos Canyon (Fig. 15.2-2). TA-21-9 was the old steam plant. The reinforced concrete septic tank is 8-ft wide by 16-ft long and 7-ft 9-in. deep, and the drain lines are 6-in. VCP (LASL 1958d). Currently, there is no surface expression of the outfall line or the septic tank, although there is a sign bearing the designation "Septic Tank 53" south of the perimeter road, south of Building TA-21-9.

A number of blowdown lines from TA-21-9 also run south toward Los Alamos Canyon (LASL 1958d). Releases from these lines would commingle with those from the septic system, clouding the origin of any contaminants. The blowdown lines were reported to have been abandoned

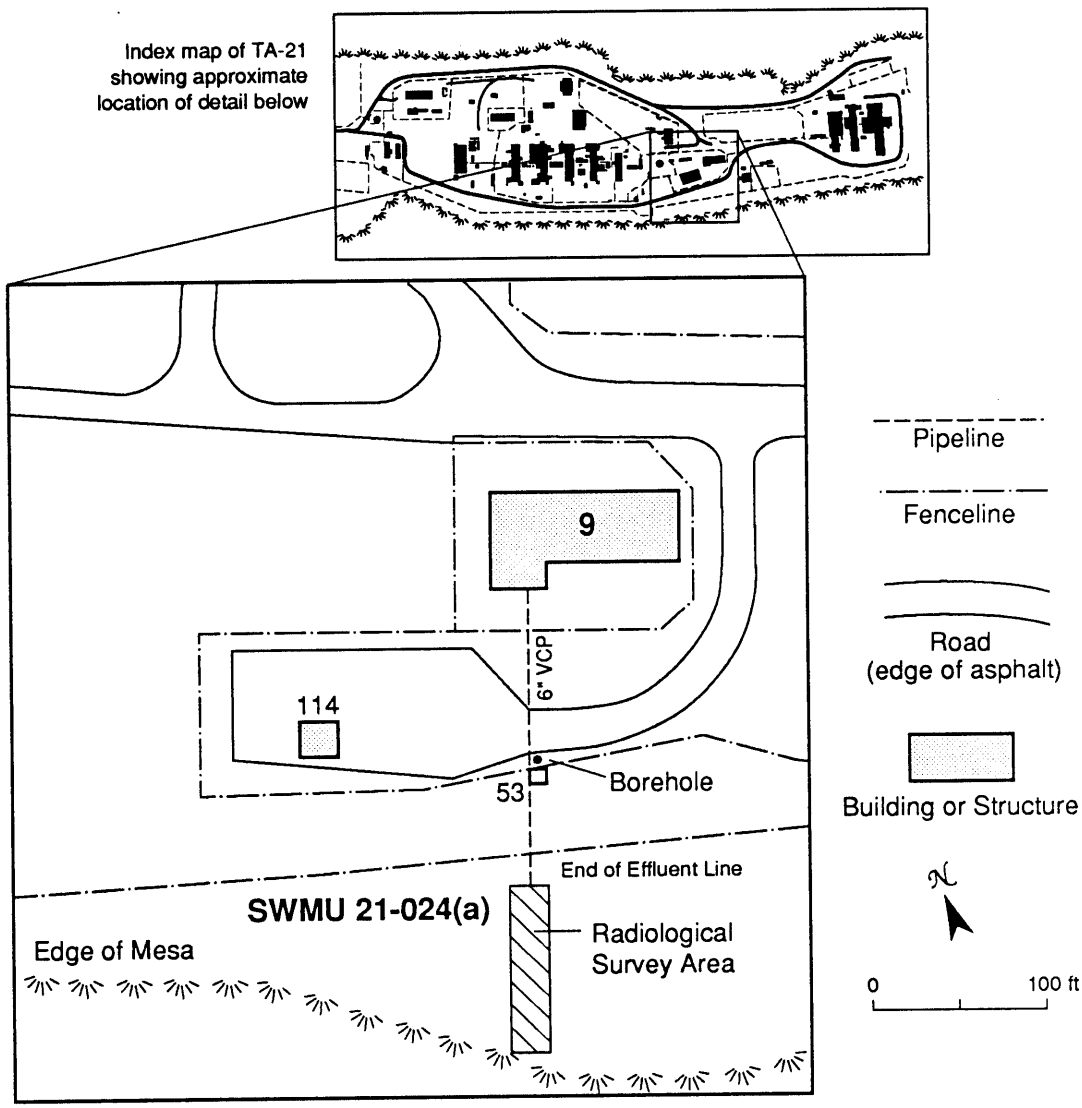


Fig. 15.2-2 Location of SWMU 21-024(a), septic tank sampling borehole, and radiological survey area. (LASL 1958d)

when the blowdown was routed to seepage pits and a dry well. These other components of the blowdown system (SWMU 21-012) are addressed in Sec. 17.4, Dry Wells.

An ER Program site visit on July 26, 1988, identified an enclosed pipeline, assumed at that time to be the outfall associated with SWMU 21-024(a), which went down the canyon wall and entered the ground on the canyon floor. Recent investigations have confirmed that pipeline as a high-pressure gas line. Therefore, no physical evidence of an outfall has been identified in the field.

SWMU 21-024(g) was a septic system (CEARP identifier 3l) that routed sewage from Buildings TA-21-7 and TA-21-31 through septic tank TA-21-125 (abandoned in place in 1966) to the surface on the north rim of DP Mesa above DP Canyon (Fig. 15.2-3). Building TA-21-7 was a warehouse and Building TA-21-31 an electronics shop. The reinforced concrete septic tank is 9-ft 6-in. wide by 18-ft long and 5-ft deep. The drain lines used in this septic system are 4-in. VCP (LASL 1958a).

There is no surface evidence of either the outfall or the septic tank. An outfall marker was placed at the sign identifying tank TA-21-125. Based on the reported distance to a nearby storm drain (LASL 1958a), the tank and outfall are probably 10 ft west of the current marker.

SWMU 21-024(l) (CEARP identifier 3x) originated in the mechanical room of Building TA-21-21 as a floor drain. It discharged to the north toward DP Canyon. TA-21-21 is the vault used for storage of plutonium and uranium metal. No drawing has been found showing the path of the drain to the outfall. It is possible that the outfall was near the present location of an aboveground tank, TA-21-335. A second likely location is a culvert approximately 40 ft northeast of TA-21-335 (Fig. 15.2-4). A CEARP marker was placed near the culvert.

SWMU 21-027(c) (CEARP identifier 3c) is reported to be a 4-in. VCP exiting from the southeast corner of Building TA-21-6 (Fig. 15.2-5). TA-21-6 housed a machine shop and cafeteria and was removed in 1966 (LASL 1968b). The drain line is believed to have been abandoned in place (LANL 1990). It discharged to the south on DP Mesa, approximately 50 ft inside the south perimeter fence (LASL 1961) in a broad, gently sloping area with no readily identified channel. It is approximately 50 ft further from the fence to the mesa edge.

15.2.1.2 Existing Information

Three of the outfalls were sampled in October 1988 as part of an ER Program reconnaissance sampling program. The soil samples collected were analyzed according to EPA Contract Laboratory Program (CLP) Statement of Work protocols for Target Compound List volatile organic compounds, semi-volatile organic compounds, pesticides/PCBs, and Target Analyte List metals. They were also analyzed for ^{241}Am, ^{137}Cs, ^{238}Pu, $^{239/240}Pu$, ^{226}Ra, ^{90}Sr, ^{232}Th, ^{234}U, ^{235}U, ^{238}U, and tritium by the standard procedures of a commercial laboratory. When these analysis results are cited below, they are referenced DOE 1989.

SWMU 21-023(c) was sampled at a single point in the outfall channel, 8 ft southwest of the outfall marker. Positive analysis results are summarized in Table 15.2-I (DOE 1989a). Compar-

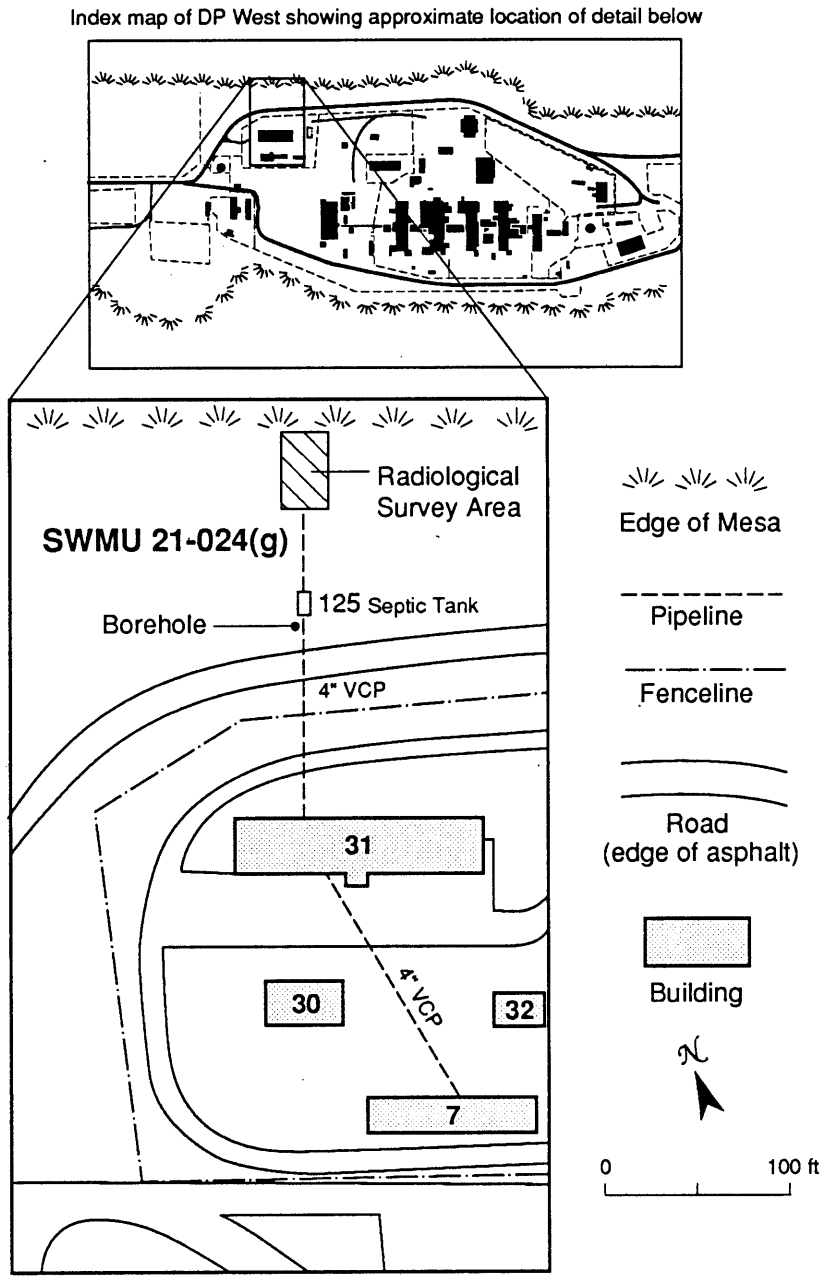


Fig. 15.2-3 Radiological survey area and septic tank sampling location at SWMU 21-024(g). (LASL 1958a)

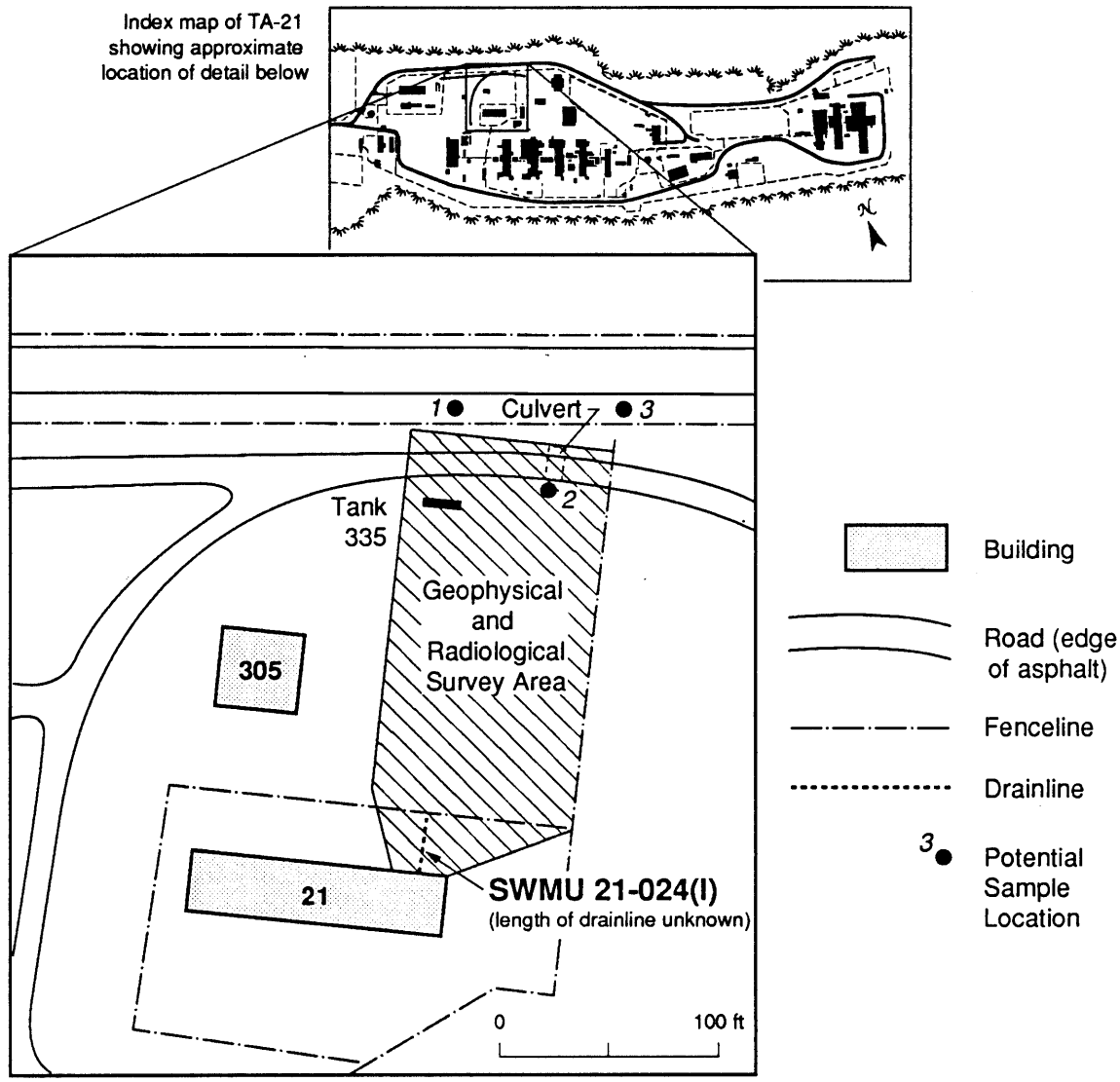


Fig. 15.2-4 Location of SWMU 21-024(I), geophysical and radiological survey area, and potential sampling locations. (LASL 1960; LANL 1983)

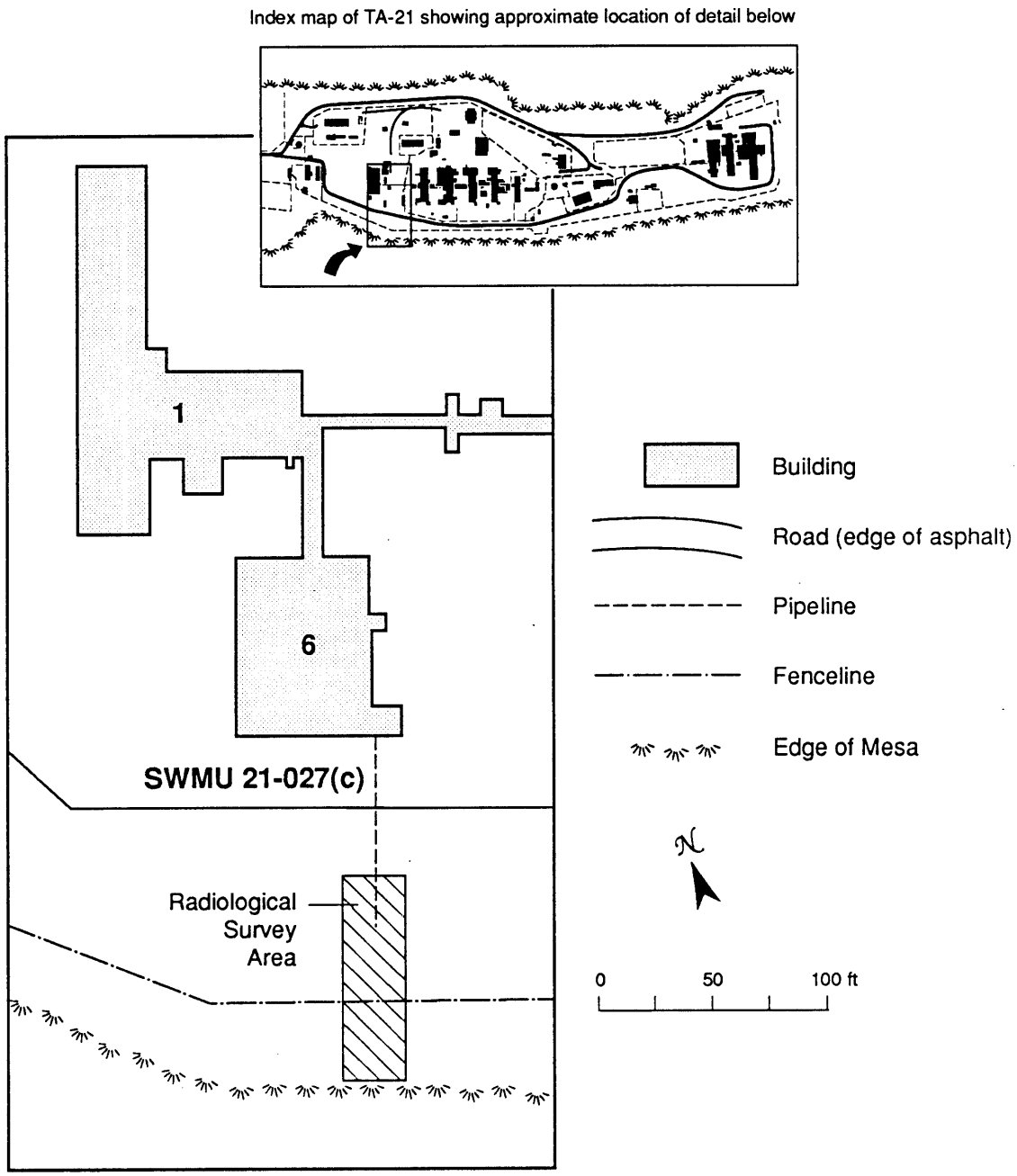


Fig. 15.2-5 Location of SWMU 21-027(c) and radiological survey area. (LASL 1961)

TABLE 15.2-I
1988 OUTFALL RECONNAISSANCE SAMPLING RESULTS FOR SWMUS
21-023(c), 21-024(g) and (l)

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[d] OF BACKGROUND $\bar{x}$ + 2s
	Metals				
SWMU 21-023(c)	ALUMINUM, TOTAL	3370	MG/KG	33	65,000
	BARIUM, TOTAL	50.8	MG/KG	33	850
	CALCIUM, TOTAL	869	MG/KG	826	—
	CHROMIUM, TOTAL	3.0	MG/KG	2.0	75
	COPPER, TOTAL	4.7	MG/KG	4.0	19
	IRON, TOTAL	3610	MG/KG	17	26,600
	LEAD, TOTAL	53.8	MG/KG	8.0	54
	MANGANESE, TOTAL	157	MG/KG	4.0	770
	OIL & GREASE BY GRAVIMETRIC	244	MG/KG	49.8	—[c]
	ZINC, TOTAL	18.9	MG/KG	4.0	78
	Radionuclides				
	PLUTONIUM-239	0.2	PCI/G	0.1	0.025
	RADIUM-226	1.0	PCI/G	0.1	2.5
	THORIUM-232	1.1	PCI/G	0.2	1.8
	TRITIUM	5.0	PCI/ML	2.0	0.0072
	URANIUM-234	1.0	PCI/G	0.2	—
	URANIUM-238	0.7	PCI/G	0.1	1.7
	Volatile Organics				
SWMU 21-024(g)	TETRACHLOROETHENE	13	UG/KG	6	—[c]
	Metals				
	Sample #1				
	ALUMINUM, TOTAL	1590	MG/KG	27	65,000
	BARIUM, TOTAL	38.5	MG/KG	27	850
	CALCIUM, TOTAL	1460	MG/KG	680	—
	CHROMIUM, TOTA	L2.9	MG/KG	2.0	75
	IRON, TOTAL	2820	MG/KG	14	26,600
	LEAD, TOTAL	69.4	MG/KG	14	54
	MANGANESE, TOTAL	104	MG/KG	2.0	770
	OIL & GREASE BY GRAVIMETRIC	848	MG/KG	51	—[c]
	ZINC, TOTAL	25.4	MG/KG	4.0	78
	Sample #2				
	ALUMINUM, TOTAL	3690	MG/KG	50	65,000
	ARSENIC, TOTAL	15.4	MG/KG	10	7.1
	BARIUM, TOTAL	137	MG/KG	50	850
	CADMIUM, TOTAL	4.8	MG/KG	2.0	0.37
	CALCIUM, TOTAL	3920	MG/KG	1250	—

TABLE 15.2-I (continued)

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[d] OF BACKGROUND $\bar{x}$ + 2s
	CHROMIUM, TOTAL	22.6	MG/KG	4.0	75
	COPPER, TOTAL	57.1	MG/KG	6.0	19
	IRON, TOTAL	5170	MG/KG	25	26,600
	LEAD, TOTAL	77.2	MG/KG	11	54
	MAGANESE, TOTAL	216	MG/KG	4.0	770
	MERCURY, TOTAL	12.2	MG/KG	0	0.03
	NICKEL, TOTAL	18.9	MG/KG	10	18.5
	OIL & GREASE BY GRAVIMETRIC	2280	MG/KG	62	—[c]
	VANADIUM, TOTAL	52	MG/KG	13	—
	ZINC, TOTAL	399	MG/KG	6.0	78
	Radionuclides				
	Sample #1				
	RADIUM-226	0.9	PCI/G	0.1	2.5
	THORIUM-232	0.5	PCI/G	0.2	1.8
	TRITIUM	5.0	PCI/ML	2.0	0.0072
	URANIUM-234	0.6	PCI/G	0.1	—
	URANIUM-238	0.3	PCI/G	0.1	1.7
	Sample #2				
	CESIUM-137	0.8	PCI/G	0.1	0.44
	PLUTONIUM-239	2.7	PCI/G	0.4	0.025
	RADIUM-226	1.1	PCI/G	0.1	2.5
	STRONTIUM-90	0.2	PCI/G	0.1	0.88
	THORIUM-232	0.9	PCI/G	0.1	1.8
	TRITIUM	900	PCI/ML	20	0.0072
	URANIUM-2348.9	PCI/G	0.7		
	URANIUM-238	5.0	PCI/G	0.5	1.7
	Volatile Organics				
SWMU 21-024(I)	DICHLOROMETHANE -METHYLENE CHLORIDE[a]	75	UG/KG	55	—[c]
	Semi-Volatile Organics[b]				
	BENZO (A) ANTHRACENE	2200	UG/KG/	2000	—[c]
	BENZO (A) PYRENE	2500	UG/KG	2000	—[c]
	BENZO (B) FLUORANTHENE	2100	UG/KG	2000	—[c]
	BENZO (G,H,I) PERYLENE	2200	UG/KG	2000	—[c]
	BENZO (K) FLUORANTHENE	2500	UG/KG	2000	—[c]
	CHRYSENE	2800	UG/KG	2000	—[c]

TABLE 15.2-I (continued)

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[d] OF BACKGROUND $\bar{x}$ + 2s
	FLUORANTHENE	5600	UG/KG	2000	—[c]
	PHENANTHRENE	4900	UG/KG	2000	—[c]
	PYRENE	6200	UG/KG	2000	—[c]
	Metals				
	ALUMINUM, TOTAL	6210	MG/KG	32.4	65,000
	BARIUM, TOTAL	65.6	MG/KG	32.4	850
	CALCIUM, TOTAL	1500	MG/KG	811	—
	CHROMIUM, TOTAL	5.3	MG/KG	1.6	75
	COPPER, TOTAL	6.1	MG/KG	4.1	19
	IRON, TOTAL	6150	MG/KG	16.2	26,600
	LEAD, TOTAL	14.6	MG/KG	3.7	54
	MAGNESIUM, TOTAL	1110	MG/KG	811	4,700
	MANGANESE, TOTAL	160	MG/KG	2.4	770
	OIL & GREASE BY GRAVIMETRIC	1550	MG/KG	53.5	—[c]
	VANADIUM, TOTAL	12.3	MG/KG	8.1	—
	ZINC, TOTAL	195	MG/KG	3.2	78
	Radionuclides				
	AMERICIUM	0.4	PCI/G	0.1	—
	CESIUM-137	0.4	PCI/G	0.1	0.44
	PLUTONIUM-239	3.4	PCI/G	0.4	0.025
	RADIUM-226	1.6	PCI/G	0.2	2.5
	STRONTIUM-90	0.3	PCI/G	0.1	0.88
	THORIUM-232	1.2	PCI/G	0.2	1.8
	TRITIUM	55	PCI/ML	3.0	0.0072
	URANIUM-234	1.1	PCI/G	0.2	—
	URANIUM-238	0.7	PCI/G	0.1	1.7

[a]This a common analytical laboratory contaminant. It is listed here for completeness.
[b]The polynuclear aromatic hydrocarbons (PAHs) listed here are common constitutents of asphalt, and are listed here for completeness. They are not contaminants of concern.
[c]Background assumed to be zero.
[d]The upper limit of background was defined by Purtymun et al. (1987) as $\bar{x}$ + 2s as used in Table 4.2-XIII. For a consistent basis of comparison, the upper limit of background given here for metals is $\bar{x}$ + 2s as calculated from the data given in Table 4.2-XV.

ing the results to the data presented in Sec. 4.2.4 indicates above-background levels of $^{239/240}Pu$ and tritium. Oil and grease were found in concentrations greater than the detection limit by gravimetric analysis.

SWMU 21-027(d). There is no quantitative information for this outfall.

SWMU 21-024(a). There is no quantitative information available for this outfall.

SWMU 21-024(g) was sampled at two locations, 13 ft 4 in. and 28 ft east of the CEARP marker. Results of these analyses are shown in Table 15.2-I (DOE 1989a). Comparing the results to the data presented in Sec. 4.2.4 indicates above-background levels of $^{239/240}Pu$, tritium, ^{234}U ^{238}U, ^{137}Cs, lead, arsenic, mercury, zinc, copper, cadmium, and nickel. Tetrachloroethene and oil/grease were found in concentrations above the detection limit.

SWMU 21-024(l) was sampled 2 ft 2 in. east-southeast of the CEARP marker in a roadside ditch. Results of these analyses are shown in Table 15.2-I (DOE 1989a). Comparing the results to the data presented in Sec. 4.2.4 indicates above-background levels of ^{241}Am, $^{239/240}Pu$, tritium, and zinc. Dichloromethane, which is a common lab contaminant, was found in concentrations greater than the detection limit as was oil/grease by gravimetric analysis. All the polynuclear aromatic hydrocarbons (PAHs) found are common constituents of asphalt and therefore are not considered further.

SWMU 21-027(c). No quantitative information exists for this outfall.

15.2.1.3 Source Term

Plutonium and tritium, which are site-wide contaminants, may be found at all outfalls.

SWMU 21-023(c) sample analysis has identified $^{239/240}Pu$ and tritium. Potential contaminants from research at TA-21-33 include plutonium-process organic solvents, such as hexone, penta-ether, and tri-n-butyl phosphate. Other by-products of plutonium processing may include nitrates, chlorides, mercury, americium, thorium, cobalt, uranium, and zirconium.

SWMU 21-027(d). Organics from petroleum products are the only likely contaminants to be discharged from this outfall, which originates in the catch basin around fuel tank TA-21-47. However, contaminants resulting from outfall SWMU 21-023(c) may also be found because of the proximity of the two outfalls.

SWMU 21-024(a) was a septic system serving TA-21-9, the steam plant, which did not house any operations producing hazardous materials. However, fuel oil leaks from the boiler may have entered the septic system by way of floor drains, and common boiler blowdown constituents, such as sulfite and copper salts, may have entered the system in the same way.

SWMU 21-024(g) sample analysis identified lead, arsenic, copper, mercury, zinc, oil/grease, tetrachloroethene, and the radionuclides $^{239/240}Pu$, tritium, ^{234}U, and ^{238}U. In addition, organic solvents used to clean electronic equipment, such as carbon tetrachloride, may be present because of operations in the electronics shop.

SWMU 21-024(l) sample analyses identified zinc, ^{241}Am, $^{239/240}Pu$, tritium, and oils. Uranium is also a possible contaminant because the outfall reportedly originated in TA-21-21, which was used to store uranium and plutonium metal.

SWMU 21-027(c). The most likely contaminants from this outfall are organic solvents and oils used in the machine shop portion of TA-21-6. Hazardous and radioactive contaminants are not likely to have been present, based on the presence of the cafeteria in this building.

15.2.2. Objectives and Data Needs

The objective of this investigation is to confirm the presence and determine the extent of contamination at each of these areas. The specific data required to assess contamination at these areas include the following:

1. Determine the locations of septic tanks TA-21-62, TA-21-125, and TA-21-53 and locate the discharge point for the six outfalls. In many cases, there is no physical evidence of the outfall or septic system.

2. Identify the contaminants present using Level II and III data. No quantitative data exist for three outfalls. For the remaining outfalls, radionuclide, metals, and some organic contaminants were previously identified.

3. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by additional surface and near-surface sampling and Level III/IV analyses.

15.2.3. Sampling/Investigation Rationale

The outfall and septic tank locations [except SWMU 21-024(l)] will be marked in the field by surveys based on old engineering drawings.

Strategy A will be used to identify appropriate soil sampling locations in the outfall drainage path. In the event no drainage path is identified, Strategy B will be used (for Strategy A and B, see Sec. 15.1.4). Surface soil samples collected as part of OU-wide characterization (see Chapter 12) will allow assessment of local contaminant levels unrelated to the releases from the outfalls.

The septic tank locations will be sampled by borehole cores for SWMUs 21-023(c), 21-024(a), and 21 -024(g). These tanks received and held all of the liquid discharged to their septic system and may have had environmental releases through leakage or overflow. A single borehole for each septic tank will provide sufficient information on contaminant presence and depth to use as design criteria for CMS planning for septic tank removal.

This investigation will be carried out in one phase (see Sec. 15.1.3). Samples will be sent directly to an analytical laboratory; no field laboratory analyses will be used; and no additional investigations are envisioned.

15.2.4. Sampling Plan

SWMU 21-023(c). The field radiological survey (for method see Sec. 11.4.1.2) will be performed in a rectangle 20-ft wide and extending from the outfall location to the mesa edge (Fig. 15.2-1). If the outfall is found to be at the mesa edge, the survey area will be a rectangle 20-ft wide by 40-ft long extending outward from the cliff face on the bench directly below the outfall.

Surface soil samples (for method see Sec. 11.5.2.1) will be taken from six locations in the likely flow channel, according to Strategy A or B (see Sec. 15.1.4). For Strategy B, the first group will be located 5 ft downslope from the outfall. The second set will be located 15 ft downslope from the first set. One or both of these sampling sets may be located on the bench depending on the surveyed location of the outfall. Either approach will generate six samples.

The borehole drilled at septic tank TA-21-62 will have a nominal depth of 20 ft (for method see Sec. 11.5.3.2). The borehole will be placed so that it passes through the center of the former location of the septic tank. Four samples will be collected (at 5-ft intervals).

The field surveying and analytics to be performed on the 10 samples for this SWMU are shown in Table 15.2-II.

SWMU 21-027(d). The field radiological survey will be performed in an area 20-ft wide extending from the outfall to the mesa edge (Fig. 15.2-1). Six surface soil samples will be taken from the outfall area according to either Strategy A or B.

Table 15.2-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT OUTFALLS WITH UNDETERMINED LOCATIONS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium	
21-023(c)																																	
Survey				X	X		X																										
Surface Soil Sample	1	0.0 - 6.0 in						X	X		X											X	X	X	X	X	X	X	X	X	X	X	
	2	0.0 - 6.0 in						X	X		X											X	X	X	X	X	X	X	X	X	X	X	
	3	0.0 - 6.0 in						X	X		X											X	X	X	X	X	X	X	X	X	X	X	
	4	0.0 - 6.0 in						X	X		X											X	X	X	X	X	X	X	X	X	X	X	
Field Blank																						X	X	X	X	X	X	X	X	X	X	X	
Rinsate Blank																						X	X	X	X	X	X	X	X	X	X	X	
Field Blank																																	
	5	0.0 - 6.0 in						X	X		X											X	X	X	X	X	X	X	X	X	X	X	
	6	0.0 - 6.0 in						X	X		X											X	X	X	X	X	X	X	X	X	X	X	
TA-21-62																																	
Vertical Borehole	1	0.0 - 5.0 ft					X	X	X		X	X	X	X								X	X	X	X	X	X	X	X	X	X	X	
		5.0 - 10.0 ft						X	X		X	X	X	X								X	X	X	X	X	X	X	X	X	X	X	
		10.0 - 15.0 ft						X	X		X	X	X	X								X	X	X	X	X	X	X	X	X	X	X	
		15.0 - 20.0 ft						X	X		X	X	X	X								X	X	X	X	X	X	X	X	X	X	X	
21-027(d)																																	
Survey				X	X		X																										
Surface Soil Sample	1	0.0 - 6.0 in						X	X		X											X	X	X	X	X	X	X	X	X	X	X	
	2	0.0 - 6.0 in						X	X		X											X	X	X	X	X	X	X	X	X	X	X	
	3	0.0 - 6.0 in						X	X		X											X	X	X	X	X	X	X	X	X	X	X	
	4	0.0 - 6.0 in						X	X		X											X	X	X	X	X	X	X	X	X	X	X	
Field Duplicate																																	
	5	0.0 - 6.0 in						X	X		X											X	X	X	X	X	X	X	X	X	X	X	
	6	0.0 - 6.0 in						X	X		X											X	X	X	X	X	X	X	X	X	X	X	
21-024(a)																																	

Table 15.2-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT OUTFALLS WITH UNDETERMINED LOCATIONS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening							Field Laboratory Measurements								Laboratory Analysis										
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium
Survey																																	
Near Surface Soil	1	0.0 – 6.0 in		X	X		X	X	X		X			X	X	X					X	X	X	X	X	X	X	X	X	X	X	X
		6.0 – 12.0 in		X	X		X	X	X		X			X	X	X					X	X	X	X	X	X	X	X	X	X	X	X
Rinsate Blank																																	
Field Blank																																	
	2	12.0 – 18.0 in						X	X		X			X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X
		0.0 – 6.0 in						X	X		X			X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X
		6.0 – 12.0 in						X	X		X			X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X
		12.0 – 18.0 in						X	X		X			X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X
	3	0.0 – 6.0 in						X	X		X			X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X
		6.0 – 12.0 in						X	X		X			X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X
		12.0 – 18.0 in						X	X		X			X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X
	4	0.0 – 6.0 in						X	X		X			X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X
		6.0 – 12.0 in						X	X		X			X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X
		12.0 – 18.0 in						X	X		X			X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X
	5	0.0 – 6.0 in						X	X		X			X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X
		6.0 – 12.0 in						X	X		X			X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X
		12.0 – 18.0 in						X	X		X			X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X
	6	0.0 – 6.0 in						X	X		X			X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X
Field Duplicate																																	
		6.0 – 12.0 in						X	X		X			X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X
		12.0 – 18.0 in						X	X		X			X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X
TA-21-53																																	
Vertical Borehole	1	0.0 – 5.0 ft				X		X	X	X	X	X		X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X
		5.0 – 10.0 ft						X	X	X	X	X		X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X
		10.0 – 15.0 ft						X	X	X	X	X		X	X	X					X	X	X	X	X	X	X	X	X	X	X	X	X

Table 15.2-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT OUTFALLS WITH UNDETERMINED LOCATIONS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Field Laboratory Measurements:	Field Laboratory Measurements:	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals	Laboratory Analysis: Isotopic Thorium	
Rinsate Blank		15.0 - 20.0 ft							X						X	X						X	X	X	X		X	X	X	X				
Field Blank									X																										
21-024(g)																																			
Survey							X																												
Near Surface Soil	1	0.0 - 6.0 in						X	X		X			X	X							X					X								
		6.0 - 12.0 in						X	X		X			X	X							X					X								
	2	0.0 - 6.0 in						X	X		X			X	X							X					X								
		6.0 - 12.0 in						X	X		X			X	X							X					X								
	3	0.0 - 6.0 in						X	X		X			X	X							X					X								
		6.0 - 12.0 in						X	X		X			X	X							X					X								
	4	0.0 - 6.0 in						X	X		X			X	X							X					X								
		6.0 - 12.0 in						X	X		X			X	X							X					X								
	5	0.0 - 6.0 in						X	X		X			X	X							X					X								
		6.0 - 12.0 in						X	X		X			X	X							X					X								
	6	0.0 - 6.0 in						X	X		X			X	X							X					X								
		6.0 - 12.0 in						X	X		X			X	X							X					X								
Field Duplicate		6.0 - 12.0 in						X	X		X			X	X							X					X								
TA-21-125																																			
Tank Excavation							X				X	X																							
Vertical Borehole	1	0.0 - 5.0 ft						X	X		X	X	X										X	X	X	X		X	X	X	X				
Rinsate Blank															X	X						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X	X				
		5.0 - 10.0 ft						X	X		X																								
		10.0 - 15.0 ft						X	X		X																								
		15.0 - 20.0 ft						X	X		X																								

Table 15.2-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT OUTFALLS WITH UNDETERMINED LOCATIONS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha	Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium
21-024(l)																															
Survey				X	X	X																									
Surface Soil Sample	1	0.0 - 6.0 in						X	X	X				X	X						X	X	X	X	X	X	X	X	X		
	2	0.0 - 6.0 in						X	X	X				X	X						X	X	X	X	X	X	X	X	X		
	3	0.0 - 6.0 in						X	X	X				X	X						X	X	X	X	X	X	X	X	X		
	4	0.0 - 6.0 in						X	X	X				X	X						X	X	X	X	X	X	X	X	X		
	5	0.0 - 6.0 in						X	X	X				X	X						X	X	X	X	X	X	X	X	X		
	6	0.0 - 6.0 in						X	X	X				X	X						X	X	X	X	X	X	X	X	X		
21-027(c)							X																								
Survey							X																								
Surface Soil Sample	1	0.0 - 6.0 in						X	X	X				X	X						X	X	X	X	X	X	X	X	X		
	2	0.0 - 6.0 in						X	X	X				X	X						X	X	X	X	X	X	X	X	X		
	3	0.0 - 6.0 in						X	X	X				X	X						X	X	X	X	X	X	X	X	X		
Rinsate Blank																															
Field Blank																															
Field Duplicate																															
	4	0.0 - 6.0 in							X	X	X				X	X						X	X	X	X	X	X	X	X		
	5	0.0 - 6.0 in							X	X	X				X	X						X	X	X	X	X	X	X	X		
	6	0.0 - 6.0 in							X	X	X				X	X						X	X	X	X	X	X	X	X		
Trip Blank																															

Analytics for the six samples and the field survey are presented in Table 15.2-II.

SWMU 21-024(a). The field radiological survey will be performed in an area 20-ft wide from the surveyed location of the outfall to the mesa edge (Fig. 15.2-2).

Contamination discharged from this outfall is unlikely. Near-surface soil samples to a depth of 18 in. (three samples per location, for method see Sec. 11.5.2.4) will be taken at six locations in the drainage channel. They will be taken at the locations showing the highest survey readings if Strategy A is successful. If Strategy B is used, the groups of three will be placed near the discharge point, the mesa edge, and at the midpoint between the two. Near-surface soil sampling is specified because the soil in this area is deeper than in other areas. This investigation results in a total of 18 soil samples.

The borehole to be drilled at septic tank TA-21-53 will have a nominal depth of 20 ft, resulting in four samples (for method see Sec. 11.5.3.2). The borehole will be placed at the north end of the septic tank near the inlet line. To do this, it may be necessary to remove soil from the upper portion of the septic tank in order to positively identify the inlet line location.

Analytics to be performed on the 22 samples gathered from this outfall system are shown in Table 15.2-II.

SWMU 21-024(g). The field radiological survey (for method see Sec. 11.4.1.2) for this outfall system will be conducted in an area 20-ft wide between the outfall and the mesa edge (Fig. 15.2-3).

Near-surface soil samples to a 12-in. depth (two 6-in. sample intervals) will be taken from six locations in the area draining the outfall (for method see Sec. 11.5.2.4). Locations will be selected by Strategy A or B, as appropriate. For Strategy B, the first group of three will be located at the outfall discharge point, and a second group will be located approximately 5 ft above the mesa edge. This investigation totals 12 soil samples.

Septic tank TA-21-125 will be sampled by drilling a borehole at its south end near the inlet line (for method see Sec. 11.5.3.2). This borehole will be drilled to a nominal depth of 20 ft and will result in four samples.

Table 15.2-II specifies the field survey and the analytics to be performed on the 16 samples for this outfall system.

SWMU 21-024(l). No engineering drawing has been found showing the location of the outfall discharge point; thus it is not possible to locate the outfall by land survey. A geophysical survey (for method see Sec. 11.4.2.1) will be used to locate the outfall discharge point by following the 3-in. cast iron drain line as it exits building TA-21-21 (LASL 1960). The geophysical survey will begin at the north end of the mechanical room and trend northeast toward the north perimeter road (Fig. 15.2-4).

If the geophysical survey does not locate the discharge point, then a field radiological survey (for method see Sec. 11.4.1.2) will be performed in the same area. If the geophysical survey does locate the discharge point, the field radiological survey will be confined to an area downgradient from the outfall.

If either type of survey locates a discharge point or effluent channel, six surface soil samples (for method see Section 11.5.2.1) will be taken according to Strategy A or B as appropriate. If Strategy B is employed, the first set of three will be located 1 ft downgradient from the outfall location, and the second set will be located roughly 15 ft further downgradient.

If neither type of survey is successful, two surface soil samples will be taken at each of the three locations shown in Fig. 15.2-4. The first location is in the ditch just outside of the security fence north of TA-21-335, the closest collection point to the suspected outfall location. The second location is at the south end of a culvert passing under the road inside the security fence. This location collects drainage from the entire area south of Building TA-21-21 and will be a good location to detect contaminants if the outfall discharged inside the fence. The third location is at the entrance to a culvert that passes under the perimeter road. This culvert collects drainage from both of the other two sampling locations, and, in addition, from the entire area to the south and west. This makes it a good location to sample for contamination discharging to any part of the area north of TA-21-21.

The analytics to be performed on the six samples gathered from the outfall are shown in Table 15.2-II.

SWMU 21-027(c). The area for the field radiological survey (for method see Sec. 11.4.1.2) will be 40-ft wide, running from the outfall to the mesa edge (Fig. 15.2-5). Surface soil samples (see Sec. 11.5.2.4) will be taken from each of six locations in the outfall area according to Strategy A or B.

The analytics to be performed on the six samples from this outfall are presented in Table 15.2-II.

15.3. Outfalls with Septic Tanks

15.3.1. Site Description

This section addresses outfall channels originating from septic systems that remain in place. The five septic systems discussed here [SWMUs 21-024(a)–(d), and (i)] are mentioned in the CEARP Phase I report (LANL 1987) as five of the six most likely to have received radioactively contaminated sewage.

15.3.1.1. History

SWMU 21-024(b) is a septic system (CEARP identifier 3g) that routed sewage from Building TA-21-17 through septic tank TA-21-55 to the surface south of Building TA-21-5 (Fig. 15.3-1). Building TA-21-17, which was removed in 1969, connected Buildings TA-21-4 and TA-21-5. Septic tank TA-21-55 is constructed of reinforced concrete, measuring 4-ft wide by 8-ft long and located 6.5 ft below ground surface. The inlet and outlet drain lines are 6-in. VCP.

At the present time, the outfall consists of a short cast iron pipe emerging from the backfill inside the security fence. There is a gentle slope, approximately 70 ft to the cliff edge, with no defined channel. It is possible that, when operational, the outfall pipe extended farther south toward the mesa edge.

SWMU 21-024(c) is a septic system (CEARP identifier 3h) that routed sewage from Building TA-21-54 (removed in 1969) through septic tank TA-21-56 (abandoned in place in 1966) to the surface on the south rim of DP Mesa above Los Alamos Canyon (Fig. 15.3-2). The reinforced concrete septic tank measures 4 ft by 8 ft and is located 6 ft below ground surface. The drain lines are 4-in.-diameter VCP. The tank is located south of the PCB-storage area (SWMU 21-003) at TA-21-61. At the present time, a 4-in. VCP surfaces above a gentle slope extending approximately 15 ft to the cliff edge. There is a vaguely defined channel.

SWMU 21-024(d) is a septic system (CEARP identifier 3f) that routed sewage from Building TA-21-1 (removed in 1965) through septic tank TA-21-106 to the surface on the south rim above Alamos Canyon (Fig. 15.3-3). The septic tank is constructed of reinforced concrete, measuring 9.5 ft by 18 ft and is located 5 ft below ground surface. The drain lines are 6-in. VCP. At the present time, the outfall drain line from this septic system runs south to the edge of DP Mesa where it terminates at the cliff edge.

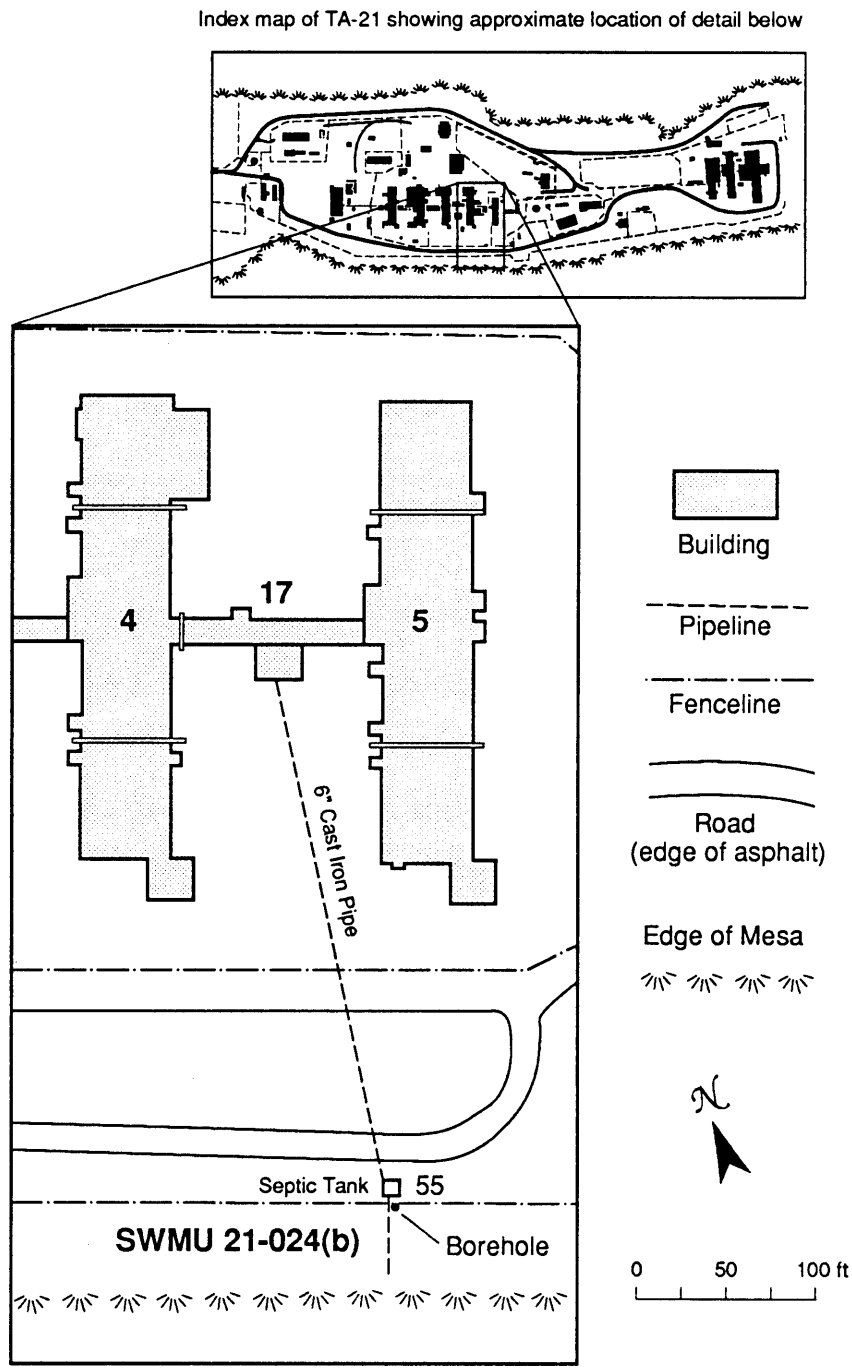


Fig. 15.3-1 Location of SWMU 21-024(b) as it appeared in 1961 on the south side of Building 17. (LASL 1961)

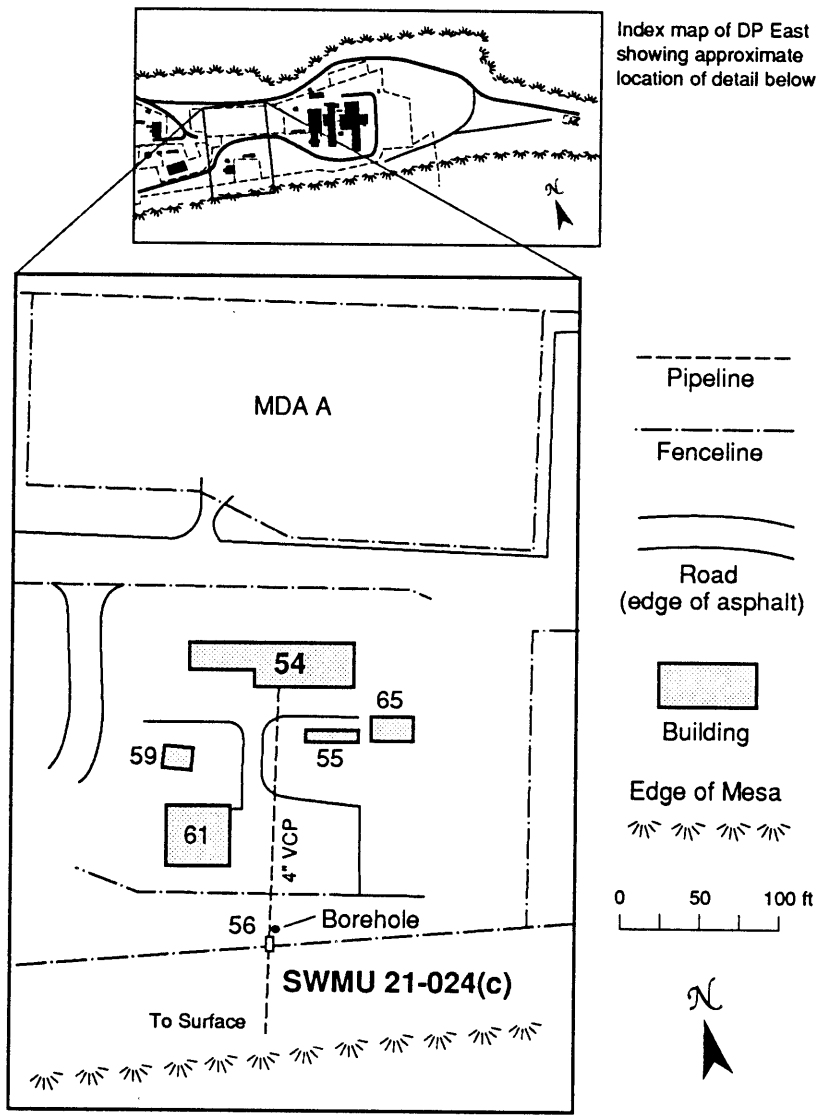


Fig. 15.3-2 Location of SWMU 21-024(c) as it appeared on the south side of Building 54 (now removed) in 1958. (LASL 1958d)

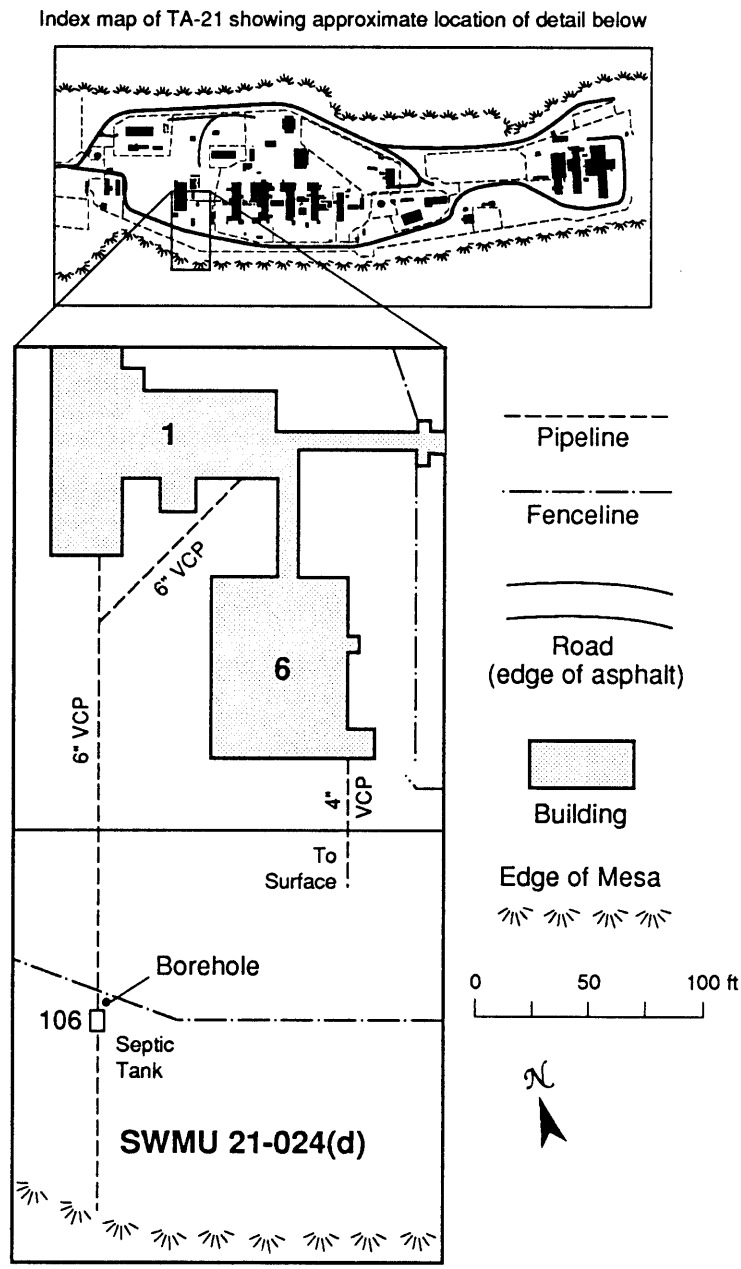


Fig. 15.3-3 Location of SWMU 21-024(d) as it appeared on the south side of Building 1 in 1961. (LASL 1961)

SWMU 21-024(e) is a septic system (CEARP identifier 3e) that routed sewage from Building TA-21-20, the former laundry, (removed in 1965) through septic tank TA-21-123 to the surface on the south rim of DP Mesa above Los Alamos Canyon (Fig. 15.3-4). TA-21-123 is a 1000-gal. steel tank, measuring 6 ft 4 in. by 11 ft 4 in. The drain lines entering and exiting the tank are 6-in. VCP.

At the present time, a survey stake marks the location of the outfall. The outfall area is broad and open, with a poorly defined channel. The outfall is located approximately 20 ft from the southern edge of DP Mesa. Below the DP Mesa cliff is a broad bench with a second drop-off to the canyon floor.

SWMU 21-024(i) is a septic system (CEARP identifier 3j) that routed sewage from Building TA-21-152 through septic tank TA-21-181 (abandoned in place in 1965) to the surface southeast of TA-21-209 (Fig. 15.3-5). Formerly, the blowdown from cooling towers at Buildings TA-21-166 and TA-21-167 was routed to this outfall. The septic system discharged effluent via a 6-in. VCP. The reinforced concrete septic tank measures 5 ft by 10 ft, and is located 7 ft 9 in. below ground surface. The VCP from the septic system surfaces in a broad open area with a gentle slope extending approximately 30 ft to the south cliff edge of DP Mesa.

15.3.1.2. Existing Information

All existing contaminant information for these outfalls was obtained from samples gathered in October 1988 as part of the ER Program reconnaissance sampling (DOE 1989a). The soil samples were analyzed according to EPA Contract Laboratory Program (CLP) Statement of Work Protocols for Target Compound List volatile organic compounds, semivolatile organic compounds, pesticides/PCBs, and Target Analyte List metals. They were also analyzed for ^{241}Am, ^{137}Cs, ^{238}Pu, $^{239/240}Pu$, ^{226}Ra, ^{90}Sr, ^{232}Th, ^{234}U, ^{235}U, ^{238}U, and tritium by the standard procedures of a commercial laboratory. Analytical results obtained from the ER Program reconnaissance sampling for the five SWMUs in this section are presented in Table 15.3-I.

SWMU 21-024(b) was sampled at a single location, 2 ft 1 in. south of the outfall pipe's discharge point. Analysis of this sample showed dichloromethane, a common lab contaminant, and oil/grease in concentrations above detection limits. Comparing the analytical results with the background levels in Sec. 4.2.4 shows elevated levels of lead and above-background concentrations of the radionuclides ^{241}Am, $^{239/240}Pu$, and tritium.

SWMU 21-024(c) was sampled at a single point in the outfall channel, 8 ft from the end of the outfall pipe. Comparing the analytical results from this sample with Sec. 4.2.4 background levels

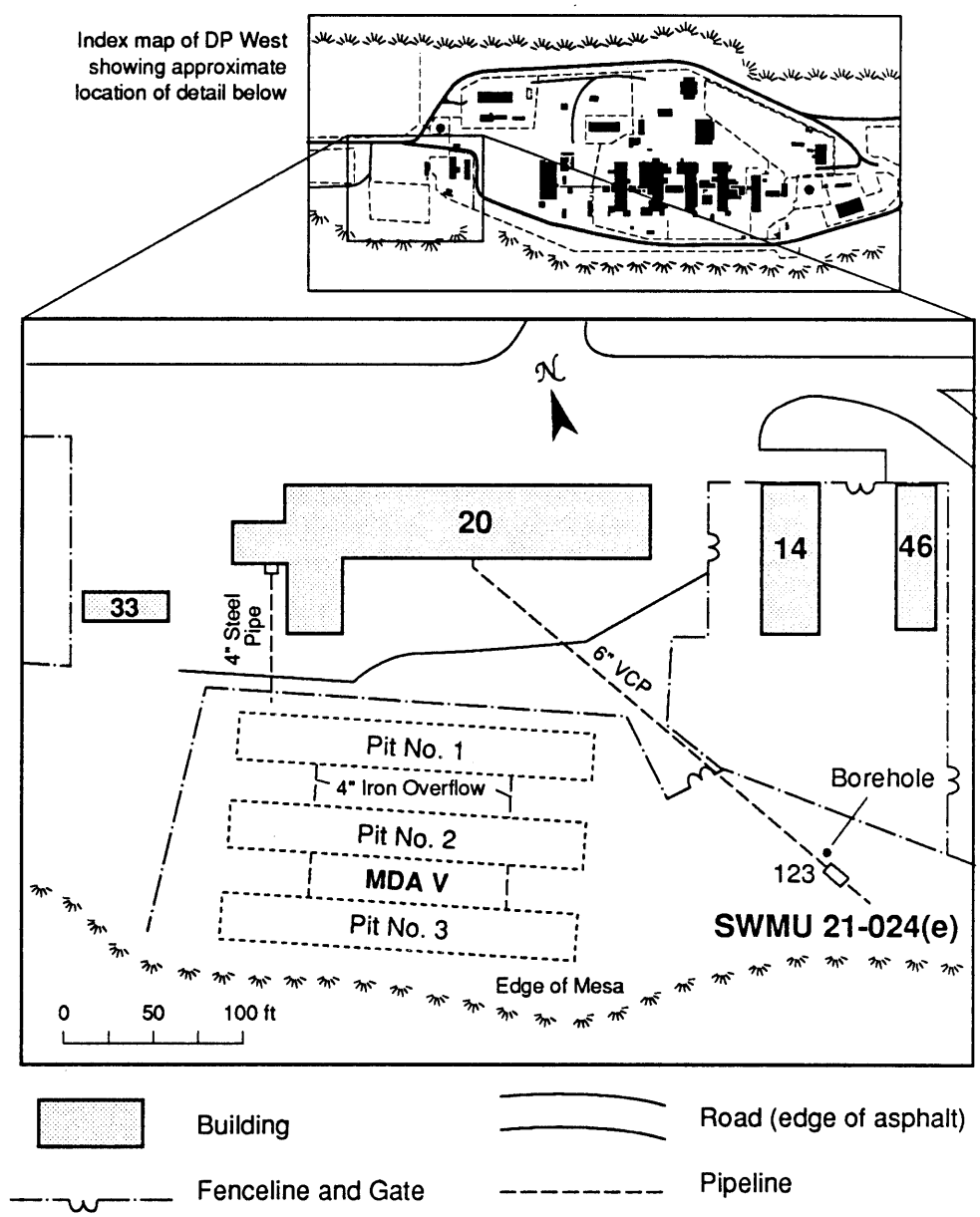


Fig. 15.3-4 Location of SWMU 21-024(e) as it appeared on the south side of Building 20 (now removed) in 1958. (LASL 1958b, 1961)

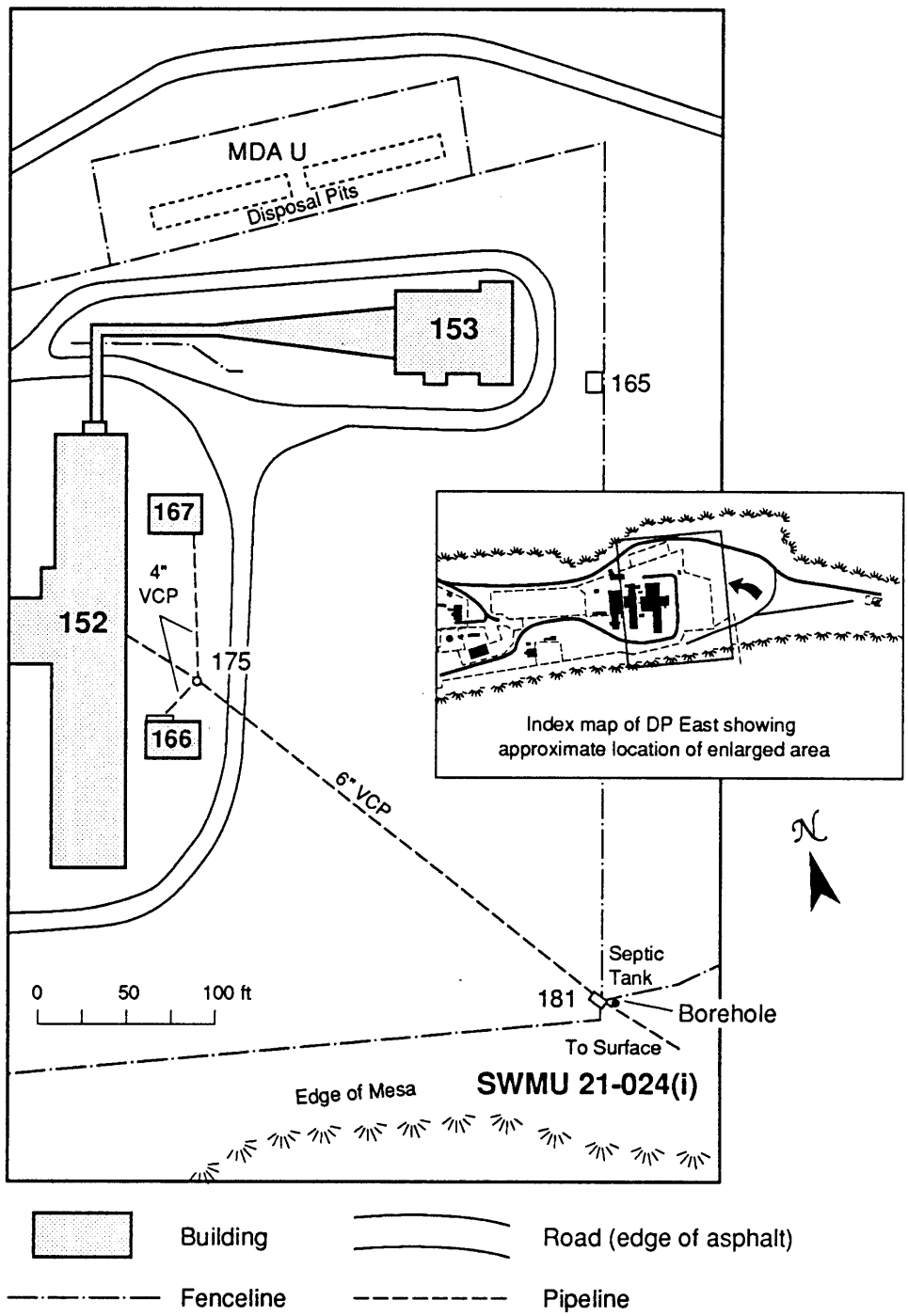


Fig. 15.3-5 Location of SWMU 21-024(i) as it appeared to the east of Building 152 in 1958. (LASL 1958e)

TABLE 15.3-I
1988 OUTFALL RECONNAISSANCE SAMPLING RESULTS FOR SWMUs
21-024(b), (c), (d), (e), and (i)

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x}$ + 2s
	Metals				
SWMU 21-024(b)	POTASSIUM, TOTAL	1240	MG/KG	846	—
	VANADIUM, TOTAL	15.3	MG/KG	8.5	—
	ZINC, TOTAL	58.8	MG/KG	3.4	78
	ALUMINUM, TOTAL	7890	MG/KG	33.8	65,000
	BARIUM, TOTAL	91.5	MG/KG	33.8	850
	CALCIUM, TOTAL	2450	MG/KG	846	—
	CHROMIUM, TOTAL	6.4	MG/KG	1.7	75
	COPPER, TOTAL	7.9	MG/KG	4.2	19
	IRON, TOTAL	6900	MG/KG	16.9	26,600
	LEAD, TOTAL	31.8	MG/KG	16.9	54
	MAGNESIUM, TOTAL	1290	MG/KG	846	11,700
	MANGANESE, TOTAL	208	MG/KG	2.5	770
	OIL & GREASE BY GRAVIMETRIC[b]	818	MG/KG	49.3	—[b]
	Radionuclides				
	AMERICIUM	0.5	PCI/G	0.1	—
	CESIUM-137	0.2	PCI/G	0.1	0.44
	PLUTONIUM-239	6.1	PCI/G	0.3	0.025
	RADIUM-226	0.8	PCI/G	0.1	2.5
	STRONTIUM-90	0.5	PCI/G	0.3	0.88
	THORIUM-232	0.9	PCI/G	0.2	1.8
	TRITIUM	13	PCI/ML	2.0	.0072
	URANIUM-234	1.2	PCI/G	0.2	—
	URANIUM-238	0.8	PCI/G	0.2	1.7
	Volatile Organics				
	DICHLOROMETHANE-METHYLENE CHLORIDE[a]	69	UG/KG	52	—[b]
	Metals				
SWMU 21-024(c)	ALUMINUM, TOTAL	5970	MG/KG	39.4	65,000
	ARSENIC, TOTAL	6.0	MG/KG	2.0	7.1
	CALCIUM, TOTAL	1190	MG/KG	984	—
	CHROMIUM, TOTAL	144	MG/KG	2.0	75
	COPPER, TOTAL	143	MG/KG	4.9	19
	IRON, TOTAL	6050	MG/KG	19.7	26,600
	LEAD, TOTAL	556	MG/KG	196	54
	MANGANESE, TOTAL	44.2	MG/KG	3.0	770

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x}$ + 2s
	MERCURY, TOTAL	8.0	MG/KG	1.0	0.03
	NICKEL, TOTAL	10.8	MG/KG	7.9	18.5
	OIL & GREASE BY GRAVIMETRIC	8350	MG/KG	50.3	—[b]
	SILVER, TOTAL	15.2	MG/KG	2.0	—
	VANADIUM, TOTAL	19.0	MG/KG	9.8	—
	ZINC, TOTAL	90.6	MG/KG	3.9	78
	Radionuclides				
	AMERICIUM	1.6	PCI/G	0.2	—
	CESIUM-137	0.2	PCI/G	0.1	0.44
	PLUTONIUM-238	0.3	PCI/G	0.1	0.005
	PLUTONIUM-239	17	PCI/G	1.0	0.025
	RADIUM-226	0.8	PCI/G	0.1	2.5
	STRONTIUM-90	0.4	PCI/G	0.3	0.88
	THORIUM-232	1.2	PCI/G	0.2	1.8
	TRITIUM	18000	PCI/ML	1000	0.0072
	URANIUM-234	17	PCI/G	1.0	—
	URANIUM-235	0.7	PCI/G	0.2	—
	URANIUM-238	8.1	PCI/G	0.8	1.7
	Volatile Organics				
	DICHOLORMETHANE-METHYLENE CHLORIDE[a]	69	UG/KG	51	—[b]
	Metals				
SWMU 21-024(d)	ALUMINUM, TOTAL	3300	MG/KG	29	65,000
	BARIUM, TOTAL	60.3	MG/KG	29	850
	CALCIUM, TOTAL	2890	MG/KG	728	—
	CHROMIUM, TOTAL	5.5	MG/KG	2.0	75
	COPPER, TOTAL	18.4	MG/KG	4.0	19
	IRON, TOTAL	3290	MG/KG	15	26,600
	LEAD, TOTAL	39.6	MG/KG	8.0	54
	MAGNESIUM, TOTAL	735	MG/KG	728	4,700
	MANGANESE, TOTAL	160	MG/KG	2.0	770
	MERCURY, TOTAL	0.19	MG/KG	0	0.03
	NICKEL, TOTAL	7.2	MG/KG	6.0	18.5
	OIL & GREASE BY GRAVIMETRIC	127	MG/KG	51	—[b]
	POTASSIUM, TOTAL	897	MG/KG	728	—
	SILVER, TOTAL	2.4	MG/KG	2.0	—
	VANADIUM, TOTAL	8.7	MG/KG	8.0	—
	ZINC, TOTAL	61.5	MG/KG	4.0	78
	Radionuclides				
	AMERICIUM	1.1	PCI/G	0.3	—
	CESIUM-137	0.4	PCI/G	0.1	0.44

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x}$ + 2s
	PLUTONIUM-238	0.8	PCI/G	0.2	0.005
	PLUTONIUM-239	16	PCI/G	1.0	0.025
	RADIUM-226	1.5	PCI/G	0.2	2.5
	THORIUM-232	1.0	PCI/G	0.2	1.8
	TRITIUM	140	PCI/ML	10	0.0072
	URANIUM-234	2.1	PCI/G	0.2	—
	URANIUM-238	1.4	PCI/G	0.2	1.7
	Metals				
SWMU 21-024(e)	ALUMINUM, TOTAL	4300	MG/KG	34	65,000
	ARESENIC, TOTAL	3.0	MG/KG	2.0	7.1
	BARIUM, TOTAL	121	MG/KG	34	850
	CALCIUM, TOTAL	1650	MG/KG	837	—
	CHROMIUM, TOTAL	13.2	MG/KG	2.0	75
	COPPER, TOTAL	14.5	MG/KG	4.0	19
	IRON, TOTAL	4180	MG/KG	17	26,600
	LEAD, TOTAL	43.3	MG/KG	19	54
	MAGNESIUM, TOTAL	883	MG/KG	837	4,700
	MANGANESE, TOTAL	227	MG/KG	4.0	770
	MERCURY, TOTAL	0.31	MG/KG	0	0.03
	OIL & GREASE BY GRAVIMETRIC	433	MG/KG	51.5	—[b]
	VANADIUM, TOTAL	19.2	MG/KG	8.0	—
	ZINC, TOTAL	102	MG/KG	4.0	78
	Radionuclides				
	AMERICIUM	0.5	PCI/G	0.2	—
	CESIUM-137	0.7	PCI/G	0.1	0.44
	PLUTONIUM-238	0.3	PCI/G	0.1	0.005
	PLUTONIUM-239	17	PCI/G	1.0	0.025
	RADIUM-226	1.3	PCI/G	0.1	2.5
	THORIUM-232	0.9	PCI/G	0.1	1.8
	TRITIUM	65	PCI/ML	3.0	0.0072
	URANIUM-234	4.6	PCI/G	0.6	—
	URANIUM-238	3.3	PCI/G	0.5	1.7
	Metals				
SWMU 21-024(i)	ALUMINUM, TOTAL	5190	MG/KG	38.1	65,000
	ARSENIC, TOTAL	38.9	MG/KG	19	7.1
	BARIUM, TOTAL	2900	MG/KG	38.1	850
	BERYLLIUM, TOTAL	1.6	MG/KG	0.95	2.9
	CADMIUM, TOTAL	3.6	MG/KG	0.95	0.37
	CALCIUM, TOTAL	2210	MG/KG	952	—
	CHROMIUM, TOTAL	145	MG/KG	1.9	75
	COPPER, TOTAL	83.4	MG/KG	4.8	19
	IRON, TOTAL	6540	MG/KG	19	26,600

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x}$ + 2s
	LEAD, TOTAL	187	MG/KG	38.1	54
	MAGNESIUM, TOTAL	1220	MG/KG	952	4,700
	MANGANESE, TOTAL	130	MG/KG	2.9	770
	MERCURY, TOTAL	0.97	MG/KG	0.1	0.03
	NICKEL, TOTAL	9.7	MG/KG	7.6	18.5
	OIL & GREASE BY GRAVIMETRIC	3520	MG/KG	56.5	—[b]
	SELENIUM, TOTAL	0.97	MG/KG	0.95	—
	VANADIUM, TOTAL	161	MG/KG	9.5	—
	ZINC, TOTAL	1530	MG/KG	3.8	78
	Radionuclides				
	PLUTONIUM-239	3.9	PCI/G	0.5	0.025
	RADIUM-226	2.7	PCI/G	0.3	2.5
	THORIUM-232	1.0	PCI/G	0.2	1.8
	TRITIUM	13000	PCI/ML	1000	0.0072
	URANIUM-234	43	PCI/G	2.0	—
	URANIUM-235	1.2	PCI/G	0.3	—
	URANIUM-238	11	PCI/G	1.0	1.7
	Volatile Organics				
	DICHOLORMETHANE-METHYLENE[a]	100	UG/KG	57	—[b]

[a]This is a common analytical laboratory contaminant. It is listed here for completeness.
[b]Background assumed to be zero.
[c]The upper limit of background was defined by Purtymun et al. (1987) as $\bar{x}$ + 2s as used in Table 4.2-XIII. For a consistent Basis of comparison, the upper limit of background given here for metals is $\bar{x}$ + 2s as calculated from the data given in Table 4.2-XV.

shows elevated concentrations of zinc, copper, lead, and mercury, and above-background levels of the radionuclides ^{241}Am, ^{238}Pu, $^{239/240}Pu$, tritium, and ^{234}U, ^{235}U, and ^{238}U. In addition, oil/grease and dichloromethane were found in concentrations above detection limits.

SWMU 21-024(d) was sampled 8 ft south of the CEARP outfall marker. Analytical results showed elevated concentrations of mercury, above-background levels of ^{241}Am, ^{238}Pu, $^{239/240}Pu$, tritium, and concentrations of oil and grease above detection limits.

SWMU 21-024(e) was sampled 5 ft 3 in. south of the CEARP outfall marker. Comparison of the analytical results from this sample with background levels given in Sec. 4.2.4 shows elevated concentrations of mercury, zinc, and above-background levels for ^{241}Am, ^{238}Pu, $^{239/240}Pu$, tritium, ^{234}U, ^{238}U, and ^{137}Cs. Oil and grease were found above the detection limits by gravimetric analysis.

SWMU 21-024(i) was sampled at a single location below the discharge point. Sample analysis indicates dichloromethane and oil/grease to be present above the detection limits. By comparison to background levels given in Sec. 4.2.4, elevated concentrations of arsenic, barium, beryllium, chromium, copper, lead, mercury, selenium, vanadium, radium, and zinc were found in the sample. In addition, ^{238}Pu, tritium, ^{226}Ra, ^{234}U, and ^{235}U, and ^{238}U were found to be present in concentrations above background levels.

15.3.1.3. Source Term

SWMU 21-024(b) sample analysis has identified lead, ^{241}Am, $^{239/240}Pu$, and tritium, to be present in the soils at this outfall.

SWMU 21-024(c) sample analysis identified chromium, copper, lead, mercury, zinc, and the radionuclides ^{241}Am, ^{238}Pu, $^{239/240}Pu$, tritium, ^{234}U, ^{235}U, and ^{238}U to be present. In addition, PCBs may be present in the area of this SWMU because it is down slope from the PCB storage area at TA-21-61.

SWMU 21-024(d) sample analysis showed above-background levels of mercury, ^{241}Am, ^{238}Pu, $^{239/240}Pu$, and tritium to be present in the soils at this outfall.

SWMU 21-024(e) sample analysis has identified mercury, zinc, and the radionuclides ^{241}Am, ^{238}Pu, $^{239/240}Pu$, tritium, and ^{234}U, ^{238}U, and ^{137}Cs to be present in the soils at this outfall. In addition to these, phosphates and various organics are likely to be present at the outfall because Building TA-21-20 was a laundry.

SWMU 21-024(i) Sample analysis determined that barium, chromium, copper, lead, mercury, selenium, vanadium, zinc, cadmium, and the radionuclides ^{238}Pu, tritium, ^{226}Ra, ^{234}U, ^{235}U, and ^{238}U were present above background level. In addition, various laboratory chemicals, both organic and inorganic, could be present because of the research performed in Building TA-21-152.

15.3.2. Objectives and Data Needs

The objective of this investigation is to confirm the presence and determine the extent of contamination at each of these areas. The specific data required to assess contamination at each of these areas include the following:

1. Identify the contaminants present using Level II and III data for the outfall discharge points and below the septic tanks. Radionuclides, metals, and some organic contaminants were previously identified.

2. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by additional surface and near-surface sampling and Level III/IV analyses.

15.3.3. Sampling/Investigation Rationale

The outfall and septic tank locations will be marked in the field by surveys based on old engineering drawings [except for SWMU 21-024(d), which is visible at the surface]. Potential environmental contamination from five discharge systems in this section will be characterized by soil sampling in the area of the outfall and the septic tank.

All of the septic tanks addressed in this section [SWMUs 21-024 (b)–(e) and (i)] received and held all of the liquid discharged to their septic systems and may have had environmental releases through leakage or overflow. Each of the septic tank locations will be sampled by borehole cores near either the inlet or outlet drain lines because these are the most likely places for leakage. Excavation will be necessary to uncover the top of the septic tanks in order to provide positive locations of the tanks and drain lines before drilling begins. A single borehole for each septic tank will provide sufficient information on contaminant presence and depth to use as design criteria for CMS planning for septic tank removal.

The drainage channels associated with each outfall will be surveyed with direct reading radiological instruments as described in Sec. 15.1.4. Strategy A will be used to identify appropriate soil sampling locations in the outfall drainage path. In the event that no sampling locations are identified from the radiological survey, Strategy C will be employed (for Strategy A and C see

Sec. 15.1.4). Surface soil samples collected as part of OU-wide characterization (see Chapter 12) will allow comparison to local contaminant levels unrelated to the releases from the outfalls.

The investigation will be carried out in one phase (see Sec. 15.1.3). Samples will be sent directly to an analytical laboratory. No field laboratory analyses will be used, and no additional investigations are expected.

15.3.4. Sampling Plan

All field radiological surveys will be performed in a rectangle 10-ft wide and extending from the outfall location to the mesa edge according to the method described in Sec. 11.4.1.2.

SWMU 21-024(b). Near-surface soil samples (see Sec. 11.5.2.4 for method) will be taken from three locations below the discharge point in the outfall channel, according to Strategy A or C (see Sec. 15.1.4). Three soil samples will be taken at each location to a total depth of 18-in. (three 6-in. sample intervals), resulting in nine samples. For Strategy C, the three sampling sites will be at small pooling areas located 7 ft, 20 ft, and 35 ft south of the southern perimeter fence.

The borehole at septic tank TA-21-55 will be drilled to a nominal depth of 20 ft (for method see Sec. 11.5.3.2). The borehole will be placed on the outlet side (south) of the septic tank because of the proximity of the road on the inlet side. Four samples will be collected (at 5-ft intervals).

Analyses to be performed on the 13 samples collected in this outfall investigation are shown in Table 15.3-II.

SWMU 21-024(c). Near-surface soil samples (see method 11.5.2.4) will be collected to a depth of 12 in. (two 6-in. intervals) at two locations in the outfall channel, according to either Strategy A or C (see Sec. 15.1.4). If the field radiological survey is successful in identifying sampling locations, the samples will be taken according to Strategy A. If the survey proves unsuccessful, Strategy C will be employed. Under Strategy C, the first sampling location will be in the ponding area at the outfall discharge point, and the second sampling location will be in a small ponding area at the mesa edge. Either approach will result in four samples.

The borehole to be drilled at septic tank TA-21-56 will have a nominal depth of 20 ft, resulting in four samples (for method see Sec. 11.5.3.2). The borehole will be placed at the north end of the septic tank near the inlet line.

Table 15.3-II shows the analytics for the eight samples taken in the investigation of this SWMU.

Table 15.3-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT OUTFALLS WITH SEPTIC TANKS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Field Laboratory Measurements:	Field Laboratory Measurements:	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals	Laboratory Analysis: Isotopic Thorium	Laboratory Analysis:
21-024(b)																																		
Survey				X	X		X																											
Near Surface Soil	1	0.0 - 6.0 in						X	X		X											X	X	X	X	X	X	X	X	X	X	X	X	
		6.0 - 12.0 in						X	X		X											X	X	X	X	X	X	X	X	X	X	X	X	
		12.0 - 18.0 in						X	X		X											X	X	X	X	X	X	X	X	X	X	X	X	
	2	0.0 - 6.0 in						X	X		X											X	X	X	X	X	X	X	X	X	X	X	X	
Field Duplicate		6.0 - 12.0 in						X	X		X											X	X	X	X	X	X	X	X	X	X	X	X	
		12.0 - 18.0 in						X	X		X											X	X	X	X	X	X	X	X	X	X	X	X	
	3	0.0 - 6.0 in						X	X		X											X	X	X	X	X	X	X	X	X	X	X	X	
		6.0 - 12.0 in						X	X		X											X	X	X	X	X	X	X	X	X	X	X	X	
		12.0 - 18.0 in						X	X		X											X	X	X	X	X	X	X	X	X	X	X	X	
TA-21-55																																		
Tank Excavation							X			X	X	X	X																					
Vertical Borehole	1	0.0 - 5.0 ft						X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	
		5.0 - 10.0 ft						X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	
		10.0 - 15.0 ft						X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	
		15.0 - 20.0 ft						X	X	X	X	X	X									X	X	X	X	X	X	X	X	X	X	X	X	
21-024(c)																																		
Survey				X	X																												
Near Surface Soil	1	0.0 - 6.0 in						X	X		X											X	X	X	X	X	X	X	X	X	X	X	X	
Rinsate Blank																						X	X	X	X	X	X	X	X	X	X	X	X	
Field Blank																						X	X	X	X	X	X	X	X	X	X	X	X	
	2	6.0 - 12.0 in						X	X		X											X	X	X	X	X	X	X	X	X	X	X	X	
		0.0 - 6.0 in						X	X		X											X	X	X	X	X	X	X	X	X	X	X	X	

Table 15.3-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT OUTFALLS WITH SEPTIC TANKS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Survey				Field Screening						Field Laboratory Measurements							Laboratory Analysis										
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium	
Field Duplicate																					X	X	X	X		X	X	X	X	X		X	
		6.0 – 12.0 in						X	X		X										X	X	X	X		X	X	X	X	X		X	
TA-21-56																																	
Tank Excavation							X				X	X																					
Vertical Borehole	1	0.0 – 5.0 ft						X	X		X	X	X								X	X	X	X		X	X	X	X	X		X	
		5.0 – 10.0 ft						X	X		X	X	X								X	X	X	X		X	X	X	X	X		X	
		10.0 – 15.0 ft						X	X		X	X	X								X	X	X	X		X	X	X	X	X		X	
		15.0 – 20.0 ft						X	X		X	X	X								X	X	X	X		X	X	X	X	X		X	
21-024(d)																																	
Survey				X	X																											
Surface Soil Sample	1	0.0 – 6.0 in						X	X		X		X								X	X	X	X		X	X	X	X			X	
Near Surface Soil	1	0.0 – 6.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
		6.0 – 12.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
		12.0 – 18.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
TA-21-106																																	
Vertical Borehole	1	0.0 – 5.0 ft						X	X		X		X								X	X	X	X		X	X	X	X			X	
		5.0 – 10.0 ft						X	X		X		X								X	X	X	X		X	X	X	X			X	
		10.0 – 15.0 ft						X	X		X		X								X	X	X	X		X	X	X	X			X	
		15.0 – 20.0 ft						X	X		X		X								X	X	X	X		X	X	X	X			X	
21-024(e)																																	
Survey				X	X		X																										
Near Surface Soil	1	0.0 – 6.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
Field Duplicate																					X	X	X	X		X	X	X	X			X	
		6.0 – 12.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
	2	0.0 – 6.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
Rinse ank																					X	X	X	X		X	X	X	X			X	

Table 15.3-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT OUTFALLS WITH SEPTIC TANKS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium	
Field Blank																																		
		6.0 – 12.0 in								X	X											X	X										X	
TA-21-123																																		
Tank Excavation							X																											
Vertical Borehole	1	0.0 – 5.0 ft						X	X		X	X	X									X	X										X	
		5.0 – 10.0 ft						X	X		X	X	X									X	X										X	
		10.0 – 15.0 ft						X	X		X	X	X									X	X										X	
		15.0 – 20.0 ft						X	X		X	X	X									X	X										X	
21-024(i)																																		
Survey				X	X		X																											
Near Surface Soil	1	0.0 – 6.0 in						X	X		X	X	X									X	X										X	
		6.0 – 12.0 in						X	X		X	X	X									X	X										X	
	2	0.0 – 6.0 in						X	X		X	X	X									X	X										X	
		6.0 – 12.0 in						X	X		X	X	X									X	X										X	
	3	0.0 – 6.0 in						X	X		X	X	X									X	X										X	
		6.0 – 12.0 in						X	X		X	X	X									X	X										X	
TA-21-181																																		
Tank Excavation			X							X	X	X																						
Vertical Borehole	1	0.0 – 5.0 ft						X		X	X	X	X									X	X										X	
Field Duplicate		5.0 – 10.0 ft						X		X	X	X	X									X	X										X	
		10.0 – 15.0 ft						X		X	X	X	X									X	X										X	
		15.0 – 20.0 ft						X		X	X	X	X									X	X										X	
Rinsate Blank																						X	X										X	
Field Blank																						X	X										X	
Trip Blank																						X	X										X	

The area above this outfall contains a PCB-contaminated area (SWMU 21-003, see Sec. 14.2). Because of that site, PCBs have been added to the analytical suite for this investigation.

SWMU 21-024(d). One surface soil sample (for method see Sec. 11.5.2.1) will be collected from a small pool located 13 ft south of the CEARP outfall marker at the very edge of DP mesa. Near-surface soil samples (for method see Sec. 11.5.2.4) will be taken at a single location on the bench directly below the outfall, at the point where effluent running over the mesa edge collects. Three samples will be taken at this location to a total depth of 18 in. (three 6-in. intervals). Field radiological surveys will be used at both locations in an attempt to identify the best point for sampling contaminants.

The borehole at tank TA-21-106 will be placed on the north (influent) side of the septic tank and will be drilled to a nominal depth of 20 ft (for method see Sec. 11.5.3.2). This will result in a total of four samples. This septic tank will not need to be excavated because the upper portions of it are already exposed and the inlet line can be located.

The analytics to be performed on the eight samples in this SWMU are presented in Table 15.3-II.

SWMU 21-024(e). Near-surface soil samples will be taken from two locations near the outfall. A depth of 12 in. (two 6-in. intervals) will be sampled at each of the locations. Field radiological surveying will be used to determine the two sampling locations according to Strategy A. If the radiological survey fails to provide sampling locations, Strategy C will be employed. Under Strategy C, the first sampling location will be 4 ft south of the CEARP outfall marker. This is a large pooling area that collects run-off from the entire area around the outfall. The second sampling location will be on the bench below the point where effluent runs over the mesa edge. Either approach, A or C, will yield a total of four samples.

The borehole at septic tank TA-21-123 will be drilled to a nominal depth of 20 ft, resulting in four samples (for method see Sec. 11.5.3.2). The borehole will be placed on the north end of the septic tank near the inlet drain line.

Table 15.3-II shows the analyses to be performed on the eight samples collected for this outfall.

SWMU 21-024(i). Three near-surface soil sampling locations sampled to a depth of 12 in. (two 6-in. intervals) will be used in the characterization of this outfall (for method see Sec. 11.5.2.4). If the field radiological survey is successful, the sampling locations will be taken in the three areas of highest readings according to Strategy A. If Strategy C is necessary, the three locations will be 8 ft, 30 ft, and 55 ft southeast of the CEARP outfall marker in the channel bed.

Septic tank TA-21-181 will be sampled by drilling a borehole near the outlet (southeast) side of the septic tank. This borehole will be to a nominal depth of 20 ft, resulting in a total of four samples.

The analytics to be performed on the 10 samples gathered for this SWMU are presented in Table 15.3-II.

15.4. Direct Discharge Outfalls

15.4.1. Site Description

This chapter addresses five outfalls that are associated with direct discharge systems: SWMUs 21-011(k), 21-022(h), 21-024(n and o), and 21-026(d). They have been grouped together because of similarities in configuration and suspected contaminants.

15.4.1.1. Site History

SWMU 21-011(k) (NPDES outfall No. EPA050050, CEARP identifier 3o) routed industrial wastewater from Building TA-21-257 through tanks TA-21-112 and TA-21-113 The discharge line runs northeast toward DP Canyon and discharges onto the north side of DP Mesa (Fig. 15.4-1). The wastewater was fed into the tanks from Building TA-21-257, the new industrial waste treatment plant (SWMU 21-011). This plant replaced and improved operations from Building TA-21-35 in the treatment of wastes from the plutonium purification process. The wastes treated were liquids remaining after the plutonium extraction, which contained a variety of radioactive and chemical constituents. The line from Tanks 112 and 113 is a 4-in. VCP that discharged to an outfall ditch and is no longer active (LASL 1976b). There is currently no visible sign of a ditch; however, there is a 4-in. cast iron line approximately 55 ft north of the perimeter road in the area where the outfall ditch would have ended. A gently sloping, rocky surface extends from the outfall pipe approximately 30 ft to the canyon rim.

SWMU 21-022(h) (NPDES outfall No. EPA03A032, CEARP identifier 3a) runs from the southeast corner of building TA-21-150 (plutonium fuel service building) and flows through sump TA-21-202 discharging to the north edge of DP Mesa (Fig. 15.4-2). It currently discharges only treated cooling water (LANL 1987). Previously, the outfall system was connected to the basement, floor, and roof drains in Building TA-21-150 (LASL 1961) and discharged industrial wastewater.

The line is currently a 24-in. corrugated metal pipe (CMP), which extends to the canyon rim. However, it is probable that this is not the original piping. The area around the pipe is broad, gently sloping and does not display a defined channel.

SWMU 21-024(n) is a drain (CEARP identifier 3aa) exiting Building TA-21-155 and discharging northward into DP Canyon (Fig. 15.4-3). TA-21-155 has been a warehouse, warehouse/laboratory, and currently contains a furnace. TA-21-155 is listed on a structure locater, although there is no reference to the type of furnace. It is believed to be a heating unit for DP East (LANL 1990).

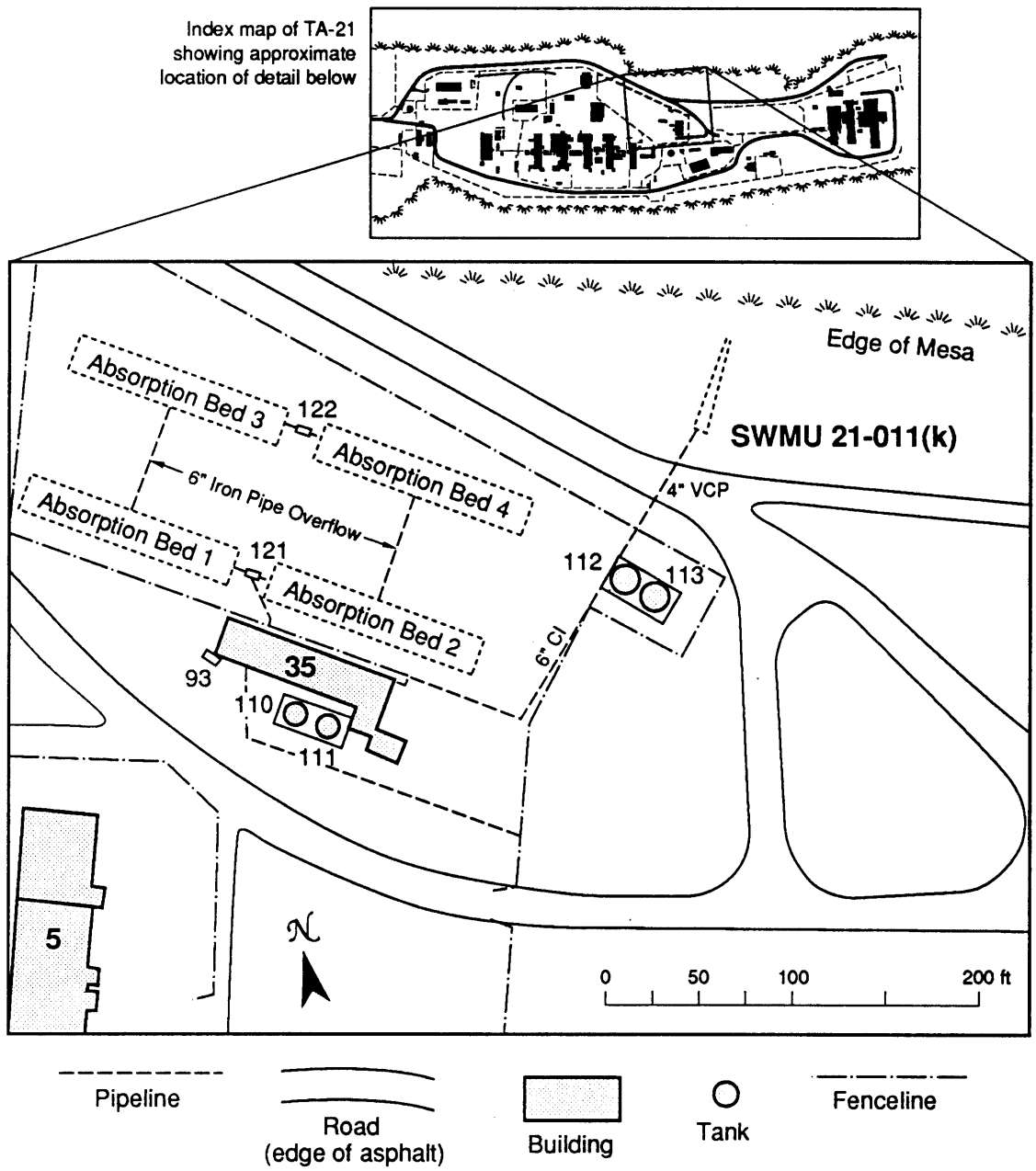


Fig. 15.4-1 Location of SWMU 21-011(k) in 1958. (LASL 1958c, 1961)

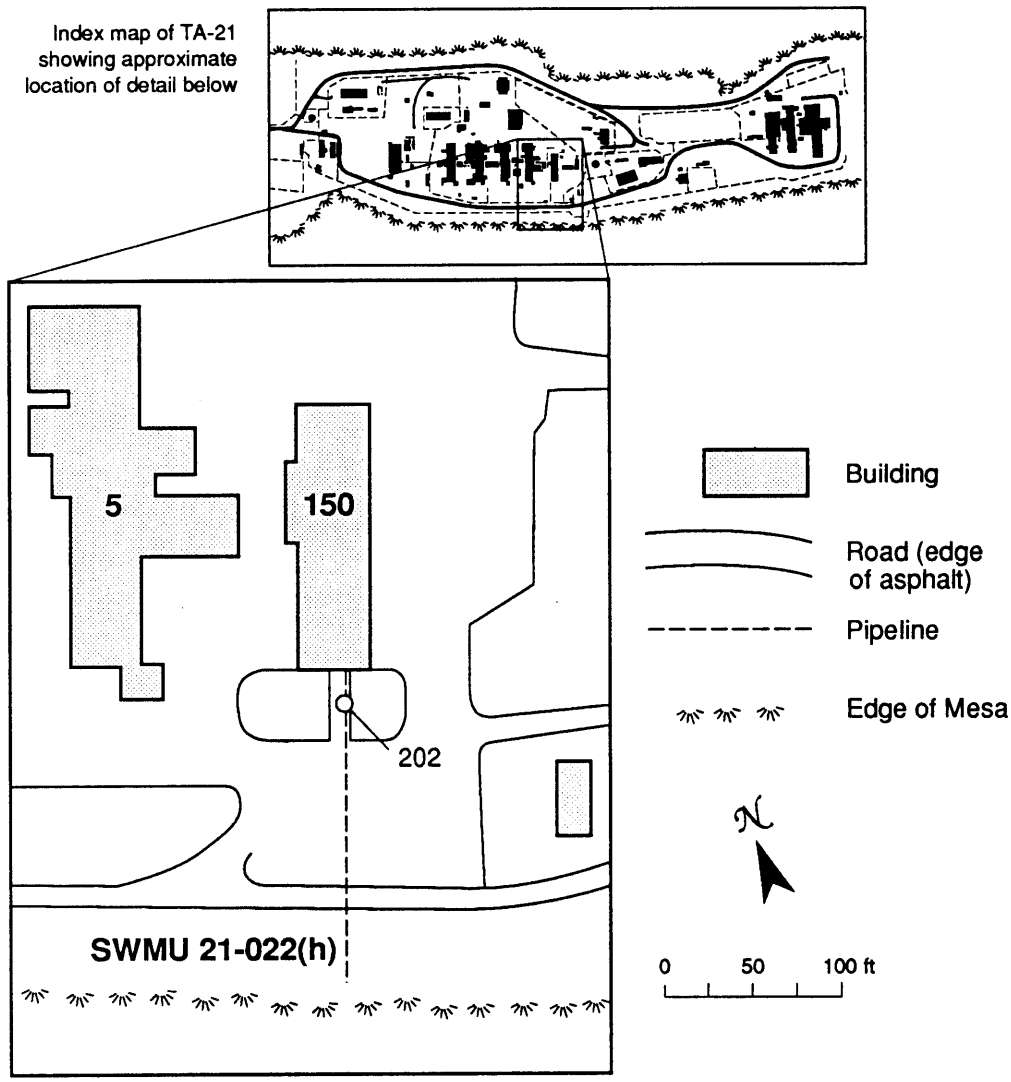


Fig. 15.4-2 Location of SWMU 21-022(h) as it appeared on the south side of Building 150 in 1975. (LASL 1976a)

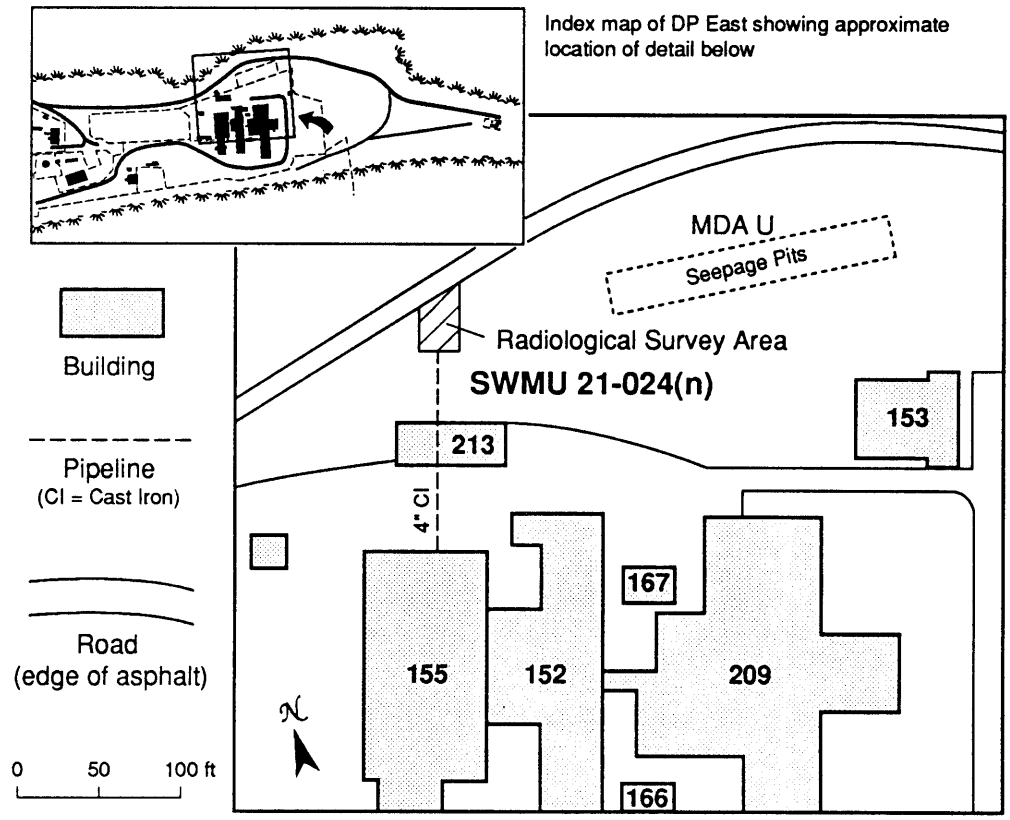


Fig. 15.4-3 Location of SWMU 21-024(n) near MDA U as it appeared in 1975. (LASL 1976a)

The drain system consists of CMP exiting a concrete bulkhead and discharging onto a gravel road immediately adjacent to MDA U. There is no evidence of a channel, which has probably been covered by the road. The effluent flowed north to the ditch paralleling the north perimeter road. From there, it flowed east to a culvert that passes under the north perimeter road and into DP Canyon.

SWMU 21-024(o) is a 4-in. VCP drain (CEARP identifier 3ab) reported to have served Building TA-21-46, the old diesel plant, which was converted to a warehouse between 1957 and 1964. The drain discharges to the south into Los Alamos Canyon (Fig. 15.4-4). The actual outfall pipe has not been located, but is shown on an engineering drawing (LASL 1958b). The area around the probable outfall location is broad and gently sloping, and the flow pattern can still be identified.

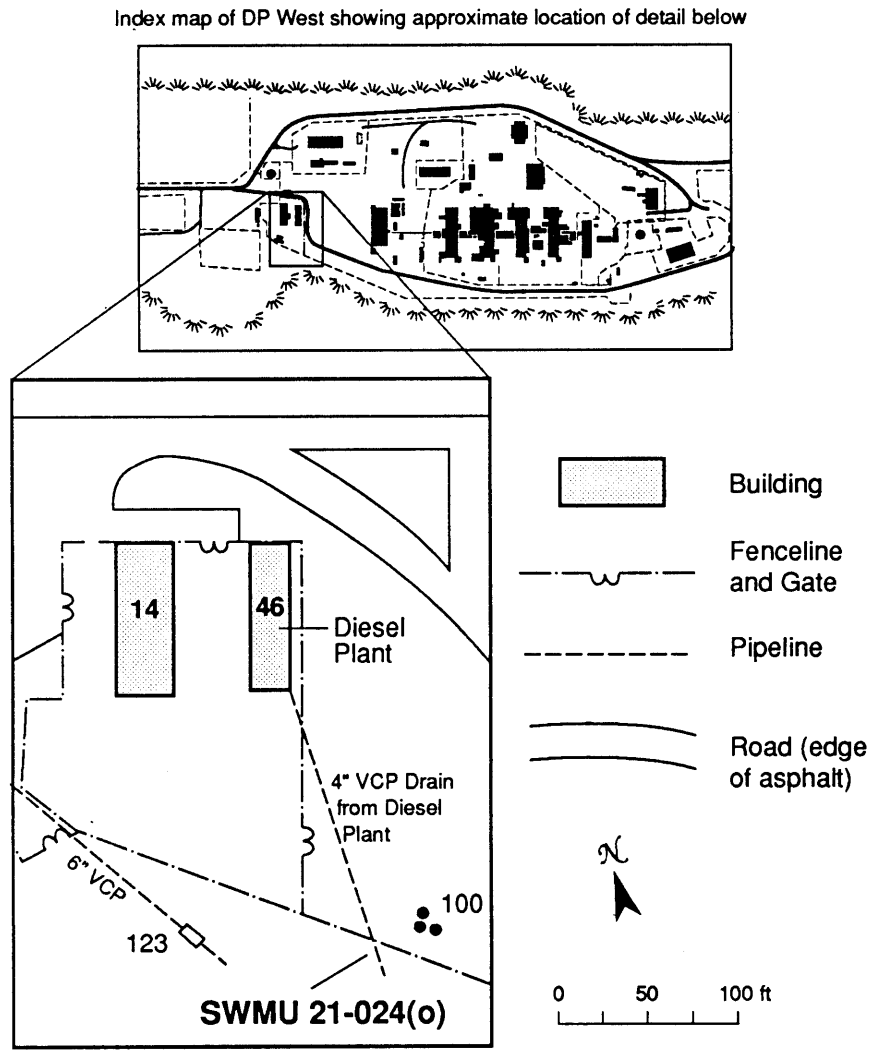


Fig. 15.4-4 Location of SWMU 21-024(o) as it appeared on the south side of Building 46 in 1958. (LASL 1958b)

SWMU 21-026(d) is a treated sewage water line (NPDES outfall No. EPASSS055, CEARP identifier 3w) discharging from the sewage treatment plant, Building 227, SWMU No. 21-026. The discharge flows into a concrete channel on the north edge of DP Mesa and runs down a steep, natural channel into DP Canyon (Fig. 15.4-5).

15.4.1.2. Existing Information

Two of the SWMUs in this section [21-024(n) and (o)] were sampled in October 1988 as part of the ER Program reconnaissance sampling (DOE 1989b). Those soil samples were analyzed

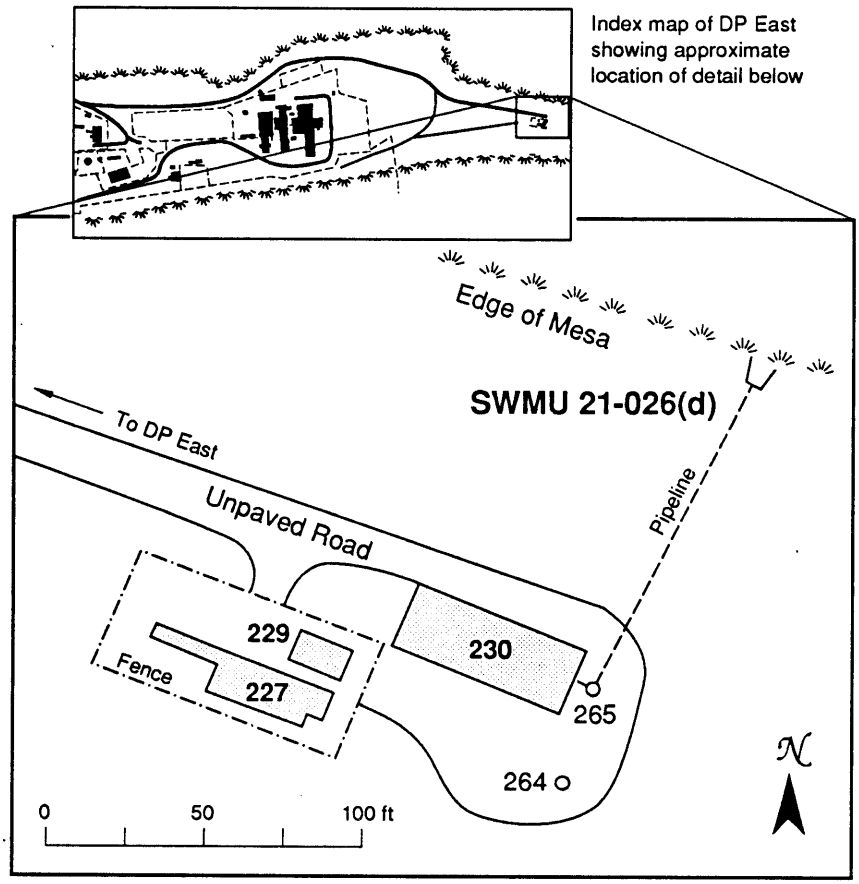


Fig. 15.4-5 Location of SWMU 21-026(d). (LANL 1983)

according to EPA Contract Laboratory Program (CLP) Statement of Work Protocols for Target Compound List volatile organic compounds, semivolatile organic compounds, pesticides/PCBs, and Target Analyte List metals. They were also analyzed for ^{241}Am, ^{137}Cs, ^{238}Pu, $^{239/240}Pu$, ^{226}Ra, ^{90}Sr, ^{232}Th, $^{234/235}U$, ^{238}U, and tritium by the standard procedures of a commercial laboratory. Analytical results, obtained from the ER Program reconnaissance sampling for the two SWMUs sampled, are presented in Table 15.4-I.

SWMU 21-011(k) was investigated by the DOE as environmental problem No. 6 (DOE 1989a). Three surface soil samples were collected from the effluent channel; one 23 ft from the end of the outfall pipe and two from below the canyon rim (Fig. 15-4.6). Table 15.4-II presents the analyses and results for the three samples. The analytical methods for these samples were not included in the reference and cannot be identified. Information in this table compared to data in Sec. 4.2.4 indicates cadmium, copper, nickel, $^{230/232}Th$, ^{235}U ^{238}U, ^{238}Pu, $^{239/240}Pu$, ^{241}Am, ^{90}Sr, ^{233}Pa, ^{40}K, and ^{137}Cs in excess of background level.

TABLE 15.4-I
1988 OUTFALL RECONNAISSANCE SAMPLING RESULTS FOR
SWMUs 21-024 (n) and (o)

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x}$ + 2s
	Metals				
SWMU 21-024(n)	ALUMINUM, TOTAL	4960	MG/KG	38	65,000
	BARIUM, TOTAL	81.4	MG/KG	38	850
	CALCIUM, TOTAL	1910	MG/KG	938	—
	CHROMIUM, TOTAL	4.8	MG/KG	2.0	75
	COPPER, TOTAL	12.4	MG/KG	6.0	19
	IRON, TOTAL	6310	MG/KG	19	26,600
	LEAD, TOTAL	7.5	MG/KG	2.0	54
	MANGANESE, TOTAL	229	MG/KG	4.0	770
	OIL & GREASE BY GRAVIMETRIC	1310	MG/KG	53	—[b]
	VANADIUM, TOTAL	12.9	MG/KG	10	——
	ZINC, TOTAL	95.9	MG/KG	4.0	78
	Radionucides				
	PLUTONIUM-239	0.5	PCI/G	0.1	0.025
	RADIUM-226	1.2	PCI/G	0.1	2.5
	STRONTIUM-90	0.4	PCI/G	0.2	0.88
	THORIUM-232	0.8	PCI/G	0.1	1.8
	TRITIUM	53	PCI/ML	3.0	0.0072
	URANIUM-234	1.0	PCI/G	0.2	—
	URANIUM-238	1.0	PCI/G	0.2	1.7
	Metals				
SWMU 21-024(o)	ALUMINUM, TOTAL	2340	MG/KG	37	65,000
	BARIUM, TOTAL	37.8	MG/KG	37	850
	CALCIUM, TOTAL	970	MG/KG	914	—
	IRON, TOTAL	2970	MG/KG	18	26,600
	LEAD, TOTAL	27.9	MG/KG	4.0	54
	MANGANESE, TOTAL	159	MG/KG	4.0	770
	OIL & GREASE BY GRAVIMETRIC	2580	MG/KG	51.3	—[b]
	ZINC, TOTAL	58	MG/KG	4.0	78
	Pesticides - PCBs				
	AROCLOR-1260	250	UG/KG	160	—[b]
	Radionuclides				
	CESIUM-137	0.2	PCI/G	0.1	0.44
	RADIUM-226	0.8	PCI/G	0.1	2.5
	TRITIUM	4.0	PCI/ML	2.0	0.0072

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x}$ + 2s
	URANIUM-234	0.4	PCI/G	0.1	—
	URANIUM-238	0.3	PCI/G	0.1	1.7

[a]The upper limit of background was defined by Purtymun et al (1987) as $\bar{x}$ + 2s as used in Table 4.2-XIII. For a consistent basis of comparison, the upper limit of background given here for metals is $\bar{x}$ + 2s as calculated from the data given in Table 4.2-XV.
[b]Background assumed to be zero.

SWMU 21-022(h) No quantitative information is available.

SWMU 21-024(n) was sampled 2 ft 6 in. west of the CEARP marker, directly under the opening of the 10 in. drainpipe as part of the 1988 reconnaissance sampling (DOE 1989b). Table 15.4.I lists the contaminant concentrations found in this sample. A comparison of this table with the background level information in Sec. 4.2.4 indicates above background levels of zinc, tritium, and $^{239/240}Pu$.

SWMU 21-024(o) was sampled as part of the 1988 reconnaissance sampling (DOE 1989b). A sample was taken 3 ft 6 in. south of the CEARP marker. Results of the sample analysis are presented in Table 15.4-I. These analyses indicate tritium concentrations above background levels and Arochlor 1260 (PCB) in concentrations above the detection limit.

SWMU 21-026(d) discharges the sewage treatment plant. As detailed in Sec. 14.7, assays of effluent indicate presence of gross alpha, gross beta, gamma, and tritium. Specific radionuclides causing the gross alpha and beta activity are not identified.

15.4.1.3. Source Term

SWMU 21-011(k) is not expected to have discharged contaminants other than those identified in the previous sampling based on actual samples obtained in the area. They are: cadmium, copper, nickel, ^{235}U, ^{238}U, ^{238}Pu, $^{239/240}Pu$, ^{230}Th, ^{232}Th, ^{241}Am, ^{90}Sr, ^{233}Pa, ^{40}K, and ^{137}Cs in excess of background level.

SWMU 21-022(h) is currently an NPDES-permitted discharge, but historical operations in TA-21-150 may have discharged contaminants to this outfall system. If present, potential contaminants

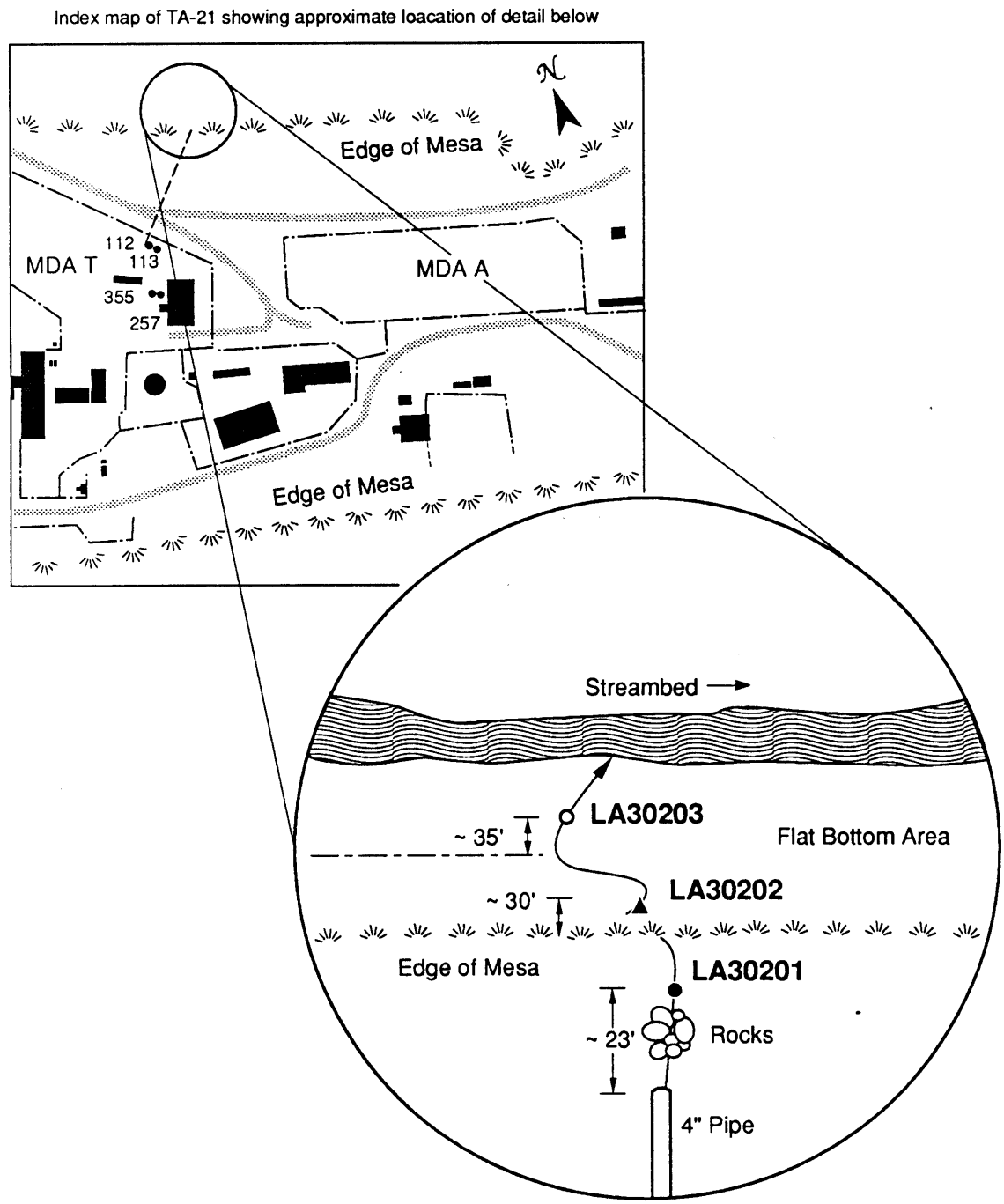


Fig. 15.4-6 DOE HQ Environmental Survey Problem #6 sampling locations at TA-21 inactive NPDES 50 outfall.

TABLE I5.4-II
ENVIRONMENTAL PROBLEM 6 ANALYTICAL DATA

AREA	TA-21-257	TA-21-257	TA-21-257	
LOCATION	OUTFALL	OUTFALL	OUTFALL	
TYPE OF LOCATION	NPDES 50	NPDES 50	NPDES 50	
SAMPLE NUMBER	LA30201XW	LA30202XW	LA30203XW	
MEDIA	SED	SED	SED	
UNITS	mg/kg	mg/kg	mg/kg	Upper Limit[d] of Background $\bar{x} + 2s$
SDG NUMBER	LA30201XW	LA30201XW	LA30201XW	
Field Measurements				
Depth (ft)	0-0.25	0-0.25	0-0.25	
Analytes				
Antimony	—	—	—	—
Arsenic	—	—	—	7.1
Barium	33.3B	41.4B	69.1	850
Beryllium	1.2	—	—	2.9
Cadmium	24.7	—	—	0.37
Chromium	8.8	—	—	75
Copper	45.8	—	—	19
Lead	26.1	6.2	10.1	54
Mercury	—	—	—	0.03
Nickel	64.3	—	—	18.5
Selenium	—	—	—	—
Silver	—	—	—	—
Thallium	—	—	—	—
Zinc	60.5	22.4	20.3	78
% Solids	87.0	80.7	85.6	
Total (allowed) Hold Time[a]	8(182)	8(182)	8(182)	
Total (allowed) Hold Time[b]	29(28)	29(28)	29(28)	
Total (allowed) Hold Time[c]	162(182)	162(182)	162(182)	

[a]ICP
[b]CVAAS
[c]GFAAS
[d]The upper limit of background was defined by Purtymun et al. (1987) as $\bar{x} + 2s$, as used in Table 4.2-XIII. For a consistent basis of comparison, the upper limit of background given here for metals is $\bar{x} + 2s$ as calculated from the data given in Table. 4.2-XV.

TABLE 15.4-II (continued)

AREA	TA-21-257	TA-21-257	TA-21-257	TA-21-257	TA-21-257	TA-21-257	
LOCATION	OUTFALL	OUTFALL	OUTFALL	OUTFALL	OUTFALL	OUTFALL	
TYPE OF LOCATION	NPDES 50	NPDES 50	NPDES 50	NPDES 50	NPDES 50	NPDES 50	Upper Limit
SAMPLE NUMBER	LA30201D	LA30201W	LA30202D	LA30202W	LA30203D	LA30203W	of Background
MEDIA	SED	SED	SED	SED	SED	SED	$\bar{x} + 2s$
UNITS	pCi/kgD	pCi/kgW	pCi/kgD	pCi/kgW	pCi/kgD	pCi/kgW	(pCi/g)
Alpha Emitters							
Thorium-230	1200 ±400	na	1800 ± 400	na	1000 ± 400	na	—
Thorium-232[e]	na	<16200 ±1200	na	<16900 ± 1200	na	<12140 ± 860	1.8
Uranium-235	na	1660 ±340	na	211 ± 71.0	na	64.0 ± 17.0	—
Uranium-238[e]	na	<14300 ±1300	na	<16400 ± 1300	na	<11670 ± 910	1.7
Uranium (all isotopes)[f]	8000 ±800	—	9000 ± 900	na	12000 ± 1200	na	—
Plutonium-238	105000 ±7000	—	336 ± 42	na	46 ± 27	na	0.005
Plutonium-239, 240	377000 ±19000	—	1880 ± 150	na	247 ±48.0	na	0.025
Americium-241	na	1440 ±140	na	2560 ± 450	na	520 ± 120	—
Beta Emitters							
Strontium-90	414000 ±38000	na	17000 ± 1400	na	<1100	na	0.88
Protactinium-233	na	340 ±110	na	—	na	—	—
Gamma Emitters							
Potassium-40	na	27000 ±3400	na	30700 ± 3000	na	22600 ± 2000	—
Cesium-137	na	144 ±13.0	na	51800 ± 3500	na	1080 ± 90.0	0.44
Samarium-153	na	<1130	na	—	na	—	—

[e] Total unbroken chain activity in equilibrium.
[f] Units are µg (/L, /kgW, or /kgD) instead of pCi (/L, /kgW, or /kgD).

are plutonium, uranium, mercury, lead, organics, and various acids that were associated with the plutonium purification process.

SWMU 21-024(n) may potentially be contaminated with petroleum products in addition to the contaminants found in the previous sampling listed above. This is because TA-21-155 currently houses the furnace for DP East.

SWMU 21-024(o) will likely be contaminated with organics, such as petroleum products related to the diesel plant. Other contaminants in the source term are Arochlor 1260 (PCBs), and tritium, which were found in the previous sampling.

SWMU 21-026(d) could potentially contain small amounts of any contaminant present at TA-21 that potentially could have entered the septic system. Most would have been removed by the waste treatment plant prior to discharge. However, tritium and other radionuclides would not be removed by any of the treatment processes.

15.4.2. Objectives and Data Needs

The objective of this investigation is to confirm the presence and determine the extent of contaminants at the previously unsampled outfalls and the remaining outfalls. The specific data required to assess contamination in each of these areas include the following:

1. Identify the contaminants present using Level II and III data for the previously unsampled outfalls and the remaining outfalls. Radionuclides, metals, and organic constituents were previously identified in three SWMUs.

2. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by additional surface and near-surface sampling and Level III/IV analyses.

15.4.3. Sampling/Investigation Rationale

This chapter contains outfalls for which drainage patterns can be identified. Therefore, if Strategy A cannot be used to identify sampling locations based on radiological surveys, Strategy C will be used (for sampling Strategies A and C see Sec. 15.1.4). Surface soil samples collected as part of OU-wide characterization (see Chapter 12) will allow assessment of local contaminant levels unrelated to releases from outfalls.

The investigation will be carried out in one phase (see Sec. 15.1.3). Samples will be sent directly to an analytical laboratory. No field laboratory analyses will be used, and no additional investigations are expected.

15.4.4. Sampling Plan

All field radiological surveys will be performed in a band 10 ft wide running from the outfall to the mesa edge (for method see Sec. 11.4.1.2). The screening and analytics to be performed on the soil samples taken in this investigation are presented in Table 15.4-III.

SWMU 21-011(k) will have five samples taken at three locations. Strategy A will be used if possible. Under Strategy C, the first sample location will be in a small pooling area 13 ft north of the outfall marker stake. This will be a surface soil sample (for method see Sec. 11.5.2.1), and soil is expected to be shallow at this location. The remaining two sampling locations will be 52 ft north of the outfall marker in a pooling area on the canyon slope and 120 ft north of the stake in the gully at the canyon bottom. Near-surface soil samples will be taken to a 12-in. depth at each location (two 6-in. increments at each location) (see Sec. 11.5.2.4 for method).

SWMU 21-022(h) is very close to the mesa edge. It will be sampled at the outfall mouth and at the effluent collection point on the bench directly below. Field radiological surveys will be used to identify sampling points if possible. Three near-surface samples will be collected (three 6-in. intervals, total depth of 18 in.) at each location (for method see Sec. 11.5.2.4).

SWMU 21-024(n) will have field radiological surveys in an area 20-ft wide between the outfall and the north perimeter road because the evidence of the outfall channel has been removed by construction of the road. Three locations will be sampled to a depth of 18 in. by the near-surface soil sampling method (Sec. 11.5.2.4). If patterns of contamination can be found that indicate the effluent channel, Strategy A will be used. Otherwise, sampling will be accomplished according to Strategy C by sampling at the outfall mouth and at two locations in the ditch 55 ft north of the outfall marker. The two locations in the ditch will be 10 ft apart and downstream from the outfall.

SWMU 21-024(o) will have a radiological survey between the outfall and the mesa edge. The investigations will consist of near-surface soil samples (for method see Sec. in 11.5.2.4) to a depth of 18 in. (three 6-in. intervals) to be taken from two locations. Under Strategy C, samples will be taken from the center of the broad channel at two locations. The first location will be 2 ft east of the outfall marker, and the second will be 15 ft southeast of the outfall marker.

SWMU 21-026(d) will have field radiological sampling performed as part of the investigation over the well-defined channel from the outfall mouth to the base of the cliff. Three surface soil samples will be taken of sediments in the drainage channel using results from the radiological survey. If it is necessary to use Strategy C, the three samples will be taken in pooling areas at

Table 15.4-III

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT DIRECT DISCHARGE OUTFALLS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Field Laboratory Measurements:	Field Laboratory Measurements:	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals	Laboratory Analysis: Isotopic Thorium	Laboratory Analysis:
21-011(k)																																		
Radiological Survey				X	X																													
Surface Soil Sample	1	0.0 - 6.0 in						X	X		X																							
Near Surface Soil	1	0.0 - 6.0 in						X	X		X																							
		6.0 - 12.0 in						X	X		X																							
	2	0.0 - 6.0 in						X	X		X																							
		6.0 - 12.0 in						X	X		X																							
21-022(h)																																		
Radiological Survey				X	X																													
Near Surface Soil	1	0.0 - 6.0 in						X	X		X																							
Field Duplicate		6.0 - 12.0 in						X	X		X																							
		12.0 - 18.0 in						X	X		X																							
	2	0.0 - 6.0 in						X	X		X																							
		6.0 - 12.0 in						X	X		X																							
		12.0 - 18.0 in						X	X		X																							
	3	0.0 - 6.0 in						X	X		X																							
		6.0 - 12.0 in						X	X		X																							
		12.0 - 18.0 in						X	X		X																							
21-024(n)																																		
Radiological Survey				X	X																													
Near Surface Soil	1	0.0 - 6.0 in						X	X		X												X	X	X	X		X	X	X	X	X		X	X
Rinsate Blank																							X	X	X	X		X	X	X	X	X		X	X
Field Blank																							X	X	X	X		X	X	X	X	X		X	X
		6.0 - 12.0 in						X	X		X												X	X	X	X		X	X	X	X	X		X	X

Table 15.4–III

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT DIRECT DISCHARGE OUTFALLS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements							Laboratory Analysis												
				Gross Gamma	Low–Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium	
		12.0 – 18.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
	2	0.0 – 6.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
		6.0 – 12.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
		12.0 – 18.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
	3	0.0 – 6.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
		6.0 – 12.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
		12.0 – 18.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
21–024(o)																																	
Radiological Survey				X	X																											
Near Surface Soil	1	0.0 – 6.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
Field Duplicate																					X	X	X	X		X	X	X	X			X	
		6.0 – 12.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
		12.0 – 18.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
	2	0.0 – 6.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
		6.0 – 12.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
		12.0 – 18.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
21–026(d)																																	
Surface Soil Sample	1	0.0 – 6.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
Rinsate Blank																					X	X	X	X		X	X	X	X			X	
Field Blank																												X				
	2	0.0 – 6.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
	3	0.0 – 6.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
Near Surface Soil	1	0.0 – 6.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
		6.0 – 12.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
		12.0 – 18.0 in						X	X		X										X	X	X	X		X	X	X	X			X	
Trip Blank																											X					

the outfall mouth, at 24 ft north of the outfall marker, and at 43 ft north of the marker (see Sec. 11.5.2.1 for method). Three near-surface soil samples will be taken to a total depth of 18 in. at the base of the cliff (for method see Sec. 11.5.2.4).

15.5. Surface Drainage South of TA-21-3

15.5.1. Site Description

This section addresses a drainage that includes four drain lines from Building TA-21-3.

15.5.1.1. Site History

SWMU 21-027(a) is a complex drainage system in the area between equipment room 3A in TA-21-3 and the south rim of DP Mesa (Fig. 15.5-1). It includes CEARP outfalls 3d, 3p (NPDES No. EPA03A031), 3ae, and 3af. The system originates at the southwest corner of Building TA-21-3 (LASL 1958c) with floor drains from equipment room 3A that connect to two 3-in. lines. Those lines connect to a 4-in. line, which empties into a 12-in. storm drain (LASL 1950). This drain line extends from the southwest corner of TA-21-3 almost to the southwest corner of the cooling tower TA-21-143 (LANL 1990) where it empties into a ponding area. This area also receives NPDES-permitted discharges of treated cooling water from the cooling tower. The combined effluents from the pond flow east along the south side of the cooling tower to a 24-in. CMP culvert, which carries them to the mesa edge.

15.5.1.2. Existing Information

This SWMU was sampled as part of DOE Headquarters Environmental Survey Problem 19 (DOE 1989b). Three samples were taken as shown in Fig. 15.5-1. Table 15.5-I identifies the analyses and presents the results. The analytical methods for these samples were not included in the reference and cannot be identified. Therefore, this data is used solely to guide future sampling.

This area was also sampled as part of the 1988 ER Program reconnaissance sampling (DOE 1989b). Two samples were taken from the ponding area, and the results are given in Table 15.5-II. The soil samples were analyzed according to EPA Contract Laboratory Program (CLP) Statement of Work Protocols for Target Compound List volatile organic compounds, semivolatile organic compounds, pesticides/PCBs, and Target Analyte List metals. They were also analyzed for ^{241}Am, ^{137}Cs, ^{238}Pu, $^{239/240}Pu$, ^{226}Ra, ^{90}Sr, ^{232}Th, ^{234}U, ^{235}U, ^{238}U, and tritium by the standard procedures of a commercial laboratory.

Comparing the results of these two sampling efforts with data given in Sec. 4.2.4 indicates above background level concentrations of cadmium, chromium, copper, lead, zinc, mercury, ^{241}Am,

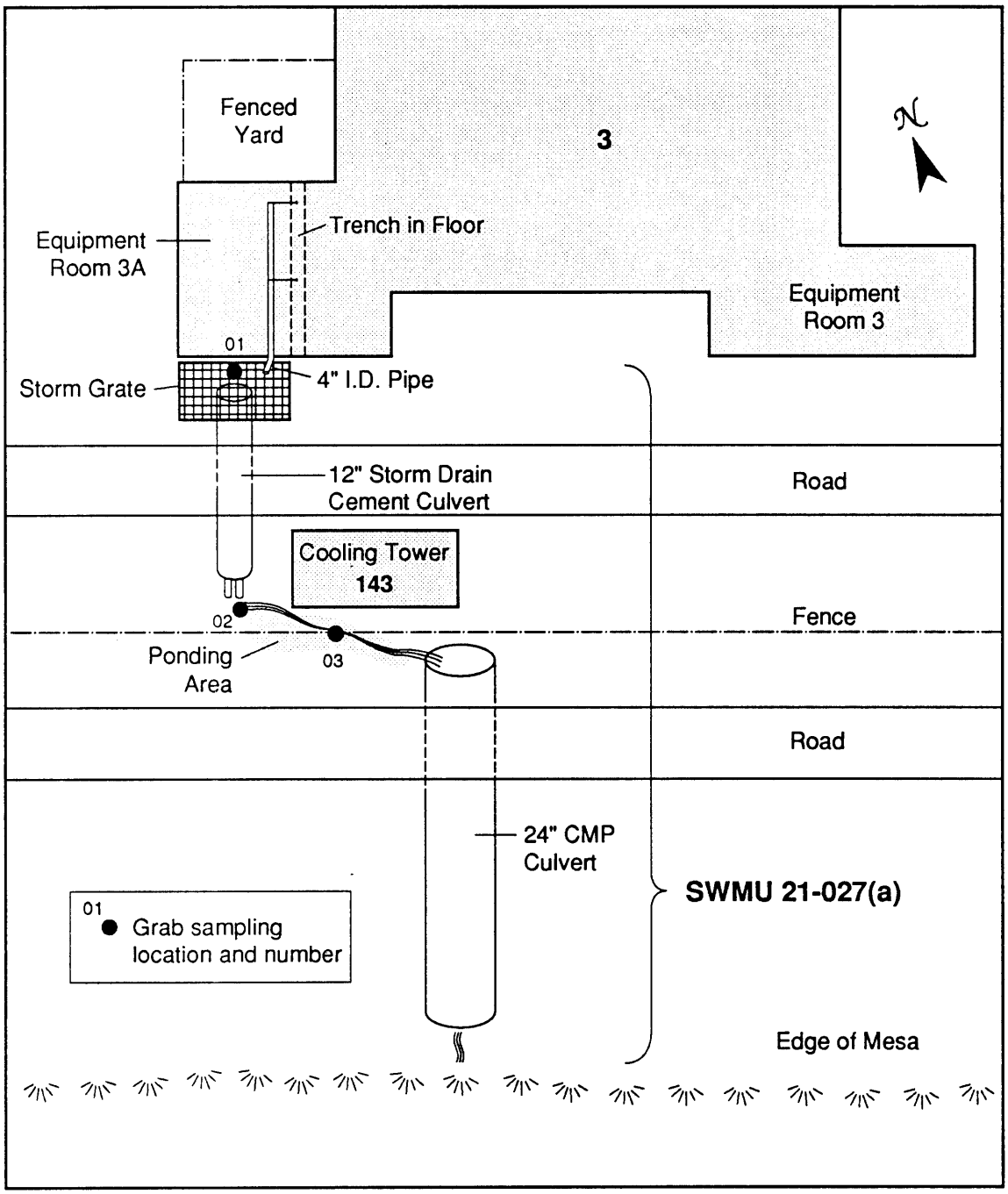


Fig. 15.5-1 Configuration of SWMU 21-027(a) and DOE HQ Environmental Survey Problem #19 sampling locations.

TABLE 15.5-I
DOE ENVIRONMENTAL SURVEY PROBLEM 19 ANALYTICAL DATA
(FROM TABLE 4.19. - LOS ALAMOS NATIONAL LABORATORY - INORGANIC DATA - ENVIRONMENTAL PROBLEM 19 APRIL 1989)

AREA	TA--21-003	TA-21-003	TA-21-003	
LOCATION	Drumstorage	Drumstorage	Drumstorage	
TYPE OF LOCATION	Stain	Stain	Stain	
SAMPLE NUMBER	LA60401XW	LA60402XW	LA60403XW	Upper Limit
MEDIA	Soil	Soil	Soil	of Background
UNITS	ug/kg	ug/kg	ug/kg	x + 2s
SDG NUMBER	LA60403XV	LA60403XV	LA60403XV	
FIELD MEASUREMENTS				
Depth (ft)	0-0.5	0-0.5	0-0.5	
TARGET COMPOUNDS				
alpha-BHC	--	--	--	--[a]
Endosulfan I	--	--	--	--[a]
Endosulfan II	--	--	--	--[a]
4,4'-DDD	--	--	--	--[a]
4,4'-DDT	--	--	--	--[a]
gamma-chlordane	--	--	--	--[a]
Aroclor-1221	--	--	--	--[a]
Aroclor-1248	2600 J	3200 J	7700 J	
Aroclor-1254				
Total (Allowed) Hold Time	7(14)d	7(14)d	7(14)d	
ELEVated/DECReased CRQL	ELEV	ELEV	ELEV	
Dilution Factor				

TABLE 15.5-I (continued)

AREA	TA--21-003	TA-21-003	TA-21-003	
LOCATION	Drumstorage	Drumstorage	Drumstorage	
TYPE OF LOCATION	Stain	Stain	Stain	Upper Limit
SAMPLE NUMBER	LA60401D	LA60401W	LA60402D	of Background
MEDIA	Soil	Soil	Soil	$\bar{x} + 2s$
UNITS	pCi/kgD	pCi/kgW	pCi/kgD	(pCi/g)
Alpha Emitters				
Thorium - 232[b]	na	<4430 ±390	na	1.8
Uranium - 234	na	—	na	—
Uranium - 235	na	469 ±47.0	na	—
Uranium - 238[b]	na	<6510 ±520	na	1.7
Uranium (all isotopes)[c]	2000 ±200	na	5000 ±500	—
Plutonium - 238	4000 ±1000	na	86000 ±6000	0.005
Plutonium - 239, 240	22300 ±2300	na	216000 ±13000	0.025
Americium - 241	na	4200 ±320	na	—
Beta Emitters				
Strontium - 90	<550	na	<760	0.88
Gamma Emitters				
Beryllium - 7	na	340 ±80.0	na	—
Potassium - 40	na	12340 ±990	na	—
Cesium - 137	na	210 ±50.0	na	0.44

TABLE 15.5-I (continued)

AREA	TA-21-003	TA-21-003	TA-21-003	
LOCATION	Drumstorage	Drumstorage	Drumstorage	Upper Limit
TYPE OF LOCATION	Stain	Stain	Stain	of Background
SAMPLE NUMBER	LA60402W	LA60403D	LA60403W	$\bar{x} + 2s$
MEDIA	Soil	Soil	Soil	(pCi/g)
UNITS	pCi/kgD	pCi/kgW	pCi/kgD	
Alpha Emitters				
Thorium - 232[b]	<9220 ±730	na	<8280 ±650	1.8
Uranium - 234	—	na	267000 ±47000	—
Uranium - 235	290 ±53.0	na	14840 ±980	—
Uranium - 238[b]	<10020 ±860	na	<7790 ±630	1.7
Uranium (all isotopes)[c]	na	6000 ±600	na	—
Plutonium - 238	na	14400 ±1800	na	0.005
Plutonium - 239, 240	na	84500 ±5400	na	0.025
Americium - 241	27400 ±2600	na	9300 ±1200	—
Beta Emitters				
Strontium - 90	na	<840	na	0.88
Gamma Emitters				
Beryllium - 7	—	na	600 ±260	—
Potassium - 40	17800 ±1800	na	17700 ±1300	—
Cesium - 137	642 ±76.0	na	1373 ±99.0	0.44

TABLE 15.5-I (continued)

AREA	TA--21-003	TA-21-003	TA-21-003	
LOCATION	Drumstorage	Drumstorage	Drumstorage	
TYPE OF LOCATION	Stain	Stain	Stain	
SAMPLE NUMBER	LA60401XV	LA60402XV	LA60403XV	Upper Limit
MEDIA	Soil	Soil	Soil	of Background
UNITS	ug/kg	ug/kg	ug/kg	$\bar{x} + 2s$
SDG NUMBER	LA60401XV	LA60401XV	LA60401XV	
FIELD MEASUREMENTS				
Depth (ft)	0-0.5	0-0.5	0-0.5	
TARGET COMPOUNDS[d]				
Acenaphthene	—	—	320 J	—[a]
Phenanthrene	720 J	680 J	3200 J	—[a]
Anthracene	180 J	—	740 J	—[a]
Fluoranthene	970 J	1000 J	6400	—[a]
Pyrene	1300 J	960 J	4400	—[a]
Benzo(a)anthracene	—	1200 J	2700 J	—[a]
Chrysene	1100 JB	1500 JB	3200 JB	—[a]
Benzo(b)fluoranthene	—	2600 J	—	—[a]
Benzo(k)fluoranthene	940 JB	2800 JB	3500 JB	—
Benzo(a)pyrene	—	3100 JB	1900 JB	—[a]
Indeno(1,2,3 - cd)pyrene	—	3900	2500 J	—[a]
Dibenz(a,h)anthracene	—	2800 J	—	—[a]
Benzo(g,h,i)perylene	—	3100 J	1500 J	—[a]
TENTATIVELY IDENTIFIED COMPOUNDS				
Chlorinated Hydrocarbon	—	—	1600 J	—[a]
Total (Allowed) hold time	3(14)d	3(14)d	3(14)d	
ELEVated/DECReased CRQL	ELEV	ELEV	ELEV	
Dilution Factor	0.100	0.100	0.100	

TABLE 15.5-I (continued)

AREA	TA--21-003 Drumstorage Stain	TA-21-003 Drumstorage Stain	TA-21-003 Drumstorage Stain	
LOCATION	LA60402XX	LA60403XX	LA60401XX	
TYPE OF LOCATION	Soil	Soil	Soil	Upper limit
SAMPLE NUMBER	ug/kg	ug/kg	ug/kg	of Background
MEDIA	LA60203XX	LA60203XX	LA60203XX	$\bar{x} + 2s$
UNITS				
SDG NUMBER				
FIELD MEASUREMENTS				
Depth (ft)	0-0.5	0-0.5	0-0.5	
TARGET COMPOUNDS				
Acetone	100 B	260 B	—	--[a]
1,1,1-Trichloroethane	—	—	—	--[a]
Trichloroethene	—	—	73	--[a]
Toluene	—	—	44	--[a]
Ethylbenzene	—	—	20 J	--[a]
Xylene (total)	—	—	18 J	--[a]
TENTATIVELY IDENTIFIED COMPOUNDS				
Prob T-Butyl Phenol	41 J	—	—	--[a]
Prob Terpene	56 J	1600 J	—	--[a]
Prob Terpene	110 J	110 J	—	--[a]
Prob Terpene	—	2000 J	—	--[a]
Total (Allowed) hold time	9(14)d	9(14)d	9(14)d	
ELEVated/DECReased CRQL	ELEV	ELEV	ELEV	
Dilution Factor	1.000	1.000	1.000	
AREA	TA--21-003 Drumstorage Stain	TA-21-003 Drumstorage Stain	TA-21-003 Drumstorage Stain	
LOCATION	LA60401XW	LA60402XW	LA60403XW	
TYPE OF LOCATION	Soil	Soil	Soil	Upper limit[e]
SAMPLE NUMBER	mg/kg	mg/kg	mg/kg	of Background
MEDIA				$\bar{x} + 2s$
UNITS				

TABLE 15.5-I (continued)

SDG NUMBER	LA50006XW	LA50006XW	LA50006XW	(mg/kg)
FIELD MEASUREMENTS				
Depth (ft)	0-0.5	0-0.5	0-0.5	
ANALYTES				
Antimony	—	—	—	—
Arsenic	—	—	—	7.1
Barium	195	103	131	850
Beryllium	—	0.53 B	0.39 B	2.9
Cadmium	—	—	4.9	0.37
Chromium	16.5	38.1	90.6	75
Copper	50.1	110	103	19
Lead	63.5	52.4	77.2	54
Mercury	NR	NR	NR	0.03
Nickel	12.4	7.3 B	10.6	18.5
Selenium	—	—	—	—
Silver	—	—	—	—
Thallium	—	—	—	—
Zinc	296	286	379	78
% Soils	90.8	87.1	86.3	
Total (Allowed) Hold Time[f]	7(182)d	7(182)d	7(182)d	
Total (Allowed) Hold Time[g]	7(182)d	7(182)d	7(182)d	

[a]Background assumed to be zero.

[b]Total unbroken chain activity in equilibrium.

[c]Units are µg (/L, /kgW, or /kgD) instead of pCi ((/L, /kgW, or /kgD).

[d]All the polynuclear aromatic hydrocarbons (PAHs) listed here are common constituents of asphalt, and are listed here for completeness. They are not contaminants of concern.

[e]The upper limit of background was defined by Purtymun et al. (1987) as $\bar{x} + 2s$ as used in Table 4.2-XIII. For a consistent basis of comparison, the upper limit of background given here for metal is $\bar{x} + 2s$ as calculated from the data given in Table 4.2-XV.

[f]ICP.

[g]GFAAS.

TABLE 15.5-II
1988 RECONNAISSANCE SAMPLING RESULTS FROM
SWMU 21-027(a)[a]

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x}$ + 2s
Sample #1	Volatiles				
	DICHLOROMETHANE-METHYLENE	75	UG/KG	65	—[c]
	CHLORIDE				
	Semi-Volatiles				
	FLUORANTHENE	3000	UG/KG	2200	—[c]
	PHENANTHRENE	2400	UG/KG	2200	—[c]
	PYRENE[b]	2300	UG/KG	2200	—[c]
	Metals				
	ALUMINUM, TOTAL	1490	MG/KG	39.1	65,000
	ARSENIC, TOTAL	3.3	MG/KG	2.0	7.1
	CADMIUM, TOTAL	1.1	MG/KG	0.98	0.37
	CALCIUM, TOTAL	1790	MG/KG	978	—
	CHROMIUM, TOTAL	48.9	MG/KG	2.0	75
	COPPER, TOTAL	35.4	MG/KG	4.9	19
	IRON, TOTAL	10200	MG/KG	19.6	26,600
	LEAD, TOTAL	46.6	MG/KG	19.6	54
	MANGANESE, TOTAL	87.7	MG/KG	2.9	770
	MERCURY, TOTAL	0.29	MG/KG	0.12	0.03
	NICKEL, TOTAL	12.8	MG/KG	7.8	18.5
	OIL & GREASE BY GRAVIMETRIC[b]	4630	MG/KG	58.2	—[c]
	VANADIUM, TOTAL	13.5	MG/KG	9.8	—
	ZINC, TOTAL	226	MG/KG	3.9	78
	Radionuclides				
	AMERICIUM	4.6	PCI/G	0.6	—
	CESIUM-137	0.5	PCI/G	0.1	0.44
	PLUTONIUM-238	1.9	PCI/G	0.2	0.005
	PLUTONIUM-239	28	PCI/G	1.0	0.025
	RADIUM-226	0.7	PCI/G	0.1	2.5
	STRONTIUM-90	0.4	PCI/G	0.2	0.88
	THORIUM 232	0.9	PCI/G	0.1	1.8
	TRITIUM	1600	PCI/ML	100	0.0072

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x}$ + 2s
	URANIUM-234	290	PCI/G	20	—
	URANIUM-235	10	PCI/G	1	—
	URANIUM-238	1.9	PCI/G	0.4	1.7
	Radionuclides				
Sample #2	AMERICIUM	7.6	PCI/G	0.5	—
	CESIUM-137	0.3	PCI/G	0.1	0.44
	PLUTONIUM-238	8.5	PCI/G	0.5	0.005
	PLUTONIUM-239	6.8	PCI/G	2.0	0.025
	RADIUM-226	1.2	PCI/G	0.1	2.5
	THORIUM 232	0.4	PCI/G	0.2	1.8
	TRITIUM	68	PCI/ML	3.0	0.0072
	URANIUM-234	4.0	PCI/G	0.4	—
	URANIUM-235	0.2	PCI/G	0.1	—
	URANIUM-238	0.7	PCI/G	0.2	1.7
	Metals				
Sample #2	ALUMINUM, TOTAL	1290	MG/KG	31.7	65,000

[a]Sample #1 was from CEARP Outfall 3d; Sample #2 from 3ae.
[b]The upper limit of background was defined by Purtymun et al. (1987) as $\bar{x}$ + 2s as used in Table 4.2-XIII. For a consistent basis of comparison, the upper limit of background given here for metals is $\bar{x}$ + 2s as calculated from the data given in Table 4.2-XV.
[c]Background assumed to be zero.

^{238}Pu, $^{239/240}Pu$, ^{234}U, ^{235}U, ^{238}U, ^{232}Th, ^{90}Sr, and ^{137}Cs. In addition, toluene and trichloroethene were found in concentrations above the detection limit. All the polynuclear aromatic hydrocarbons (PAHs) found are common constituents of asphalt and, therefore, are not considered further.

15.5.1.3. Source Term

The source term for this discharge system includes all the contaminants found in the previous sampling efforts, These contaminants will likely be found throughout the discharge system, at the final outfall point on the south edge of DP Mesa and on the bench directly below the mesa.

15.5.2. Objectives and Data Needs

The objective of this investigation is to confirm the presence and determine the extent of contaminants at SWMU 21-017(a). The specific data required to assess contamination of SWMU 21-017(a) include the following:

1. Identify the contaminants present using Level III data from the discharge and below the ponding area. Contaminants may be driven downward into the tuff by the constant water head available at the ponding area. Contaminants may include radionuclides, organic and inorganic constituents.

2. If contamination is identified, determine the lateral and vertical extent of contaminant migration by additional subsurface sampling and Level III/IV analyses.

15.5.3. Sampling/Investigation Rationale

Surface soil sampling will be used to address contaminant levels at various points along the drainage system on DP Mesa and on the bench below the south rim of the mesa. Vertical boreholes will be used to assess the migration of contaminants into subsurface soil and tuff in the ponding area.

Because sampling locations are evident on the mesa top, sampling Strategy C will be used. On the bench, appropriate locations are not as evident, and Strategy B will be used (for Strategies B and C, see Sec. 15.1.4). Surface soil samples collected as part of OU-wide characterization (see Chapter 12) will allow assessment of local contaminant levels unrelated to releases from the outfalls.

The investigation will be carried out in one phase (see Sec. 15.1.3). Samples will be sent directly

to an analytical laboratory. No field laboratory analyses will be used, and no additional investigations are expected.

15.5.4. Sampling Plan

Five surface soil samples (for method see Sec. 11.5.2.1) will be taken along the drainage system: one from beneath the storm drain at the corner of Room 3A, three from the ponding area, and one from the end of the 24-in. CMP, about 2 ft from the mesa edge (see Fig. 15.5-2). Radiological surveys may be used to refine the sampling locations (for method see Sec. 11.4.1.2).

Two boreholes will be drilled to a nominal depth of 20 ft in the ponding area (for method see Sec. 11.5.3.2). The boreholes will be placed at opposite ends of the ponding area as shown in Fig. 15.5-2. Four samples will be acquired from each borehole (5-ft core intervals).

The bench below the mesa edge will be sampled according to Strategy B. Three groups of three sampling locations will be placed at 5-ft intervals outward from the base of the cliff on the bench. Surface soil samples will be taken at each location (see Sec. 11.5.2.4 for method), resulting in nine samples from the bench. The screening and analytics to be performed on the soil samples taken in this investigation are presented in Table 15.5-III.

Table 15.5–III

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS OF THE SURFACE DRAINAGE SOUTH OF TA–21–3.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low–Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals	Laboratory Analysis: Isotopic Thorium
21–027(a)				X	X																								
Radiological Survey								X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Surface Soil Sample	1	0.0 – 6.0 in						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	2	0.0 – 6.0 in						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	3	0.0 – 6.0 in						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	4	0.0 – 6.0 in						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	5	0.0 – 6.0 in						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Vertical Borehole	1	0.0 – 5.0 ft						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		5.0 – 10.0 ft						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		10.0 – 15.0 ft						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		15.0 – 20.0 ft						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	2	0.0 – 5.0 ft						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Field Duplicate		5.0 – 10.0 ft						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		10.0 – 15.0 ft						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		15.0 – 20.0 ft						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Surface Soil Sample	1	0.0 – 6.0 in						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	2	0.0 – 6.0 in						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	3	0.0 – 6.0 in						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	4	0.0 – 6.0 in						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	5	0.0 – 6.0 in						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	6	0.0 – 6.0 in						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	7	0.0 – 6.0 in						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	8	0.0 – 6.0 in						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	9	0.0 – 6.0 in						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 15.5–III

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS OF THE SURFACE DRAINAGE SOUTH OF TA-21-3.

Sample Identification	Interval	Sampling Location	Sample Type		
			Rinsate Blank		
			Field Blank		
			Trip Blank		
			Gross Gamma		Field Surveys
			Low-Energy Gamma		
			Electromagnetic		
			Land Survey		
			Gross Gamma		Field Screening
			Gross Alpha		
			Organic Vapor		
			Combustible Gas/Oxygen		
			Lithological Logging		
			Gross Alpha		Field Laboratory Measurements
			Gamma Spectrometry		
			Tritium		
			Volatile Organics		
			PCB		
			Soil Moisture		
		X	Gamma Spectrometry		Laboratory Analysis
		X	Tritium		
		X	Total Uranium		
		X	Isotopic Plutonium		
			Isotopic Uranium		
		X	Strontium 90		
X	X	X	VOA (SW 8240)		
	X	X	Semivolatiles (SW 8270)		
	X	X	Metals (SW 6010)		
			PCB (SW 8080)		
			TCLP Metals		
		X	Isotopic Thorium		

15.6. Septic Tanks

15.6.1. Site Description

This chapter addresses two abandoned septic tanks, a leach field, and the associated lines and outfalls at DP East, SWMU 21-024(j) and (k). They have been grouped together because of similarities in contaminants and configuration.

15.6.1.1. Site History

SWMU 21-024(j) consists of septic tank TA-21-194 and associated drain lines. The septic tank received sewage from TA-21-155 (warehouse/laboratory), but it is not known where (or if) the septic tank discharged overflow to the environment (LANL 1990; LANL 1989a). The function and operation of the laboratory in Building TA-21-155 cannot be determined. The reinforced concrete tank is located off the southwest corner of TA-21-155 near the south edge of the perimeter road (Fig. 15.6-1). It was constructed in December 1961 and has dimensions of 5-ft long by 3-ft wide and 6-ft deep. In October 1966, the septic system was abandoned by pumping out the septic tank and filling it with earth (LANL 1989a).

SWMU 21-024(k) consists of septic tank TA-21-219, associated drain lines, and a leach field (Fig. 15.6-2). Sewage discharged from TA-21-209 (high-temperature chemistry building) was carried south to manhole TA-21-217 via a 6-in. cast iron line. Six-inch VCPs carried the sewage south to manhole TA-21-228 and on southwest to septic tank TA-21-219. The septic tank, which has two chambers, was constructed in September 1965 from reinforced concrete (LANL 1989a). The outside dimensions are 18-ft 6-in. long by 6-ft 4-in. wide and 8-ft 10-in. deep (LASL 1964). Overflow from the septic tank went to a leach field which was 30-ft long by 20-ft wide and 5-ft 6-in. deep (Fig. 15.6-2). Also, two 4-in. VCP lines are shown to extend from the downslope edge of the leach field as shown in Fig. 15.6-2. The two drain lines daylighted somewhere between the leach field and the mesa edge; however, the exact location is not known. In October 1966, the septic system was abandoned by pumping out the tank and filling it with earth.

Currently two manholes and two vent pipes can be observed south of TA-21-155 just outside the security fence above the location of septic tank TA-21-219. No evidence of the two leach field drain lines is evident, although pieces of VCP can be seen in the area. The leach field may have been removed because there is evidence of backfill in the area suspected of containing the leach field. However, there is no documentation that states any portion of the septic system was removed.

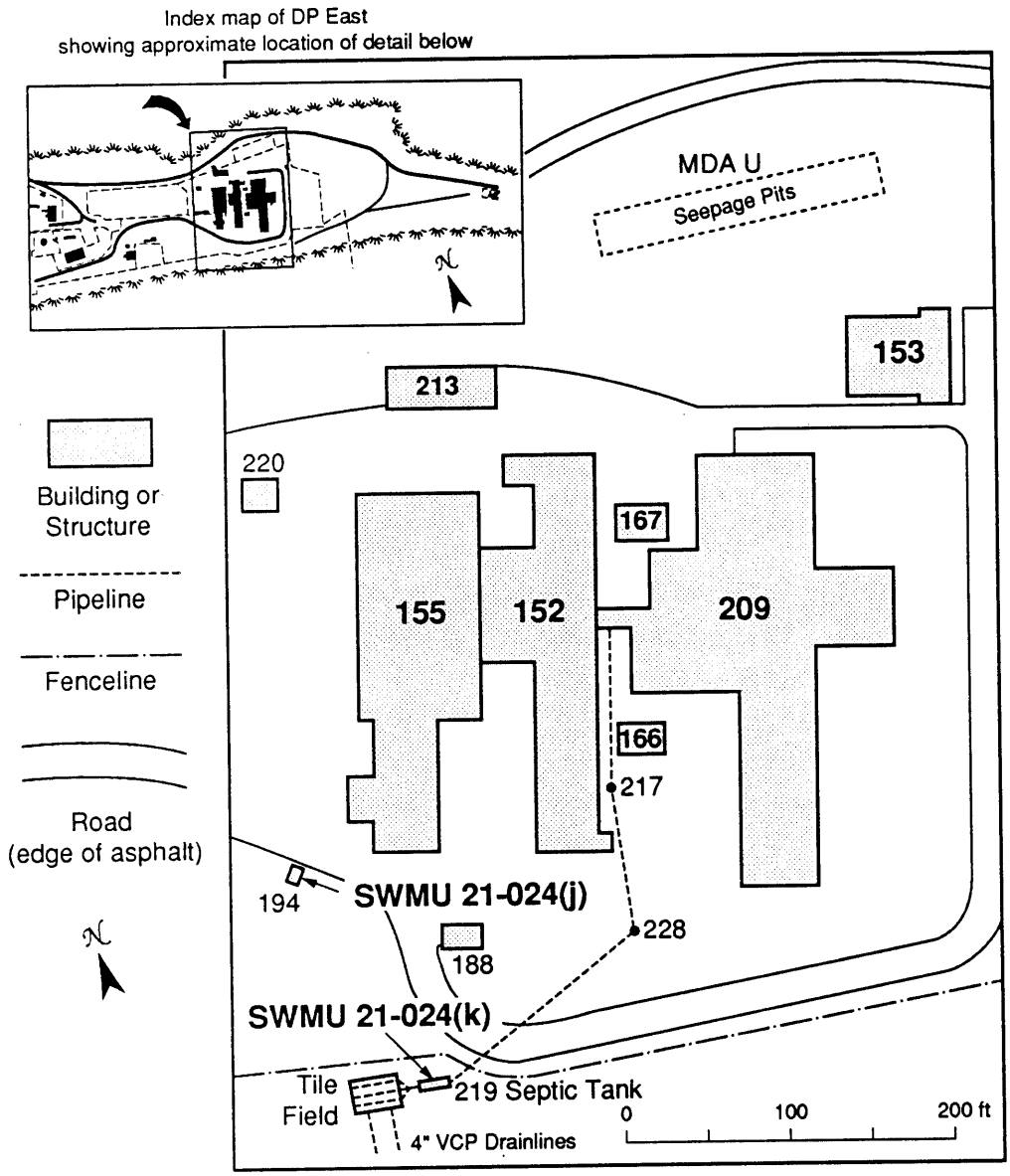


Fig. 15.6-1 Location of SWMUs 21-024(j) and -024(k). (LASL 1964)

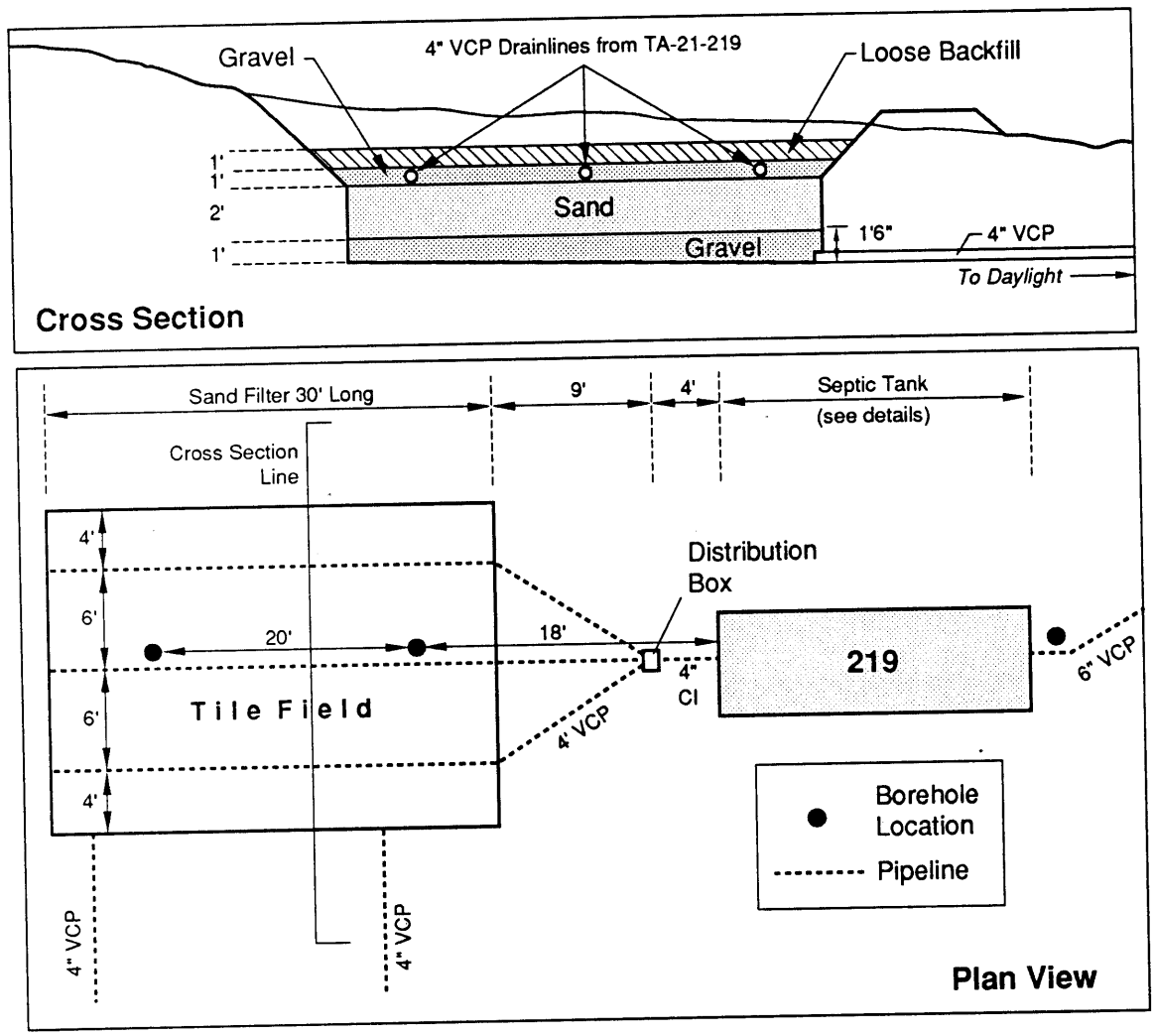


Fig. 15.6-2 Leach field details and borehole sampling locations. (LASL 1964)

15.6.1.2. Existing Information

No quantitative information exists on potential contaminants.

15.6.1.3. Source Term

SWMU 21-024(j) can potentially contain radionuclides, organics, metals, and inorganic lab chemicals.

SWMU 21-024(k) may have radionuclides, organics, metals, and common laboratory chemical present in the septic tank, the leach field, and the outfall.

15.6.2. Objectives and Data Needs

The objective of this investigation is to confirm the absence of contamination at SWMU 21-024 (j) and (k). The specific data required to assess contamination at SWMU 21-024 (j) and (k) include the following:

1. Determine the location of septic tank TA-21-194. This system has been abandoned, and its exact location is not known.
2. Identify contaminants present using Level II and III data. Potential contaminants in these areas may include radionuclides, organic and inorganic constituents.
3. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by additional surface and near-surface sampling and Level III/IV analyses.

15.6.3. Sampling/Investigation Rationale

The location of SWMU 21-024(j) will be marked in the field by surveys based on an engineering drawing. Geophysical surveys will be used to confirm the exact location of the tanks, assuming a response to the rebar in the concrete. Excavation will be necessary to uncover the top of the septic tanks in order to provide positive locations of the tanks and drain lines before drilling begins.

Subsurface soil sampling will be performed at each septic tank to identify the presence of contaminants released by overflow or leaks. This single borehole will provide sufficient information on contaminant presence and depth to use as design criteria for CMS planning for septic tank removal. Subsurface samples will also be taken in the leach field to determine whether the liquid distribution system has carried contaminants into the soil and tuff beneath the field.

15.6.4. Sampling Plan

SWMU 21-024(j). The location of septic tank TA-21-194 will be determined by surveying from an engineering drawing (LASL 1964) and will be marked in the field. A geophysical survey (for method see Sec. 11.4.2.1) will be used to confirm the location if a response to the rebar in the reinforced concrete can be obtained. A vertical borehole will be sampled to a nominal depth of 20 ft near the drain line inlet of the septic tank (see Sec. 11.5.3.2 for method). A total of four samples will result (5-ft core intervals).

Table 15.6-I lists the screening and analyses to be performed on the samples.

SWMU 21-024(k) sampling will be performed by drilling three vertical boreholes to a nominal depth of 20 ft (for method see Sec. 11.5.3.2). The first borehole will be placed on the inlet side of the septic tank as close to the tank as possible (Fig. 15.6-2). The remaining two boreholes will be drilled within the area occupied by the leach field. These two boreholes will be 18 ft and 38 ft from the west end of the septic tank (Fig. 15.6-2).

If contamination is found to be present in the leach field, then a radiologic survey and sampling may be required downslope from the leach field to the mesa edge to identify any contamination that may be associated with the two 4-in. VCP drain lines shown to extend from the leach field south towards the mesa edge.

Table 15.6-I lists the screening and analyses to be performed on the samples.

Table 15.6-1

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SEPTIC TANKS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture		Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium	
21-024(j)																																
Survey																																
Vertical Borehole	1	0.0 - 5.0 ft						X	X		X	X	X								X	X	X	X	X	X	X	X	X	X	X	X	
		5.0 - 10.0 ft						X	X		X	X	X								X	X	X	X	X	X	X	X	X	X	X	X	
		10.0 - 15.0 ft						X	X		X	X	X								X	X	X	X	X	X	X	X	X	X	X	X	
		15.0 - 20.0 ft						X	X		X	X	X								X	X	X	X	X	X	X	X	X	X	X	X	
21-024(k)																																
Survey	1	0.0 - 5.0 ft		X	X	X	X	X	X		X	X	X								X	X	X	X	X	X	X	X	X	X	X	
Vertical Borehole		5.0 - 10.0 ft						X	X		X	X	X								X	X	X	X	X	X	X	X	X	X	X	
		10.0 - 15.0 ft						X	X		X	X	X								X	X	X	X	X	X	X	X	X	X	X	
		15.0 - 20.0 ft						X	X		X	X	X								X	X	X	X	X	X	X	X	X	X	X	
Trip Blank	2	0.0 - 5.0 ft						X			X	X	X								X	X	X	X	X	X	X	X	X	X	X	
		5.0 - 10.0 ft						X	X		X	X	X								X	X	X	X	X	X	X	X	X	X	X	
Field Duplicate		10.0 - 15.0 ft						X	X		X	X	X								X	X	X	X	X	X	X	X	X	X	X	
		15.0 - 20.0 ft						X	X		X	X	X								X	X	X	X	X	X	X	X	X	X	X	
	3	0.0 - 5.0 ft						X	X		X	X	X								X	X	X	X	X	X	X	X	X	X	X	
		5.0 - 10.0 ft						X	X		X	X	X								X	X	X	X	X	X	X	X	X	X	X	
		10.0 - 15.0 ft						X	X		X	X	X								X	X	X	X	X	X	X	X	X	X	X	
		15.0 - 20.0 ft						X	X		X	X	X								X	X	X	X	X	X	X	X	X	X	X	
Rinsate Blank																																
Field Blank																																
Trip Blank																																

15.7. Surface Drainage South of TA-21-155

15.7.1. Site Description

This section contains two SWMUs that have separate histories and origins but drain in the same area, resulting in a common sampling plan. Their histories will be discussed separately, but in the remainder of the section, they will be discussed together.

15.7.1.1. Site History

SWMU 21-024(m) (CEARP identifier 3z) is reported to be an 8-in. VCP that exits TA-21-209, the high-temperature chemistry lab, and leads south toward Los Alamos Canyon. The outfall cannot be located in the field. The former location, as indicated on engineering drawing ENGR-4821, is shown on Fig. 15.7-1.

At the approximate site where the outfall should be, there is an 8-in. CMP discharging water. This pipe appears to come from a storm drain below the lawn area of TA-21-209. Adjacent to the pipe is an NPDES-type stake, but no placard. The construction of this pipe may have destroyed the SWMU 21-024(m) outfall pipe. Immediately adjacent to the flowing outfall is a dry, 12-in. CMP with no labeling. It is unlikely that either of these pipes represents SWMU 21-024(m), although the location appears correct. The area around the outfall is gently sloping and is drained by the channel associated with the SWMU 21-027(b) outfall.

SWMU 21-027(b) consists of two outfalls with CEARP identifiers 3q and 3r. CEARP outfall 3r is an active NPDES outfall (No. EPA03A034). It discharges treated cooling water from cooling towers TA-21-166 and TA-21-167 on the south edge of DP Mesa (Fig. 15.7-1). Formerly, these cooling towers discharged through SWMU 21-024(i) (see Sec. 15.3).

CEARP outfall 3q is identified as discharging south into Los Alamos Canyon from a cooling tower associated with TA-21-152. The outfall could not be located during the site reconnaissance. A LANL report on NPDES outfalls (LANL 1989c) states that this outfall was eliminated. In addition, no engineering drawings showing a line discharging southward from TA-21-152 have been found other than those showing the line considered to be CEARP outfall 3r. It is probable that this outfall is the same as CEARP outfall 3r, and they will be considered to be the same under SWMU 21-027(b).

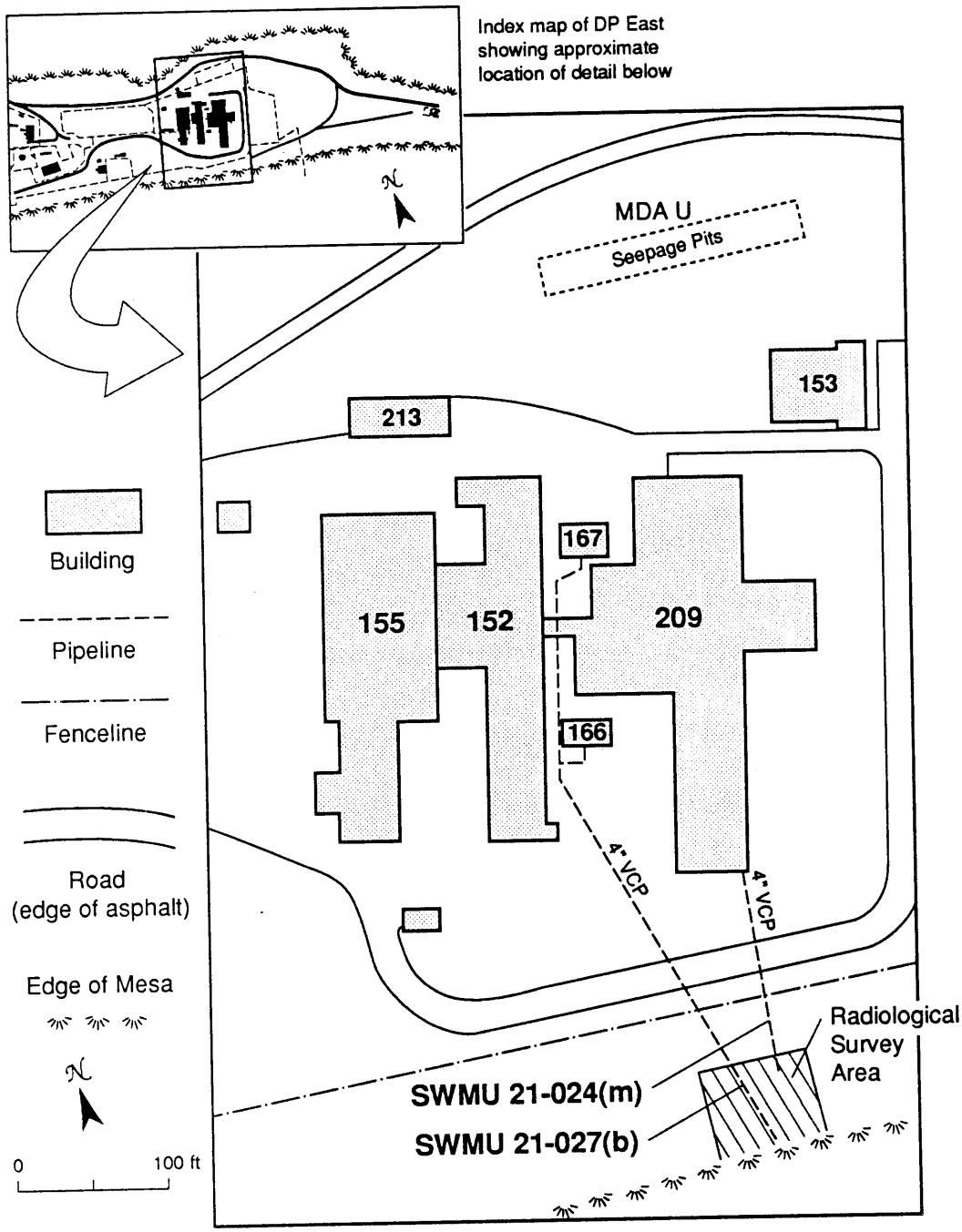


Fig. 15.7-1 Location of SWMU 21-024(m) and -027(b). (LASL 1976a)

15.7.1.2. Existing Information

The drainage serving these SWMUs has not previously been sampled and no quantitative contaminant information is available.

15.7.1.3. Source Term

The source term for the channel serving both SWMUs includes radionuclides and organic and inorganic lab chemicals from the high-temperature chemistry lab, TA-21-209.

15.7.2. Objectives and Data Needs

The objective of this investigation is to confirm the absence of contamination at SWMUs 21-024(m) and 21-027(b). Specific data required to assess contamination at SWMUs 21-024(m) and 21-027(b) include the following:

1. Identify the contaminants present using Level II and III data. These outfalls discharge what appears to be stormwater and cooling tower water; no contamination has been previously identified.

2. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by additional surface and near-surface sampling and Level III/IV analyses.

15.7.3. Sampling/Investigation Rationale

Field radiological surveys will be used, if possible, to identify sampling locations within the well defined drainage serving SWMUs 21-024(m) and 21-027(b). Surface soil samples collected a part of OU-wide characterization (see Chapter 12) will allow assessment of local contaminant levels unrelated to releases from outfalls.

15.7.4. Sampling Plan

A field radiological survey will be performed in the entire area around the channel, including both outfall locations as shown in Fig. 15.7-1 (see Sec. 11.4.1.2 for method).

Near-surface soil samples (for method see Sec. 11.5.2.2) will be taken to an 18-in. depth (three 6-in. intervals) from two locations according to Strategy A, if possible, or Strategy C if not. Under

Strategy C, the sampling locations will be the mouth of outfall SWMU 21-027(b) and the small pooling area at the mesa edge, 15 ft south of the outfall.

Table 15.7-I lists the screening and analyses to be performed in this investigation.

Table 15.7-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS FOR THE SURFACE DRAINAGE SOUTH OF TA-21-155.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium	
Surface Drainage South of TA-21-155																																		
Survey				X	X																													
Near Surface Soil	1	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
		6.0 - 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
		12.0 - 18.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
	2	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
Field Duplicate																						X	X	X	X		X	X	X	X			X	
		6.0 - 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
		12.0 - 18.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
Rinsate Blank																						X	X	X	X		X	X	X	X			X	
Field Blank																												X	X	X				
Trip Blank																												X						

15.8. Surface Drainage North of TA-21-155

15.8.1. Site Description

This section discusses two outfall systems, SWMUs 21-004(d) and 21-024(h), whose effluents are drained by the same channel. Both systems have distinct histories and contaminant information, but their sampling plans are related and will overlap.

15.8.1.1. Site History

SWMU 21-004(d) was an overflow line (CEARP identifier 3n) from an acid waste pumping station, structure TA-21-223, that carried waste from DP East to TA-21-257 at DP West for treatment. It ran north from the pump station and discharged at a concrete bulkhead approximately 15 ft north of the perimeter road (Fig. 15.8-1). This outfall would discharge in the event that the pumps failed. The discharged wastes generally consisted of diluted laboratory wastes and liquids from chilled water systems originating from operations at DP East. The wastes may have also been contaminated with tritium (Buchholz 1991), polonium and actinium (Merrill 1990), and mercury and $^{239/240}Pu$ (DOE 1989). Engineering drawings indicate that between 1968 and 1979, a 14-ft extension line was added to the bulkhead to discharge effluents further downslope (LASL 1968a; LASL 1979). In 1979, two holding tanks were added approximately 50 ft downslope from the bulkhead to store overflow (LASL 1979). These tanks are discussed in Sec. 14.3 as part of SWMU 21-004(d). Prior to 1979, the station would at times overflow to the canyon (LANL 1987). When the tanks were installed, the pipe was extended from the bulkhead into the tanks, which were erected roughly where effluent from the outfall would have gone. The area was extensively reworked to construct the pad for the tanks.

Effluent discharging from the bulkhead, and later from the 14 ft extension, would have flowed approximately 75 ft northwest to a deep channel that also drains SWMU 21-024(h). This channel leads to a drainage ditch for the east-west road on the north side of the tanks. Effluent in the ditch is discharged northward through a CMP under the road and thence to DP Canyon.

SWMU 21-024(h) (CEARP outfall 3i) discharged sewage from TA-21-151 through septic tank TA-21-163 (abandoned in place in 1966) to the surface on the north rim of DP Mesa (Fig. 15.8-1). The septic tank is constructed of reinforced concrete with dimensions of 6 ft by 14 ft by 5-ft deep. Six-in. VCP lines carry effluent from TA-21-151 to the septic tank and then to the outfall.

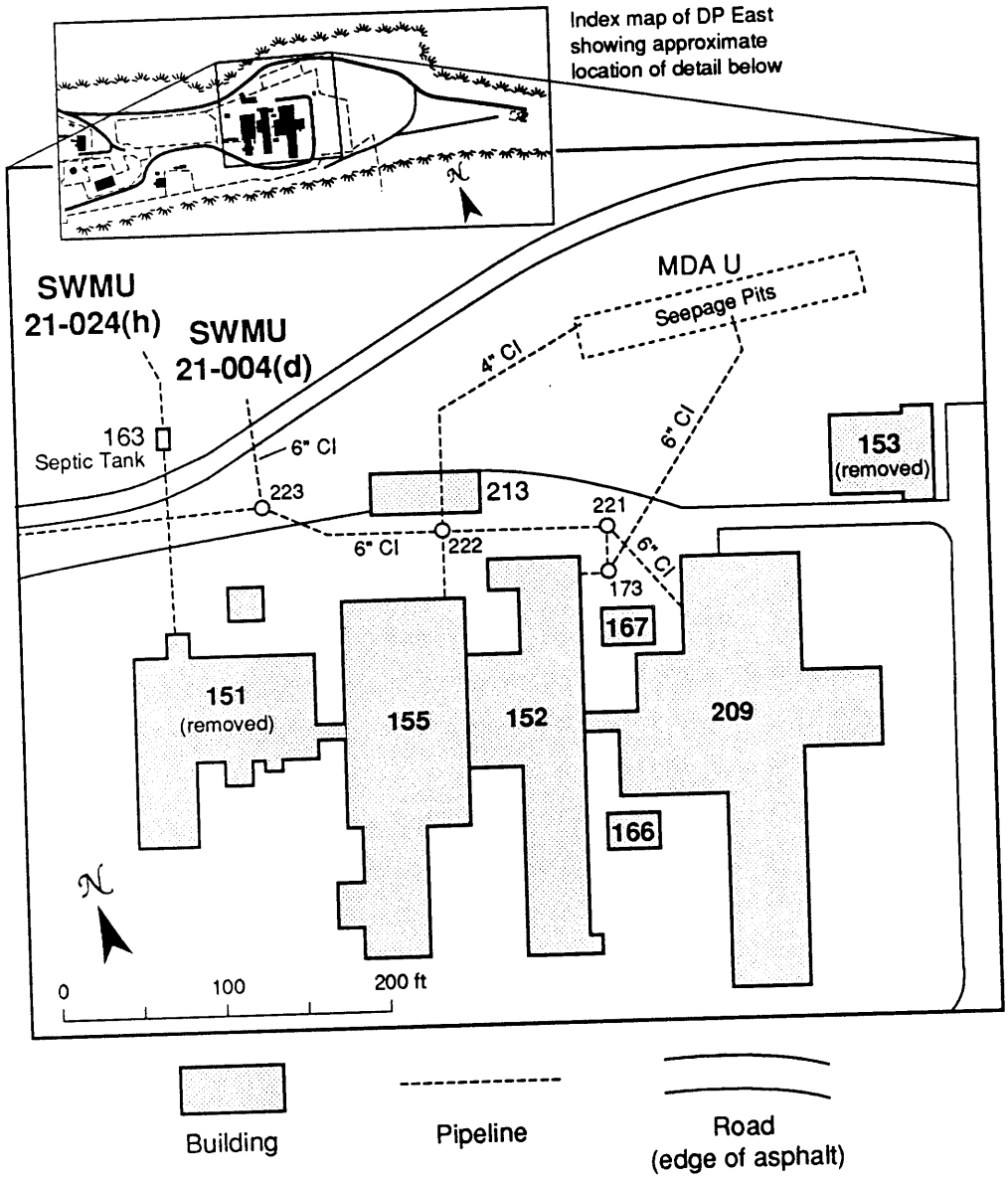


Fig. 15.8-1 Location of SWMUs 21-004(d) and 21-024(h). (LASL 1958d, 1976a)

An engineering drawing bears the notation "field check could not locate end of pipe" (LASL 1958d). And no surface expression of the pipe can be found at present. A CEARP marker was placed in the channel mentioned above, at the location LASL investigators felt was the most likely site of the outfall. This marker should be considered as only an approximate location.

15.8.1.2. Existing Information

All existing contaminant information for these outfalls was obtained from samples gathered in October 1988 as part of the ER Program reconnaissance sampling (DOE 1989a). The soil samples were analyzed according to EPA Contract Laboratory Program (CLP) Statement of Work Protocols for Target Compound List volatile organic compounds, semivolatile organic compounds, pesticides/PCBs, and Target Analyte List metals. They were also analyzed for ^{241}Am, ^{137}Cs, ^{238}Pu, $^{239/240}Pu$, ^{226}Ra, ^{90}Sr, ^{232}Th, ^{234}U, ^{235}U, ^{238}U, and tritium by the standard procedures of a commercial laboratory. The analytical results are presented in Table 15.8-I.

SWMU 21-004(d). A sample was taken from beneath the pipe extending from the bulkhead, approximately 2 ft downslope of the bulkhead. Comparing the results with the background data presented in Sec. 4.2.4 indicates above-background levels of mercury, $^{239/240}Pu$, and tritium. Also, oil and grease by gravimetric analyses were found in concentrations above the detection limit.

SWMU 21-024(h) had a grab sample taken at the junction of two channels leading away from the CEARP marker. The results show above-background level readings of ^{241}Am, tritium, and $^{239/240}Pu$, as well as oil and grease in concentrations above the detection limit.

15.8.1.3. Source Term

SWMU 21-004(d). This SWMU is associated with waste at DP East because the pipeline replaced the outfall. Therefore, the source term for this SWMU includes ^{227}Ac and organic and inorganic laboratory chemicals, as well as the contaminants identified in the sample described above.

SWMU 21-024(h) may be contaminated with tritium because of the fusion fuel research conducted at DP East, in addition to the contaminants identified in the sample described above.

15.8.2. Objectives and Data Needs

The objective of this investigation is to confirm the absence of contamination at SWMUs 21-004(d) and 21-024(b). The specific data required to assess contamination at SWMUs 21-004(d) and 21-024(h) include the following:

1. Determine the location of the septic tank TA-21-163. The location of this tank is unclear and has not been previously located.

TABLE 15.8-I
1988 OUTFALL RECONNAISSANCE SAMPLING RESULTS FOR SWMUS 21-004(d) and 21-024(h)

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x}$ + 2s
SWMU 21-004(d)	Metals				
	ALUMINUM, TOTAL	7790	MG/KG	31	65,000
	BARIUM, TOTAL	95.5	MG/KG	31	850
	CALCIUM, TOTAL	2760	MG/KG	777	—
	CHROMIUM, TOTAL	6.1	MG/KG	2.0	75
	COPPER, TOTAL	7.0	MG/KG	4.0	19
	IRON, TOTAL	7330	MG/KG	16	26,600
	LEAD, TOTAL	13.1	MG/KG	10	54
	MAGNESIUM, TOTAL	1400	MG/KG	777	4,700
	MANGANESE, TOTAL	246	MG/KG	2.0	770
	MERCURY, TOTAL	0.17	MG/KG	0	0.03
	NICKEL, TOTAL	6.6	MG/KG	6.0	18.5
	OIL & GREASE BY GRAVIMETRIC	596	MG/KG	54	—[b]
	POTASSIUM, TOTAL	1200	MG/KG	777	—
	SILVER, TOTAL	2.1	MG/KG	2.0	—
	VANADIUM, TOTAL	14.2	MG/KG	8.0	—
	ZINC, TOTAL	35.1	MG/KG	4.0	78
	Radionuclides				
	CESIUM-137	0.3	PCI/G	0.1	0.44
	PLUTONIUM-239	3.5	PCI/G	0.3	0.025
	RADIUM-226	1.3	PCI/G	0.2	2.5
	THORIUM-232	0.9	PCI/G	0.3	1.8
	TRITIUM	260	PCI/ML	10	0.0072
	URANIUM-234	1.4	PCI/G	0.2	—
	URANIUM-238	0.7	PCI/G	0.2	1.7
SWMU 21-024 (h)	Metals				
	ALUMINUM, TOTAL	2230	MG/KG	35	65,000
	CHROMIUM, TOTAL	2.4	MG/KG	2.0	75
	IRON, TOTAL	3170	MG/KG	18	26,600
	LEAD, TOTAL	8.5	MG/KG	6.0	54
	MANGANESE, TOTAL	194	MG/KG	4.0	770
	OIL & GREASE BY GRAVIMETRIC	272	MG/KG	53	—[b]
	ZINC, TOTAL	26.8	MG/KG	4.0	78

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x}$ + 2s
	Radionuclides				
	AMERICIUM	0.2	PCI/G	0.1	—
	PLUTONIUM-239	1.5	PCI/G	0.2	0.025
	RADIUM-226	1.0	PCI/G	0.1	2.5
	STRONTIUM-90	0.6	PCI/G	0.3	0.88
	THORIUM-232	0.6	PCI/G	0.2	1.8
	TRITIUM	7.0	PCI/ML	2.0	0.0072
	URANIUM-234	0.5	PCI/G	0.1	—
	URANIUM-238	0.3	PCI/G	0.1	1.7

[a] The upper limit of background was defined by Purtymun et al. (1987) as $\bar{x}$ + 2s as used in Table 4.2-XIII. For a consistent basis of comparison, the upper limit of background given here for metals is $\bar{x}$ + 2s as calculated from the data given in Table 4.2-XV.
[b] Background assumed to be zero.

2. Identify the contaminants present using Level II and III analyses at the SWMU 21-004(d) outfall area, the SWMU 21-024(h) septic tank and outfall, and the area where both systems commingle.

3. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by additional surface and near-surface sampling and Level III/IV analysis.

15.8.3. Sampling/Investigation Rationale

Before sampling begins, the location of TA-21-163 will be marked by surveying from old engineering drawings. The location of the end of the outfall line cannot be determined in this way because its location on the engineering drawings has been marked as unknown.

Appropriate soil sampling locations for both SWMUs and the commingling area will be determined using Strategy A. If Strategy A does not identify radioactively contaminated areas for sampling, Strategy B will be employed at SWMU 21-004(d), and Strategy C will be used at SWMU 21-024(h) and in the commingling area (for explanation of these strategies see Sec. 15.1.4).

The area of septic tank will be sampled by borehole coring to identify subsurface contamination resulting from leaks or overflows. Surface soil samples collected as part of OU-wide characterization (see Chapter 12) will allow assessment of local contaminant levels unrelated to releases from outfalls.

15.8.4. Sampling Plan

SWMU 21-004(d) will have a field radiological survey (see method in Sec. 11.4.2.1) performed in an area approximately 20-ft wide between the bulkhead and the roadside ditch to the north where the effluent commingles with SWMU 21-024(h) (Fig. 15.8-2).

Near-surface soil samples (see Sec. 11.5.2.4 for method) will be taken at six locations in the drainage between the bulkhead and the point where it merges with the main channel. If a definite drainage path can be established by the radiation surveys, Strategy A will be used to select sampling locations. Otherwise, Strategy B will be used with one three-location group placed below the opening of the concrete bulkhead and a second group placed halfway between the bulkhead and the roadside ditch. Each near-surface soil sampling location will be sampled to a depth of 18 in. (three 6-in. intervals), resulting in a total of 18 samples by either strategy.

Screening and analyses to be performed on the 18 samples gathered in this plan are presented in Table 15.8-II.

SWMU 21-024(h). A field radiological survey will be performed in the channel from the septic tank to the roadside ditch to the north.

Near-surface soil samples (for method see Sec. 11.5.2.4) will be taken from three locations: two in the channel and one at the commingling area in the roadside ditch. Each location will be sampled to a total depth of 18 in. (three 6-in. intervals), giving nine samples. If areas of radioactive contamination are detected, Strategy A will be used to select sampling locations. Otherwise, Strategy C sampling locations will be: a large pooling area 30 ft upstream (south) of the CEARP marker, a pooling area around the CEARP marker, and 40 ft north of the CEARP marker in the roadside ditch.

The borehole at the septic tank will be located on the south (influent) side and drilled to a nominal depth of 20 ft (see Sec. 11.5.3.2 for method), resulting in four samples (5-ft core intervals). It will be necessary to remove soil from the upper portion of the septic tank in order to provide positive identification of the drilling location (Fig. 15.8-2).

Screening and analyses to be performed on the 13 samples gathered in this plan are presented in Table 15.8-II.

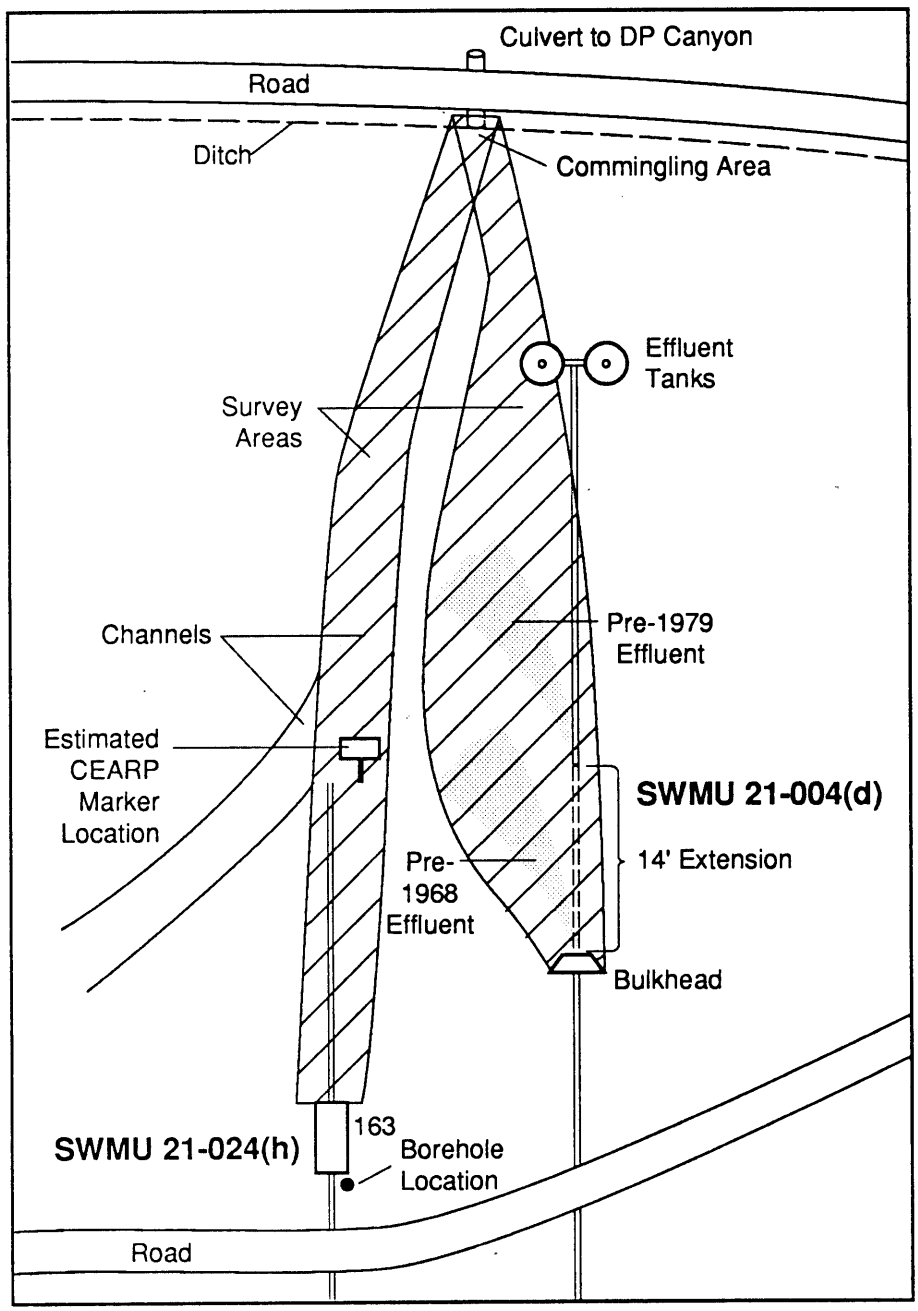


Fig. 15.8-2 SWMU 21-004(d) and SWMU 21-024(h) survey and sampling locations.

Table 15.8-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT THE SURFACE DRAINAGE NORTH OF TA-21-155.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium	
21-004(d)																																	
Survey				X																													
Near Surface Soil	1	0.0 - 6.0 in		X				X	X		X																						
		6.0 - 12.0 in						X	X		X																						
		12.0 - 18.0 in						X	X		X																						
	2	0.0 - 6.0 in						X	X		X																						
		6.0 - 12.0 in						X	X		X																						
		12.0 - 18.0 in						X	X		X																						
	3	0.0 - 6.0 in						X	X		X																						
		6.0 - 12.0 in						X	X		X																						
		12.0 - 18.0 in						X	X		X																						
	4	0.0 - 6.0 in						X	X		X																						
		6.0 - 12.0 in						X	X		X																						
		12.0 - 18.0 in						X	X		X																						
	5	0.0 - 6.0 in						X	X		X																						
		6.0 - 12.0 in						X	X		X																						
		12.0 - 18.0 in						X	X		X																						
	6	0.0 - 6.0 in						X	X		X																						
		6.0 - 12.0 in						X	X		X																						
		12.0 - 18.0 in						X	X		X																						
Field Duplicate		6.0 - 12.0 in						X	X																								
		12.0 - 18.0 in						X	X		X																						
	3	0.0 - 6.0 in						X	X		X																						
		6.0 - 12.0 in						X	X		X																						
		12.0 - 18.0 in						X	X		X																						
	4	0.0 - 6.0 in						X	X		X																						
		6.0 - 12.0 in						X	X		X																						
		12.0 - 18.0 in						X	X		X																						
	5	0.0 - 6.0 in						X	X		X																						
		6.0 - 12.0 in						X	X		X																						
		12.0 - 18.0 in						X	X		X																						
	6	0.0 - 6.0 in						X	X		X																						
		6.0 - 12.0 in						X	X		X																						
		12.0 - 18.0 in						X	X		X																						
Rinsate Blank								X	X													X	X	X	X	X	X	X	X	X	X	X	
Field Blank								X	X													X	X	X	X	X	X	X	X	X	X	X	
21-024(h)																																	
Survey				X																													

Table 15.8-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT THE SURFACE DRAINAGE NORTH OF TA-21-155.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium	
Near Surface Soil	1	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
		6.0 - 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
		12.0 - 18.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
	2	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
Field Duplicate																						X	X	X	X		X	X	X	X			X	
		6.0 - 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
		12.0 - 18.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
	3	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
		6.0 - 12.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
		12.0 - 18.0 in						X	X		X											X	X	X	X		X	X	X	X			X	
TA-21-163 Septic Tank																																		
Trench Excavation							X				X	X																						
Vertical Borehole	1	0.0 - 5.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X	
		5.0 - 10.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X	
		10.0 - 15.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X	
		15.0 - 20.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			X	
Rinsate Blank																						X	X	X	X		X	X	X	X			X	
Field Blank																												X	X	X				
Trip Blank																												X						

15.9. Special Cases

15.9.1. Site Description

15.9.1.1. Site History

SWMU 21-006(b) (CEARP identifier 3u) originates in TA-21-2 as a 3-in. acid drain line. It passes southward through sump (settling tank, acid pit) TA-21-118 and thence to Los Alamos Canyon (Fig. 15.9-1). A 2-in. steel vapor line extends southward from the sump over the canyon rim and partially down the cliff face. It ends approximately 8 ft above the land surface on the bench below.

This sump and outfall system was built to receive ether waste from the ethyl ether extraction process, which was part of the original design of the TA-21 plutonium purification process (LASL 1969). The sump is being investigated in Sec 17.2 as part of SWMU 21-006(b).

SWMU 21-024(f) (CEARP identifier 3k) discharged sewage from TA-21-45 (the safety training building) through septic tank 124 (abandoned in place in 1966) to the surface on the north rim of DP Mesa (Fig. 15.9-2). The septic tank is a 1000-gal. steel tank with 4-in.-diameter VCP lines serving it.

Currently, there is no surface expression of the septic tank. A 4-in. VCP outfalls into a shallow pit with dimensions approximately 3 ft by 3 ft by 2-ft deep. This pit may have held all discharges when the septic tank was in operation because it shows no signs of effluent ever flowing out of it. There is a broad, moderate slope to the north edge of the mesa, then a steep slope to the bottom of DP Canyon.

15.9.1.2. Existing Information

All existing contaminant information for these outfalls was obtained from samples gathered in October 1988 as part of the ER Program reconnaissance sampling (DOE 1989a). The soil samples were analyzed according to EPA Contract Laboratory Program (CLP) Statement of Work Protocols for Target Compound List volatile organic compounds, semivolatile organic compounds, pesticides/PCBs, and Target Analyte List metals. They were also analyzed for ^{241}Am, ^{137}Cs, ^{238}Pu, $^{239/240}Pu$, ^{226}Ra, ^{90}Sr, ^{232}Th, ^{234}U, ^{235}U, ^{238}U, and tritium by the standard procedures of a commercial laboratory. Analytical results are presented in Table 15.9-I.

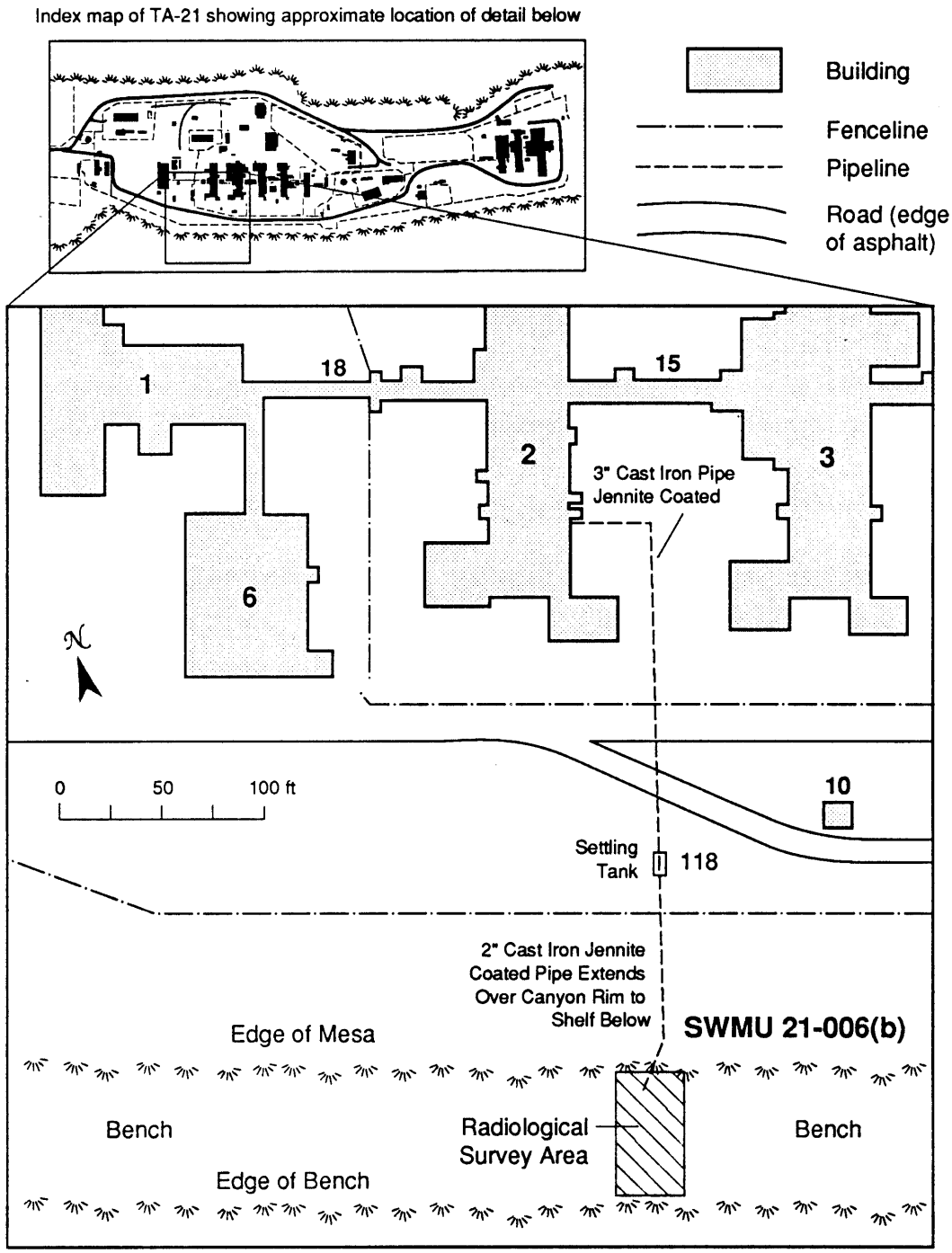


Fig. 15.9-1 Location of SWMU 21-006(b) as it appeared on the south side of Building 2 in 1961. (LASL 1961)

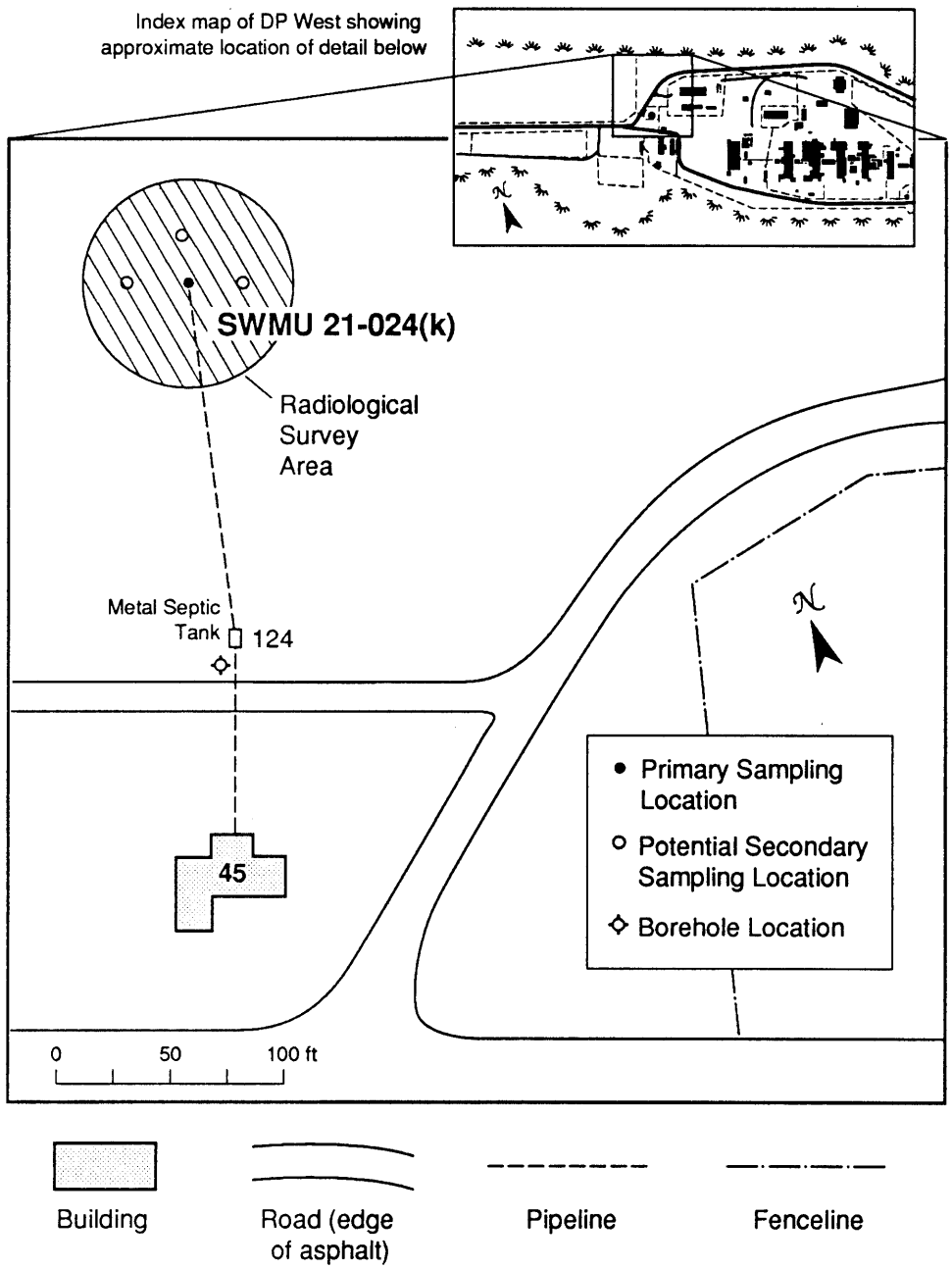


Fig. 15.9-2 Location of SWMU 21-024(k), sampling points, and radiological survey area. (LASL 1958a)

TABLE 15.9-I
1988 OUTFALL RECONNAISSANCE SAMPLING RESULTS FOR SWMUS 21-006(b) and 21-024(f)

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x}$ + 2s
	Metals				
SWMU 21-006(b)	ALUMINUM, TOTAL	3990	MG/KG	37	65,000
	BARIUM, TOTAL	48.8	MG/KG	37	850
	CALCIUM, TOTAL	1340	MG/KG	932	—
	CHROMIUM, TOTAL	6.2	MG/KG	2.0	75
	COPPER, TOTAL	7.1	MG/KG	6.0	19
	IRON, TOTAL	3560	MG/KG	19	26,600
	LEAD, TOTAL	191	MG/KG	93	54
	MANGANESE, TOTAL	137	MG/KG	4.0	770
	NICKEL, TOTAL	9.1	MG/KG	8.0	18.5
	ZINC, TOTAL	44.8	MG/KG	4.0	78
	Radionuclides				
	CESIUM-137	1.5	PCI/G	0.2	0.44
	PLUTONIUM-239	1.3	PCI/G	0.3	0.025
	RADIUM-226	1.2	PCI/G	0.2	2.5
	THORIUM-232	1.0	PCI/G	0.2	1.8
	TRITIUM	31	PCI/ML	3.0	0.0072
	URANIUM-234	1.8	PCI/G	0.3	—
	URANIUM-238	1.0	PCI/G	0.2	1.7
	Volatile Organics				
	TOLUENE	9.9	UG/KG	6	—[b]
	Metals				
SWMU 21-024 (f)	ALUMINUM, TOTAL	9750	MG/KG	37	65,000
	ARSENIC	2.2	MG/KG	2.0	7.1
	BARIUM, TOTAL	131	MG/KG	37	850
	CALCIUM, TOTAL	2130	MG/KG	914	—
	CHROMIUM, TOTAL	8.9	MG/KG	2.0	75
	COPPER, TOTAL	9.0	MG/KG	6.0	19
	IRON, TOTAL	9920	MG/KG	18	26,600
	LEAD, TOTAL	34.5	MG/KG	10	54
	MAGNESIUM, TOTAL	2150	MG/KG	914	4,700
	MERCURY, TOTAL	0.22	MG/KG	0	0.03
	NICKEL, TOTAL	12.4	MG/KG	8.0	18.5
	OIL & GREASE BY GRAVIMETRIC	257	MG/KG	56	—[b]
	POTASSIUM, TOTAL	1330	MG/KG	914	—
	VANADIUM, TOTAL	23.5	MG/KG	10	—
	ZINC, TOTAL	44.2	MG/KG	4.0	78

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x}$ + 2s
	Radionuclides				
	CESIUM-137	1.0	PCI/G	0.1	0.44
	PLUTONIUM-239	1.6	PCI/G	0.2	0.025
	RADIUM-226	1.8	PCI/G	0.2	2.5
	THORIUM-232	1.0	PCI/G	0.2	1.8
	TRITIUM	15	PCI/ML	2.0	0.0072
	URANIUM-234	1.7	PCI/G	0.4	—
	URANIUM-238	1.3	PCI/G	0.3	1.7

aThe upper limit of background was defined by Purtymun et al. (1987) as $\bar{x}$ + 2s as used in Table 4.2-XIII. For a consistent basis of comparison, the upper limit of background given here for metals is $\bar{x}$ + 2s as calculated from the data given in Table 4.2-XV.
[b]Background assumed to be zero.

SWMU 21-006(b) was sampled on the bench immediately below the outfall (DOE 1989a) (Table 15.9-I). Comparison of these results with background level data given in Sec. 4.2.4 indicates above background levels of lead, ^{137}Cs, $^{239/240}Pu$, and tritium. Toluene was found in concentrations above the detection limit.

SWMU 21-024(f). A sample was taken from the center of the pit, 4 ft 6 in. north of the CEARP marker (DOE 1989a) (Table 15.9-I). The results indicate that mercury, ^{137}Cs, $^{239/240}Pu$, and tritium are present in concentrations above background level, as well as oil and grease in concentrations greater than the detection limit.

15.9.1.3. Source Term

SWMU 21-006(b) will likely contain organics, both volatile and semivolatile, in addition to the contaminants identified in the previous sampling above, because it was originally built to receive ether waste.

SWMU 21-024(f). No evidence is available to support the selection of contaminants for the source term other than those indicated above.

15.9.2. Objectives and Data Needs

The objective of this investigation is to confirm the presence and determine the extent of contamination of SWMUs 21-006(b) and 21-024(f). The specific data required to assess contamination at SWMUs 21-006(b) and 21-01-24(f) include the following:

1. Identify the contaminants present using Level II and Level III data. This area below the vapor line at SWMU 21-006(b) may contain lead, radionuclides, and organic constituents. The pit as well as subsurface soils beneath septic tank 124 area [SWMU 21-024(f)], may contain metals, radionuclides, and organic constituents.

2. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by additional surface and near-surface sampling and Level III/IV analyses.

15.9.3. Sampling/Investigation Rationale

SWMU 21-006(b) will be investigated by soil sampling on the bench beneath the outfall of the vapor line. Surface soil samples collected as part of OU-wide characterization (see Chapter 12) will allow assessment of local contaminant levels unrelated to releases from outfalls.

SWMU 21-024(f). The location of septic tank TA-21-124 will be marked by surveying from old engineering drawings. A borehole will be drilled adjacent to the tank to determine if it has leaked contaminants into the subsurface soil. A shallow borehole will be placed in the pit at the outfall from tank TA-21-124 to determine if contaminants are present in subsurface soils. The area around the pit will be surveyed for radioactive contamination and sampled to identify contaminants in any drainage path leading from the pit. This approach will provide sufficient information on contaminant presence and depth to use as design criteria for CMS planning for septic tank removal.

15.9.4. Sampling Plan

SWMU 21-006(b). Field radiological surveys (for method see Sec. 11.4.1.2) will be performed in a 20-ft-wide area, starting directly below the vapor line and running to the edge of the bench (Fig. 15.9-1).

If Strategy A (see Sec. 15.1.4) identifies radioactively contaminated areas, six surface soil samples will be biased to those locations (for method see Sec. 11.5.2.1). Otherwise, Strategy B will be used, with one three-sample group of surface soil samples taken from directly below the

Table 15.9-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SPECIAL CASE SWMU'S.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Field Laboratory Measurements:	Field Laboratory Measurements:	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals	Laboratory Analysis: Isotopic Thorium
21-006(b)																																	
Survey				X																													
Surface Soil Samples	1	0.0 - 6.0 in						X	X		X				X	X						X	X	X	X	X	X	X	X	X	X	X	X
	2	0.0 - 6.0 in						X	X		X				X	X						X	X	X	X	X	X	X	X	X	X	X	X
	3	0.0 - 6.0 in						X	X		X				X	X						X	X	X	X	X	X	X	X	X	X	X	X
	4	0.0 - 6.0 in						X	X		X				X	X						X	X	X	X	X	X	X	X	X	X	X	X
	5	0.0 - 6.0 in						X	X		X				X	X						X	X	X	X	X	X	X	X	X	X	X	X
	6	0.0 - 6.0 in						X	X		X				X	X						X	X	X	X	X	X	X	X	X	X	X	X
21-024(f)				X																												
Survey																																
Near Surface Soil	1	0.0 - 6.0 in						X	X		X				X	X						X	X	X	X	X	X	X	X	X	X	X	X
		6.0 - 12.0 in						X	X		X				X	X						X	X	X	X	X	X	X	X	X	X	X	X
		12.0 - 18.0 in						X	X		X				X	X						X	X	X	X	X	X	X	X	X	X	X	X
		0.0 - 6.0 in						X	X						X	X						X	X	X	X	X	X	X	X	X	X	X	X
	2																																
Field Duplicate		6.0 - 12.0 in						X	X		X				X	X						X	X	X	X	X	X	X	X	X	X	X	X
		12.0 - 18.0 in						X	X		X				X	X						X	X	X	X	X	X	X	X	X	X	X	X
	3	0.0 - 6.0 in						X	X		X				X	X						X	X	X	X	X	X	X	X	X	X	X	X
		6.0 - 12.0 in						X	X		X				X	X						X	X	X	X	X	X	X	X	X	X	X	X
		12.0 - 18.0 in						X	X		X				X	X						X	X	X	X	X	X	X	X	X	X	X	X
Shallow Borehole	1	0.0 - 2.5 ft						X	X		X	X	X	X	X	X						X	X	X	X	X	X	X	X	X	X	X	X
Rinsate Blank																																	
Field Blank								X	X		X	X	X		X	X						X	X	X	X	X	X	X	X	X	X	X	X
		2.5 - 5.0 ft						X	X		X	X	X		X	X						X	X	X	X	X	X	X	X	X	X	X	X
		5.0 - 7.5 ft						X	X		X	X	X		X	X						X	X	X	X	X	X	X	X	X	X	X	X
		7.5 - 10.0 ft						X	X		X	X	X		X	X						X	X	X	X	X	X	X	X	X	X	X	X

Table 15.9–II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SPECIAL CASE SWMU'S.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys	Field Screening	Field Laboratory Measurements	Laboratory Analysis
				Gross Gamma			
				Low–Energy Gamma			
				Electromagnetic			
				Land Survey			
Vertical Borehole	1	0.0 – 5.0 ft			Gross Gamma		
		5.0 – 10.0 ft			Gross Alpha		
		10.0 – 15.0 ft					
		15.0 – 20.0 ft			Organic Vapor		
					Combustible Gas/Oxygen		
					Lithological Logging		
						Gross Alpha	
						Gamma Spectrometry	
						Tritium	
						Volatile Organics	
						PCB	
						Soil Moisture	
Field Duplicate							Gamma Spectrometry
Rinsate Blank							Tritium
Field Blank							Total Uranium
Trip Blank							Isotopic Plutonium
							Isotopic Uranium
							Strontium 90
							VOA (SW 8240)
							Semivolatiles (SW 8270)
							Metals (SW 6010)
							PCB (SW 8080)
							TCLP Metals
							Isotopic Thorium

end of the vapor line, and a second group taken in a small channel near the southern edge of the bench.

Table 15.9-II lists the screening and analyses to be performed on the six samples collected.

SWMU 21-024(f). Field radiological surveys will be performed throughout a 50-ft radius centered on the outfall pit (see Fig. 15.9-2). If a pattern of radioactive contamination is found that indicates a drainage channel, Strategy A will be used, and near-surface soil samples (for method see Sec. 11.5.2.4) will be collected at three sampling locations. If a flow pattern is not found, the three near-surface soil sampling locations will be on the east, north, and west sides of the outfall pit at a distance of 10 ft from the center (Fig. 15.9-2). In either case, each near-surface sampling location will be sampled to an 18-in. depth (three 6-in. intervals), resulting in a total of nine samples.

At the outfall pit, a shallow borehole (for method see Sec. 11.5.3.1) will be drilled to a nominal depth of 10 feet, resulting in six samples (2.5-ft core interval).

At the septic tank, a vertical borehole (see method in Sec. 11.5.3.2.) will be drilled to a nominal depth of 20 ft on the south (inlet) side, resulting in four samples (5-ft core intervals).

Table 15.9-II lists the screening and analyses to be performed on the 19 samples to be collected.

15.10. NPDES Discharge Systems

15.10.1. Site Description

There are five outfalls in this section. All are NPDES discharge systems, which have not been assigned a SWMU number. The reason for sampling these outfalls, even though they are permitted discharges, is that prior to being permitted, they may have discharged contaminants. The majority of them have not been sampled before.

15.10.1.1. Site History

EPA 02A129 (CEARP identifier 3ag) discharges from the steam plant, TA-21-357. It exits southward from the building and discharges onto DP Mesa (Fig. 15.10-1). A channel carries the effluent over the south rim of DP Mesa and into Los Alamos Canyon. According to the NPDES description (EPA 1987), it discharges boiler blowdown.

EPA 03A035 (CEARP identifier 3t) exits southward from a cooling tower in TA-21-210, the plutonium research support building. It discharges treated cooling water (EPA 1987) approximately 4 ft inside the security fence (Fig. 15.10-1). The outfall consists of an 8-in. CMP located in a bank above the interior perimeter road and flowing a small quantity of water (less that 1 gal. per minute).

Water from the outfall ponds and flows to a storm drain and then south toward the rim of DP Mesa, seeping into the ground before reaching the mesa edge. The area surrounding the outfall is a steep slope to the mesa rim, approximately 75-ft distant.

EPA 03A036 (CEARP outfall 3s) discharges to the north from cooling tower TA-21-220. The discharge point is at the security fence in a heavily vegetated channel leading down to the north perimeter road (Fig. 15.10-1). The effluent passes through a culvert into DP Canyon. A Laboratory report (LANL 1989b) indicates that the cooling tower may have been replaced by Building 151. However, an actively flowing outfall exists at the site, appearing to originate at TA-21-220. The discharge is treated cooling water (EPA 1987).

EPA 03A037 (CEARP identifiers 3b and 3v) runs south from the corridor (TA-21-314) between Buildings TA-21-3 and TA-21-4. It discharges from the bank above the interior perimeter road, inside the south security fence (Fig. 15.10-1). Effluent from the outfall pools on the north side of the road and flows through a culvert to the south rim of DP Mesa and over the cliff onto the bench above Los Alamos Canyon.

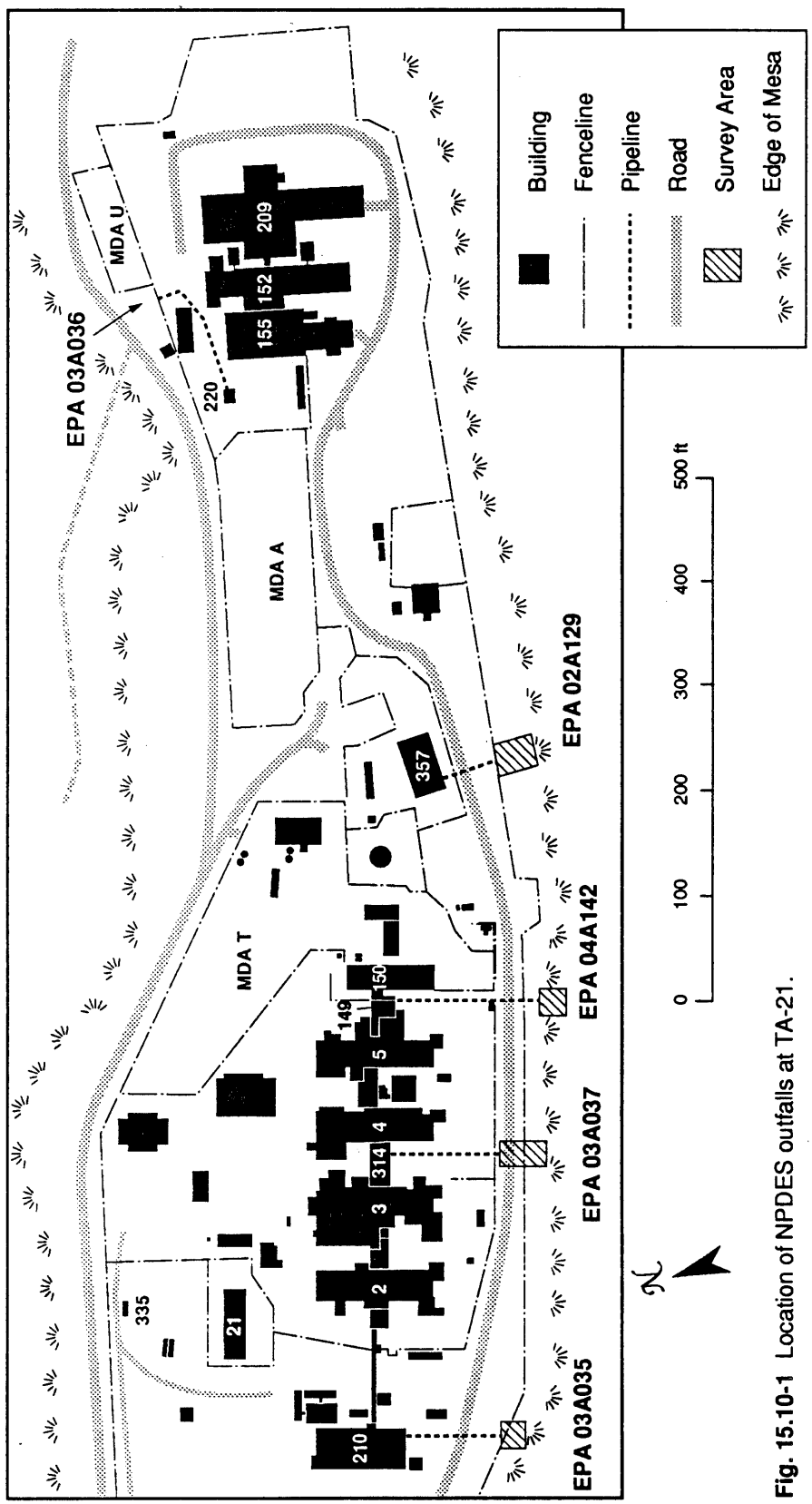


Fig. 15.10-1 Location of NPDES outfalls at TA-21.

EPA 04A142 consists of noncontact cooling water from TA-21-149, the corridor between Buildings TA-21-5 and TA-21-150. The outfall consists of an 8-in. CMP discharging to the south edge of DP Mesa with effluent running over the cliff onto the bench above Los Alamos Canyon.

15.10.1.2. Existing Information

EPA 02A129 is the only outfall in this section to have previous soil sampling performed. It was sampled as part of the 1988 reconnaissance sampling (DOE 1989a). A grab sample was taken from a precipitate-stained pool below the canyon rim. Results of analyses are shown in Table 15.10-I. Comparing these results to Sec. 4.2.4 indicates above background levels of $^{239/240}Pu$, tritium, and ^{235}U.

15.10.1.3. Source Term

EPA 02A129 may be contaminated with fuel oil from the boiler and common boiler blowdown constituents, such as sulfite and copper salts in addition to the plutonium, tritium, and uranium previously identified.

EPA 03A035 could potentially be contaminated with plutonium, uranium, various metals, and organic and inorganic lab chemicals because it is associated with the plutonium research support building.

EPA 03A036. No information is available to support the selection of a source term.

EPA 03A037 has a potential source term, which includes plutonium, uranium, mercury, lead, and organic solvents because it is connected to a corridor that is associated with plutonium processing.

EPA 04A142 may potentially be contaminated with plutonium, uranium, mercury, lead, and organics because it is connected to a structure that is associated with plutonium processing.

15.10.2. Objectives and Data Needs

The objective of this investigation is to confirm the absence of contaminants from previous discharges at NPDES discharge systems. The specific data required to assess contamination at the NPDES discharge systems include the following:

1. Identify the contaminants present using Level II and III data for the NPDES discharge system sites. Only EPA 02A129 indicates radionuclide contamination.

TABLE 15.10-I
1988 OUTFALL RECONNAISSANCE SAMPLING RESULTS FOR
NPDES OUTFALL EPA 02A129

OUTFALL	CONSTITUENT	CONCENTRATION	UNITS	DETECTION LIMIT	UPPER LIMIT[c] OF BACKGROUND $\bar{x}$ + 2s
	Metals				
EPA 02A129	ALUMINUM, TOTAL	1530	MG/KG	43	65,000
	IRON, TOTAL	1520	MG/KG	22	26,000
	LEAD, TOTAL	11.6	MG/KG	10	54
	MANGANESE, TOTAL	89.2	MG/KG	4.0	770
	NICKEL, TOTAL	14.0	MG/KG	10	18.5
	OIL & GREASE BY GRAVIMETRIC	82.1	MG/KG	55	—[b]
	SODIUM, TOTAL	1600	MG/KG	1070	—
	ZINC, TOTAL	39.6	MG/KG	4.0	78
	Radionuclides				
	CESIUM-137	0.4	PCI/G	0.1	0.44
	PLUTONIUM-239	0.2	PCI/G	0.1	0.025
	RADIUM-226	1.6	PCI/G	0.2	2.5
	STRONTIUM-90	0.2	PCI/G	0.1	0.88
	THORIUM-232	1.5	PCI/G	0.2	1.8
	TRITIUM	8	PCI/ML	3.0	0.0072
	URANIUM-234	1.0	PCI/G	0.2	—
	URANIUM-238	1.0	PCI/G	0.2	1.7

[a]The upper limit of background was defined by Purtymun et al. (1987) as $\bar{x}$ + 2s as used in Table 4.2 -XIII. For a consistent basis of comparison, the upper limit of background given here for metals is $\bar{x}$ + 2s as calculated from the data given in Table 4.2-XV.
[b]Background assumed to be zero.

2. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by additional surface and near-surface sampling and Level III/IV analyses.

15.10.3. Sampling/Investigation Rationale

Field radiological surveys will be performed at each outfall. If these surveys detect contaminants in the channel, Strategy A will be used to determine biased soil sampling locations. Otherwise, Strategy C will be used to sample the channels. For a complete description of these strategies, see Sec. 15.1.4. Surface soil samples collected as part of OU-wide characterization (see Chapter 12) will allow assessment of local contaminant levels unrelated to releases from outfalls.

15.10.4. Sampling Plan

Field radiological surveys will be performed according to the method in Sec. 11.4.1.2. Table 15.10-II lists the analytical procedures to be performed at each of the outfalls.

EPA 02A129 will be surveyed for radioactivity in an area 10-ft wide, along the channel, between the outfall and the mesa edge.

Near-surface soil samples will be taken from two locations according to Strategy A, if possible (see Sec. 11.5.2.4 for method). Otherwise, Strategy C will be used, with one location at the pool under the outfall mouth and the second 15 ft south of the security fence in the effluent channel. The near-surface soil samples will be taken to an 18-in. depth (three 6-in. intervals), resulting in six samples by either strategy.

EPA 03A035 will be surveyed for radioactivity along the effluent channel between the outfall and the mesa edge.

Near-surface sampling will be performed to a depth of 18 in. (three 6-in. intervals) at two locations for a total of six samples (see Sec. 11.5.2.4 for method). Strategy A will be used if the field radiological survey identifies contaminated areas. Under Strategy C, sampling locations will be at the outfall mouth and at a pool 6 ft south of the security fence.

EPA 03A036 will be surveyed for radioactivity along the channel. Sampling location will be selected based on Strategy A if possible, although the generally wet conditions in this channel will reduce the effectiveness of these surveys. Otherwise, Strategy C will be used to obtain near-surface samples from two locations (for method see Sec. 11.5.2.4). A depth of 18 in. will be sampled at each location (three 6-in. intervals), resulting in a total of six samples. Under Strategy

Table 15.10-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT NPDES DISCHARGE SYSTEMS.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium	
EPA 02A129																																		
Survey				X	X																													
Near Surface Soil	1	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
		6.0 - 12.0 in						X	X		X											X	X	X	X		X	X	X	X				
		12.0 - 18.0 in						X	X		X											X	X	X	X		X	X	X	X				
	2	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
		6.0 - 12.0 in						X	X		X											X	X	X	X		X	X	X	X				
		12.0 - 18.0 in						X	X		X											X	X	X	X		X	X	X	X				
EPA 03A035																																		
Survey				X	X																													
Near Surface Soil	1	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
		6.0 - 12.0 in						X	X		X											X	X	X	X		X	X	X	X				
		12.0 - 18.0 in						X	X		X											X	X	X	X		X	X	X	X				
	2	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
		6.0 - 12.0 in						X	X		X											X	X	X	X		X	X	X	X				
		12.0 - 18.0 in						X	X		X											X	X	X	X		X	X	X	X				
EPA 03A036																																		
Near Surface Soil	1	0.0 - 6.0 in		X	X			X	X		X											X	X	X	X		X	X	X	X				
		6.0 - 12.0 in						X	X		X											X	X	X	X		X	X	X	X				
		12.0 - 18.0 in						X	X		X											X	X	X	X		X	X	X	X				
	2	0.0 - 6.0 in						X	X		X											X	X	X	X		X	X	X	X				
		6.0 - 12.0 in						X	X		X											X	X	X	X		X	X	X	X				
		12.0 - 18.0 in						X	X		X											X	X	X	X		X	X	X	X				

Table 15.10–II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT NPDES DISCHARGE SYSTEMS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low–Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Field Laboratory Measurements:	Field Laboratory Measurements:	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals	Laboratory Analysis: Isotopic Thorium	
EPA 03A037																																			
Survey				X	X																														
Near Surface Soil	1	0.0 – 6.0 in						X	X		X											X	X	X	X	X	X	X	X						
		6.0 – 12.0 in						X	X		X											X	X	X	X	X	X	X	X						
		12.0 – 18.0 in						X	X		X											X	X	X	X	X	X	X	X						
	2	0.0 – 6.0 in						X	X		X											X	X	X	X	X	X	X	X						
Field Duplicate		6.0 – 12.0 in						X	X		X											X	X	X	X	X	X	X	X						
		12.0 – 18.0 in						X	X		X											X	X	X	X	X	X	X	X						
EPA 04A142																																			
Survey				X	X																														
Near Surface Soil	1	0.0 – 6.0 in						X	X		X											X	X	X	X	X	X	X	X						
		6.0 – 12.0 in						X	X		X											X	X	X	X	X	X	X	X						
		12.0 – 18.0 in						X	X		X											X	X	X	X	X	X	X	X						
	2	0.0 – 6.0 in						X	X		X											X	X	X	X	X	X	X	X						
Rinsate Blank								X	X		X											X	X	X	X	X	X	X	X						
Field Blank		6.0 – 12.0 in						X	X		X											X	X	X	X	X	X	X	X						
		12.0 – 18.0 in						X	X		X											X	X	X	X	X	X	X	X						
Trip Blank																																			

C, the first sample location will be at the outfall mouth and the second will be at the culvert entrance on the south side of the perimeter road.

EPA 03A037. A field radiological survey will be conducted in an area 10-ft wide along the channel between the outfall and the mesa edge.

Using Strategy A, near-surface samples will be taken at two locations selected on the basis of radioactive contamination (for method see Sec. 11.5.2.4). A depth of 18 in. will be sampled at each location (three 6-in. intervals), giving a total of six samples. If Strategy A cannot be used, these samples will be taken from the pool at the outfall mouth and at the small pooling area near the mesa edge, according to Strategy C.

EPA 04A142 will be surveyed for radioactivity at the outfall and on the bench directly below the outfall.

Eighteen-inch deep near-surface soil sampling will be performed at two locations, producing six samples (see Sec. 11.5.2.4 for method). Strategy A will be used, if possible. If Strategy C is used, the first location will be from below the outfall mouth, and the second will be on the bench directly below the outfall.

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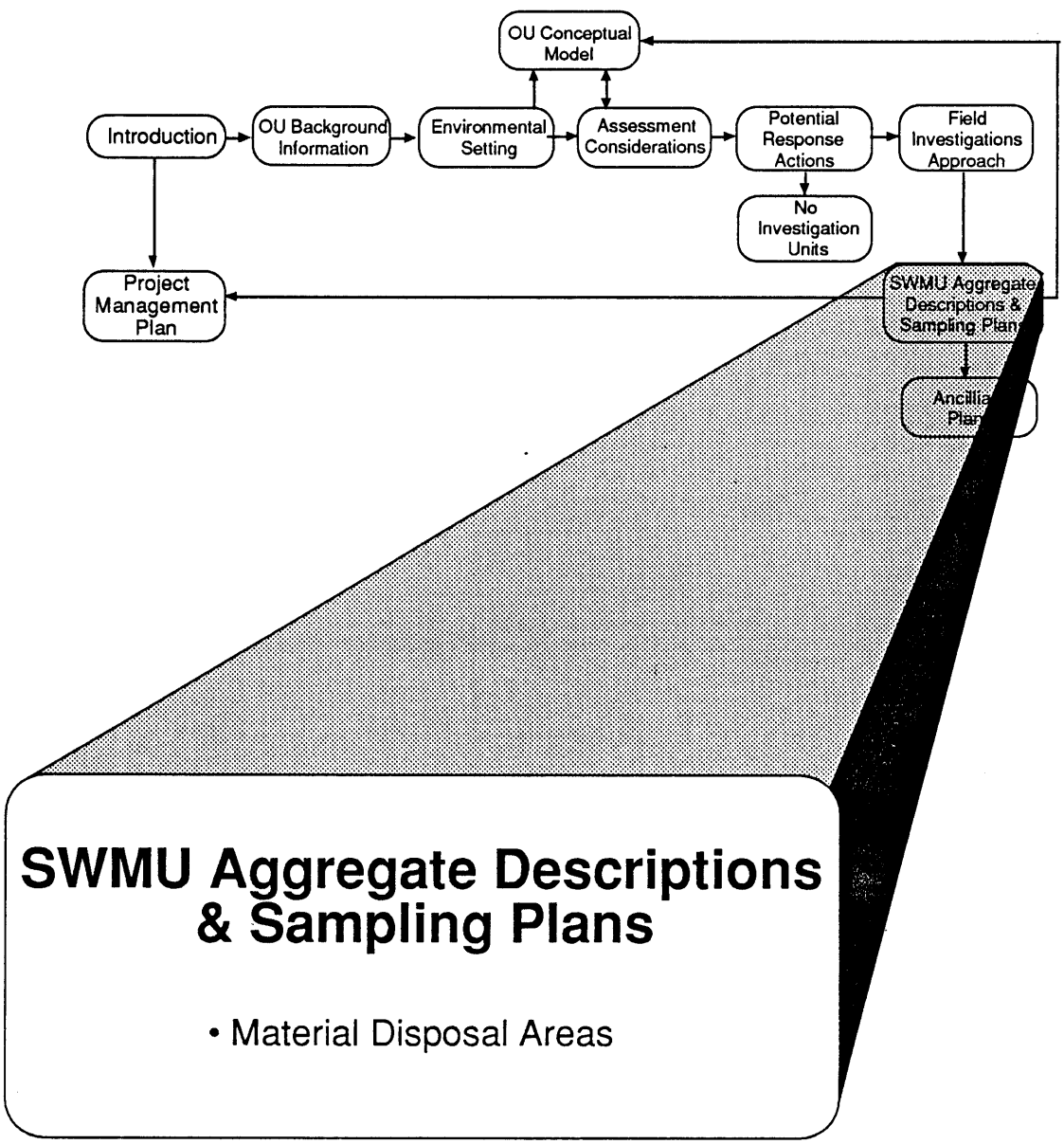
Purtymun, W. D., R. J. Peters, T. E. Buhl, M. N. Maes, and F. H. Brown, November 1987. "Background Concentrations of Radionuclides in Soils and River Sediments in Northern New Mexico, 1974-1986," Los Alamos National Laboratory Report LA-11134-MS, Los Alamos, New Mexico.

CHAPTER 16


OU Conceptual Model
Introduction
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Ancillia
Plan
SWMU Aggregate Descriptions & Sampling Plans
• Material Disposal Areas

16.1 INTRODUCTION

This chapter addresses the five material disposal areas at TA-21 (MDAs A, B, T, U, and V) and associated structures (see Fig. 16.1-1). In this chapter, tables and figures are located at the end of each section. Initially, these MDAs were used for disposal of solid and liquid wastes generated from plutonium-processing operations at DP West and initiator production at DP East (see Table 3.2-I). Later, the nature of waste disposal activities at certain MDAs, such as MDAs T and A, changed dramatically, as detailed in Table 16.1-I. For example, early waste disposal at MDA A was of plutonium-processing liquid wastes in below-ground tanks; however, in the late 1960s, a pit at MDA A was used for solid waste disposal of radioactively contaminated building D&D waste.

Two treatment plants used to treat effluent prior to its release to MDA T, Buildings 35 and 257, are addressed in conjunction with MDA T. They are included with MDA T because of their proximity and their effect on waste disposal at MDA T. Table 16.1-II briefly describes the regulated units addressed in this chapter.

Also in this chapter, a detailed surface and subsurface field sampling plan is described for each MDA. This introduction summarizes the rationale guiding the development of the sampling plans and describes the sampling approaches for surface, geomorphic, and subsurface sampling. Sampling to be repeated for each MDA is described in this section and not repeated in the sampling plan for each MDA.

Potential migration pathways at TA-21 SWMUs are discussed in Chapter 5. Surface and subsurface soil are the contaminated media for all of the MDAs. The identified potential contaminant migration pathway for all of the MDAs include infiltration, vapor phase movement, and erosive exposure of waste. Exposure routes and potential receptors for each environmental transport pathway are identified in Chapter 6.

The criteria for potential response actions at TA-21 SWMUs are discussed in Chapter 10. Preliminary remedial alternatives that are identified for all of the MDAs include monitoring, capping-in-place, treatment, removal and disposal, and removal and treatment.

The strategy for the field investigations at the MDAs is summarized in flow charts and tables. Figure 16.1-2 presents a summary of the field investigations for the solid waste MDAs (A and B), and Fig. 16.1-3 presents a summary of the field investigations for the liquid waste MDAs (MDA T, U, and V). Field measurements and laboratory analyses for each MDA are summarized in Tables

16.1-III through 16.1-VI. Methods for field measurements and laboratory analyses are presented in Chapter 11. Table 16.1-VII summarizes the geohydrological analyses for Chapter 16 and Table 16.1-VIII summarizes all investigation types by borehole sampling interval.

16.1.1 Sampling Rationale

Because one of the primary potential remedial alternatives to be evaluated for all MDAs is passive remediation through *in situ* stabilization with capping-in-place, the emphasis of all MDA characterization is on whether and how waste is migrating and not on source term definition. However, source term characterization will occur for those MDAs that received liquid waste because contaminant transport has been demonstrated at these sites.

Both because the major activity at most MDAs occurred in the 1940s (see Table 16.1-I) and because previous surface and subsurface studies have been conducted at most MDAs, we can confirm previous findings and evaluate the migration that has occurred over time to the present. For example, MDA B has not been used since 1952; therefore, we can evaluate if any waste has migrated beyond the site in the past 40 years. We can place boreholes near boreholes drilled in 1966 to evaluate migration away from MDA B, to find out whether results have changed in time. At MDA T, by placing boreholes near the 30-m boreholes that were drilled into absorption beds in 1978, we can evaluate if any migration has occurred in the past 13 years.

Because most MDAs were stabilized and capped in the mid-1980s, comparison of contamination data from past surveys with current data may show if migration of contaminants via surface run-off is taking place.

16.1.2 Surface and Subsurface Sampling Objectives

The primary objective for surface and subsurface characterization for all five MDAs is to determine if contaminants are migrating from the MDAs. The resulting data needs are described for each SWMU later in this chapter. Transport mechanisms and pathways for migration include surface erosion and lateral and vertical subsurface migration. The characterization objective yields the following sampling objectives:

1. Detect and identify contaminants.
2. Determine the vertical and lateral distribution of contaminants.
3. Identify potential contaminant transport pathways on the surface and in the upper part of the vadose zone.

4. Identify the lithologic, chemical, and mineralogic properties of rock that may affect contaminant migration.

5. Determine the geologic stability of each MDA, particularly with respect to erosion.

6. Collect geologic and hydrologic data to support transport model calculations.

16.1.3. Surface Sampling Approach

MDA surface sampling will be evaluated in conjunction with two OU-wide investigations, surface sampling on a 40- by 40-m grid, and erosional drainage channel evaluation. Both are discussed in Chapter 12. MDA surface sampling results will also be evaluated in the context of MDA-specific erosion-feature sampling discussed in Sec. 16.1.4.

Sequential surface sampling plans will be used in conjunction with spatial prediction techniques such as kriging to achieve surface sampling goals of

- detecting and identifying contaminants;
- determining the lateral distribution of contaminants; and
- identifying potential contaminant transport pathways on the surface.

Sequential sampling involves selecting two or more samples in stages. The results of measurements on the initial investigation sample are used to guide the selection of the second-stage sample. The rationale and advantages of sequential sampling are discussed in Appendix H of the IWP.

Because spatial prediction surfaces such as kriging surfaces will be used for characterization of the MDAs, the goals of the initial investigation samples are to collect data for

- constructing a model relating the observed outcome variables to the outcomes for unobserved units;
- predicting the unobserved units using the model; and
- estimating the prediction errors for these units.

In general, the model will consist of a trend component and a correlation component. The usual method for using this model for prediction is called best linear unbiased prediction (BLUP), but in much of the geostatistical literature this method is called "kriging."

If preliminary predictions and/or prediction uncertainties are deemed inadequate for the site characterization, then a second-stage sample will be taken. Adequacy will be based on the level of uncertainty acceptable for adequately characterizing migration (including transport parameters and their uncertainty) and erosion patterns, making comparisons to action levels, or evaluating impacts such as human health risks (see Chapter 11).

The number and locations of additional samples to be taken will depend on the results of the initial investigation sample predictions. For example, if it is apparent that some areas of the site will require remediation, the subsequent investigation(s) can be devoted to confirming low predictions, so that unnecessary remediation can be avoided with sufficient confidence for the risk assessment. On the other hand, if the bulk of the site appears to be in satisfactory condition, the subsequent investigation may be devoted largely to more detailed characterization of apparent "hot spots" to determine precisely the extent of remediation required. Another possibility is that in the subsequent investigation, it will only be necessary to take a systematic "infill" sample to reduce prediction errors.

Developing appropriate spatial prediction surfaces requires understanding the nonsampling component of variability (measurement error), as well as the naturally occurring local variability. This requirement motivates split and replicate sampling. Split samples are duplicates, two or more samples taken from the same sampling point. These split samples allow estimation of measurement error. Replicate samples are taken at closely spaced points and permit estimation of local variability thus providing better estimation of the spatial correlation needed for the prediction model.

The initial investigation samples for all MDAs will consist of grid samples augmented with off-grid samples to allow an estimate of spatial variability and radiation surveys between grid points. The surface sampling will be conducted inside and outside the fence at each MDA to the mesa edge. The objective of sampling inside the MDA fence is to evaluate the effectiveness of past MDA capping efforts and to confirm the absence of surface contamination at the present time. The sampling outside the MDA fence will identify the presence of contaminants which may be subject to continuing dispersal. The objective of radioactive screening using Level I/II instruments within the gridded area is to identify any areas of elevated radioactivity between grid points. Additional samples will be taken to characterize any such areas detected.

MDAs A, B, and V were sampled in October 1990. Samples were taken on 10-m grids with replicates 3 m apart inside the fence of each MDA. These data will be evaluated in combination with the general surface grid sampling data (Sec. 12.4) and with the sampling of sediment

deposition areas (Sec. 16.1.4). MDAs A and B will be sampled on 20- by 20-m grids outside the MDA fences. MDA V will not be sampled in the initial investigation.

Because MDAs T and U have not been extensively surface-sampled recently, the initial investigation samples for MDAs T and U consist of 20- by 20-m and 10- by 10-m grids, respectively, both inside the MDAs and outside the fence extending to DP canyon. The sample points outside the MDAs will be coordinated with the surface grid sampling plan (Sec. 12.4) and the sampling of sediment deposition areas (Sec. 16.1.4). Ten replicate samples will be taken at each MDA.

16.1.3.1 Contaminant Analysis on Soil Samples

Generally, all surface samples will be analyzed for the full suite of contaminants, except volatile organic compounds. The analytical laboratory analyses will include radionuclide, metals, and semivolatiles, as detailed in analytical tables in field sampling plans in later sections of this chapter. In any subsequent sampling, a reduced analytical suite may be used, based on the initial results.

16.1.4. Detailed Drainage Sampling

Geomorphic characterization of each MDA (following the Geomorphic Characterization SOP) will involve preparation of a 1:500 scale map of surficial deposits and landforms extending from the site downslope into the adjacent canyon. The mapping will identify erosional features including rills, gullies, major drainage channels, sites of seepage erosion, rockfall, and landsliding. In conjunction with results of surface grid sampling inside and outside MDA fences to the edge of the mesa top, geomorphic mapping will be used both to evaluate the erosional stability of the ground surface in each MDA and to evaluate potential compromise to the integrity of each site by erosional and mass-wasting processes. The geomorphic studies described in this section are not repeated in the sampling plans for each MDA given later in this chapter.

As a complement to the surface sampling in grids, more detailed sampling of sediment along drainage channels will be undertaken because the drainage channels are the most probable offsite transport pathway for contaminants. This topographically based surface sampling will follow identification of drainage channels and local sediment storage sites in the geomorphic characterization activities (Sec. 12.3.3) and MDA-specific geomorphic characterization described in the above paragraph. The initial investigation of this sampling will be along the primary drainage channels on canyon walls on each side of DP Mesa and along minor channels directly

draining the MDAs. Subsequent sampling, if needed, will be focused on upslope branches of the channels in an attempt to identify the source and define the extent of contamination.

Near-surface soil samples will be collected from the first 18 in. of sediment. At sites where the geomorphic characterization suggests significant recent deposition of sediment, additional samples may be collected at depth to determine if sediments with a higher level of contamination have been buried. The appropriate depth and number of samples needed to characterize sites of active sediment accumulation will be based on local site characteristics.

It is assumed that five drainages will be sampled at each MDA, at three 6-in. depth increments for a total of 15 samples per MDA. These samples will be analyzed in an analytical laboratory for radionuclides, semivolatiles, and metals as detailed in Table 16.1-IX. The drainage sample analyses are not repeated in the sampling plans for each MDA given later in this chapter.

16.1.5 Subsurface Sampling Approach

A staged drilling approach will be used to characterize subsurface contamination at the MDAs. The configuration and number of drill holes for the initial investigation differ significantly between solid waste MDAs (A and B) and liquid waste MDAs (T, U, and V) because of the different contaminant characteristics for these two types of sites. This section also describes borehole geophysics, geochemical parameter determination and mineralogic data that will be collected from boreholes at MDAs.

16.1.5.1 Solid Waste MDAs

The solid waste MDAs (A and B) are landfills where the nature of the solid waste is highly heterogeneous and where the addition of liquid waste was minimal. Existing data suggest that contaminant migration is not a significant problem at the solid waste MDAs because of the dry conditions in these landfills and because of the arid conditions of the site. Therefore, source term characterization may not be necessary at these MDAs if drilling beside and beneath the site demonstrates that contaminants are not migrating from the landfill pits. If contaminants are not migrating, the most likely remedial action will be to cap the site and monitor for future releases. Based on these objectives, the initial phase of drilling at the solid waste MDAs is designed to systematically survey the site for the presence of contamination adjacent to and beneath the solid waste pits. Sample locations were chosen based on existing information. The sample locations were those locations determined to have the greatest probability of detecting a migration plume if such a plume exists. Hydrogeological data, including vertical fracture information, will also be collected

from these shallow angle holes. This information will be used in conjunction with computer transport models to determine the potential for preferential pathway transport.

Subsequent investigations, including the need to collect source term information for the solid waste disposal beds, will be based on results from the initial investigation. For example, at solid waste areas, if initial drilling shows that waste has migrated away from the MDA, subsequent holes may be required for source term characterization and to determine the lateral and vertical extent of contaminant migration. Should such holes be necessary at MDA A, previous geophysics studies (Gerety et al. 1989) can guide borehole placement. However, as detailed in Sec. 16.3, the number of pits and trenches at MDA B is uncertain. Therefore, a geophysical investigation may be required prior to placement of any source term characterization boreholes.

16.1.5.2 Liquid Waste MDAs

The approach for characterizing contaminants at the liquid waste MDAs T, U, and V is based on previous studies that indicate that contaminant transport occurred in the past at these three sites. Source term characterization is necessary for the transport modelling required for these sites. The initial investigation is limited to drilling source term characterization holes in the absorption beds. These drill holes are intended to fully penetrate the contaminant plume. Because they penetrate the zones of greatest contamination, these source term holes will be analyzed for a full analytical suite in an effort to identify contaminants of concern. Additionally, one hole at each liquid MDA (T,U, and V), will be extended 50 ft below the contamination plume. Samples from the additional 50 ft will document conditions below the contaminant plume and may allow a comparison to rock properties within the plume to determine if the passage of the plume has altered rock properties.

A subsequent investigation will be required to define the extent of migration from each liquid MDA. The initial investigation results will be used to define the location and appropriate drilling angle for subsequent investigation core holes beneath each MDA. Evaluation of analytical results from the initial sampling may allow a reduced analytical suite to be used in subsequent holes.

16.1.5.3 Borehole Drilling Method

Drilling equipment used to characterize the MDAs may include both hollow-stem augers and rotary core drills (using Hollow-Stem Auger and Air Rotary Drilling SOPs). Core samples collected during the drilling operation will be used to detect contaminant migration away from absorption beds, disposal pits, and buried storage tanks. Continuous coring will provide samples

for characterizing contaminant plumes and for conducting characterization of physical and chemical transport mechanisms. These holes will be dry-cored to minimize possible mobilization of contaminants by drilling fluids and to minimize disturbance of the natural saturation conditions in the tuff. The borehole depth stopping criteria (see Sec. 11.5.3) will be defined by the depth of contaminant plumes as determined by field laboratory sample analysis. As described in Sec. 11.5.3, coring will continue for two 5-ft intervals once field laboratory measurements cease to detect contaminants. Drill core not used for analytical samples will be archived for the duration of the RFI. Holes will be completed and abandoned according to the drilling SOP.

16.1.5.4 Borehole Lithologic Logging

Logs describing lithologic changes with depth, stratigraphic contacts, alteration features, welding characteristics, color, and phenocryst and lithic contents will be prepared for all MDA drill holes. The lithologic log will include descriptions of fracture density, the occurrence of fracture-lining minerals, and the dip of fractures. Following the immediate removal of samples for volatile compounds, lithologic logs will be prepared and the drill core photographed in color before cores are sampled for remaining contaminant analysis. This will ensure that a complete lithologic description of the drill core is available for characterization of the site and for the permanent record of studies at TA-21. The geophysical and lithologic logging described in this section is not repeated in individual MDA sampling plans given later in this chapter.

16.1.5.5 Liquid Waste MDA Hydrogeological Characterization and Geophysical Logging Boreholes

In addition to the five general hydrogeologic characterization boreholes detailed in Sec. 12.5, one 300-ft vertical borehole will be drilled at each liquid waste MDA (T,U, and V) for similar characterization. Investigations in each borehole will include hydrogeological and geochemical analyses, pore gas sampling, and geophysical logging using the methods detailed in Sec. 12.5.1. Tables detailing these investigations and the radiological and chemical analytical requirements for each borehole are given in Sec. 12.5.1.

16.1.5.6 Soil Moisture Determination

Characterization of the vertical variation in moisture content is an important parameter for evaluating transport of contaminants. Other investigations at the Laboratory have determined that moisture content can vary greatly over a short vertical distance. Therefore, core samples for

gravimetric moisture content determination will be collected at 5-ft intervals on all initial investigation MDA boreholes.

16.1.5.7 Geochemical and Mineralogic Characterization of Core Samples

For all MDA initial investigation boreholes, mineralogic and geochemical data will be collected, using established SOPs for laboratory tests, as detailed in Sec. 12.5.1.5 and in hydrogeological tables for each MDA in this chapter. Specific sampling locations will be guided by lithological logging, so all hydrostratigraphic units present in a borehole are sampled. Additionally, contaminated zones will be sampled. Both systematic sampling at 20-ft intervals and selective sampling in contaminated zones to define the geochemical parameters associated with particular contaminants will be conducted.

Mineralogic data will be collected for matrix and fracture-lining minerals; emphasis will be placed on characterizing mineralogic controls on contaminant distribution and on identifying zones of smectites, zeolites, and iron-manganese oxides. These samples will be used to map vertical and lateral changes in mineralogy as a function of lithology and to characterize zones of contaminant accumulation. Data from mineralogic studies at the MDAs will also be used to identify potential migration pathways and to assess the natural retardation potential of tuffs.

Fracture-lining minerals commonly differ significantly from those found in the rock matrix and provide direct evidence of groundwater flow in fractures in the vadose zone. The number and distribution of samples for the characterization of fracture-lining minerals are dependent on the number and nature of fractures encountered during drilling; samples appropriate for characterization will be identified after inspection of the drill core. A contingency of five fracture samples per borehole is detailed in the geohydrologic tables for each MDA.

16.1.5.8 Contaminant Analysis on Core

Generally, in all initial investigations, the full suite of analyses (radionuclides, metals, VOAs, semivolatiles) will be conducted on all core samples. If a fracture is encountered within a 5-ft sampling interval, two samples will be taken from that sampling interval to allow a comparison of analytical results for rock and the fractured material.

In any subsequent sampling, a reduced analytical suite will be used, based on an assessment of the results from the initial investigation.

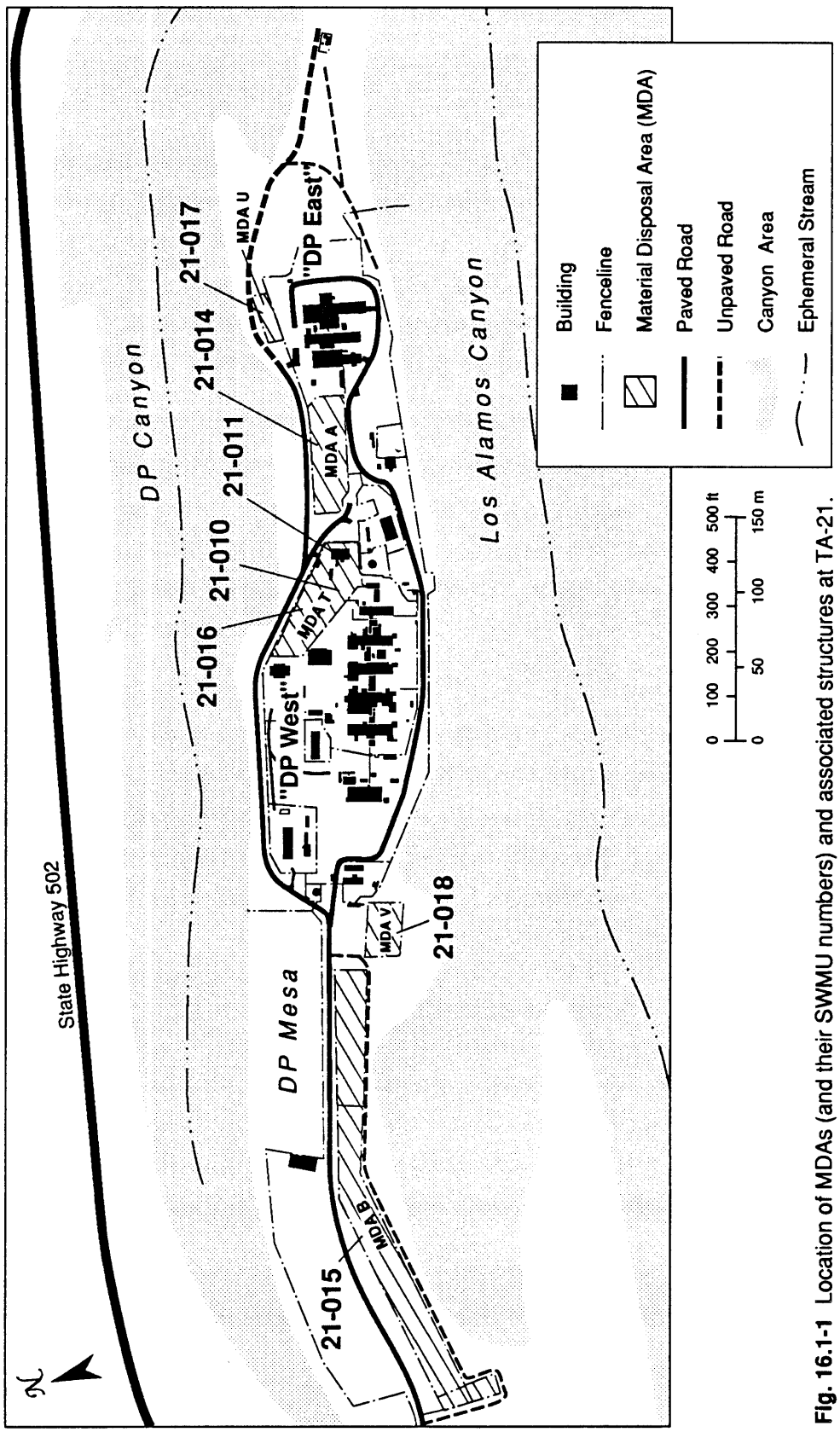


Fig. 16.1-1 Location of MDAs (and their SWMU numbers) and associated structures at TA-21.

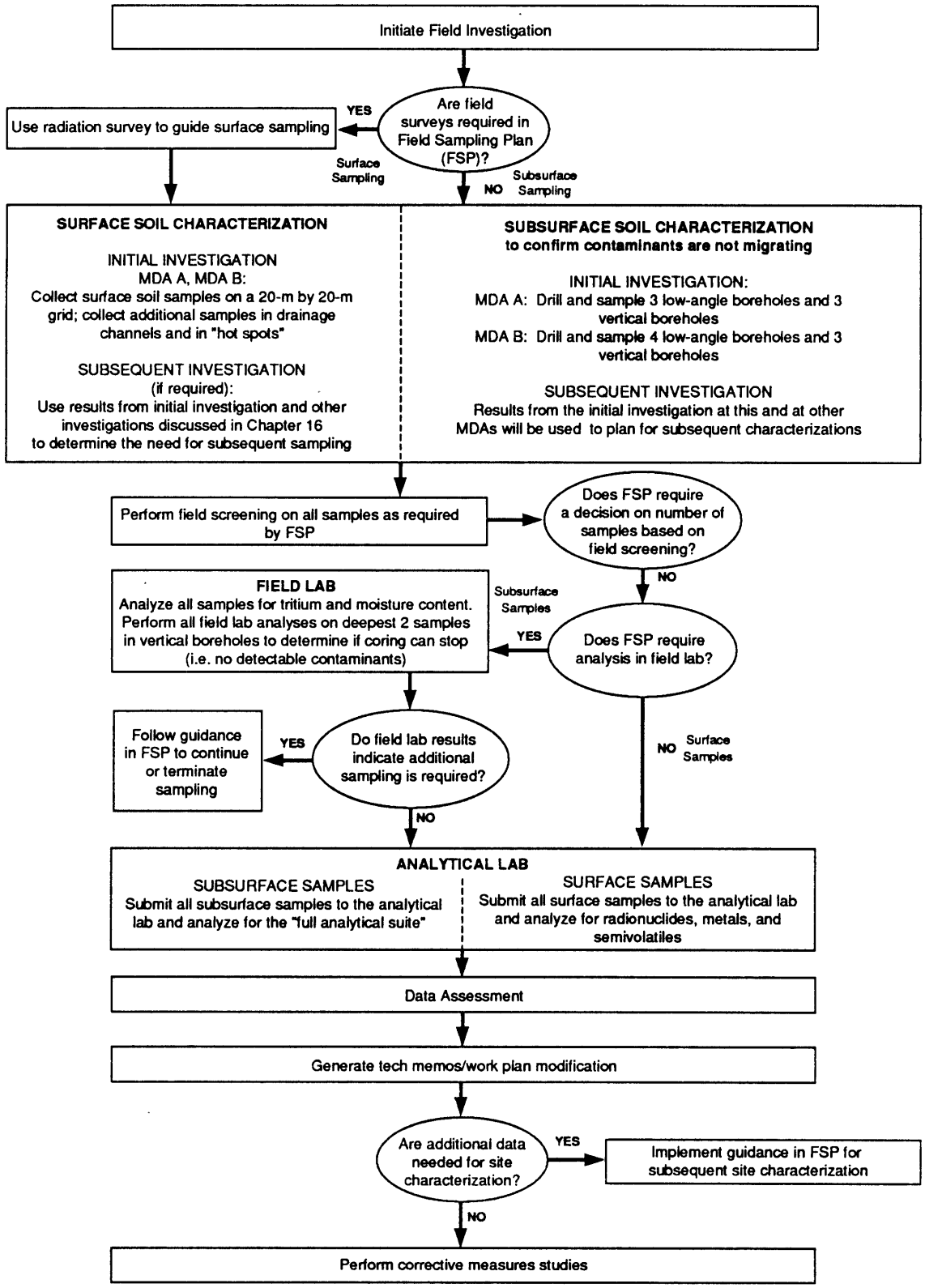


Fig. 16.1-2 Logic flow for the field investigation at the solid waste MDAs (MDA A and MDA B).

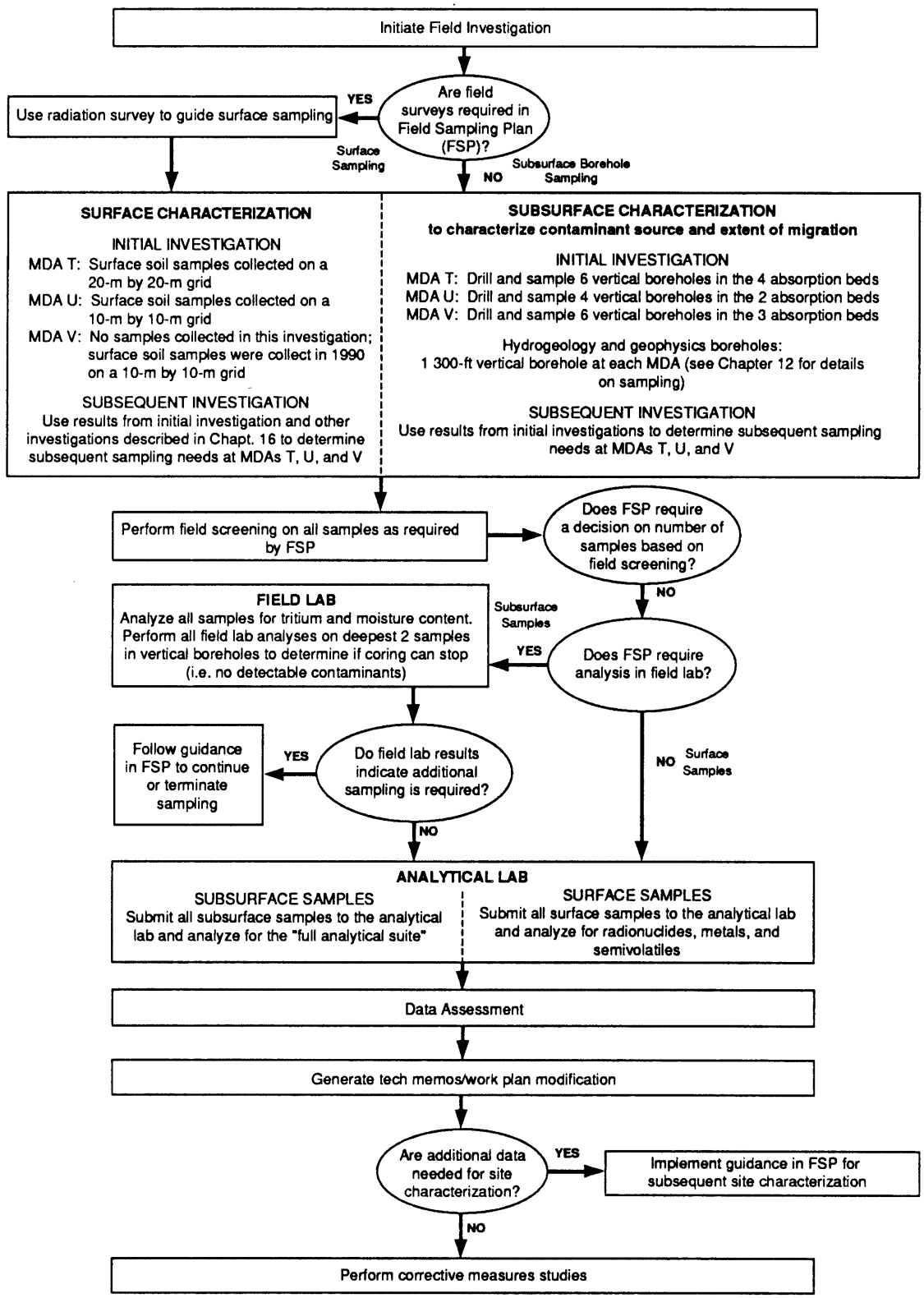


Fig. 16.1-3 Logic flow for the field investigation at the liquid waste MDAs (MDA T, MDA U, and MDA V).

TABLE 16.1-I. BRIEF MDA DESCRIPTIONS

MDA	Area (acres)	Solid/Liquid Waste Disposal	Brief Description	Date Became Inactive
A	1.25	Solid	• Four pits used 1944-1947 • Large pit used 1969-1978 for building D&D • Below ground General's tanks used 1945-1949	1978
B	6.03	Solid	• Unknown number of pits/trenches used 1945-1948 • Western 2/3 of site paved 1966 • Eastern 1/3 of site used for trench cover studies 1982-present	1952
T	2.21	Liquid	• Four absorption beds used 1945-1967 • 62 shafts for ^{241}Am cement paste disposal used 1968-1976 • TRU cement paste storage 1975-1983	1983
U	0.20	Liquid	• Two absorption beds used 1948-1968	1968
V	0.88	Liquid	• Three absorption beds used 1945-1961	1961

TABLE 16.1-II. SWMUS AND AREAS OF CONCERN ADDRESSED IN CHAPTER 16

MDA/Associated Structure	SWMU No.	Area of Concern	Brief Description
A	21-014	—	Five pits and two underground tanks for solid waste disposal
B	21-015	—	Unknown number of pits or trenches for solid waste disposal
T	21-016(a)	—	Four absorption beds
T	21-016(b)	—	Experimental caisson at NW corner absorption bed 1
T	21-011(c)	—	An acid holding tank and an acid sump located within MDA T
T	21-016(c)	—	62 Shafts between absorption beds 2 and 4
T	21-028(a)	—	Satellite container storage area for alcohol, acetone, and freon inactive as of January 1990
T	—	C-21-009	1978 spill of ^{241}Am in cement paste at Area T shafts. Paste was removed and area was decontaminated
T	—	C-21-012	1976 spill of ^{241}Am and plutonium in a cement paste
TA-21-35	21-010(a)–(h)	—	Old industrial liquid waste treatment facility and associated structures
TA-21-257	21-011(a)–(j)	—	New industrial waste treatment plant and associated structures
TA-21-257	21-001	—	Radioactive container storage area at SW corner of TA-21-257
TA-21-257	—	C-21-005	Release of ^{241}Am and plutonium on west side of building; soil was decontaminated
TA-21-257	—	C-21-007	Release of Pu, Am, U from tank vent
TA-21-257	—	C-21-033	1976 TRU cement paste spill
U	21-017(a) and (b)	—	Two absorption beds
U	21-017(c)	—	Sump, TA-21-164, between two absorption beds
V	21-018(a)	—	Three absorption beds
TA-21-20	21-018(b)	—	Laundry building

TABLE 16.1-III SUMMARY OF INITIAL INVESTIGATIONS BY SECTION FOR CHAPTER 16.

		Survey Areas			Surface	Near Surface Soil Samples	
Section	Description	Land	Radiological	Geophysical	Soil Samples	No. of Locations	No. of Samples
16.1	MDA Drainages		10			15	45
16.2	MDA B	1	2		80		
16.3	MDA T	1	2		60		
16.4	TA-21-35	3		3			
16.5	TA-21-257	1	2			5	25
16.6	MDA U	1	2		60		
16.7	MDA V						
16.8	MDA A	1	2		55		
	Total	8	10	3	255	5	25

		Boreholes									Q A
		Shallow			Vertical			Angled			
Section	Description	Number	Total Footage	No. of Samples	Number	Total Footage	No. of Samples	Number	Total Footage	No. of Samples	
16.1	MDA Drainages										15
16.2	MDA B				3	90	33	5	940	213	70
16.3	MDA T				6	650	178				38
16.4	TA-21-35	10	75	28	5	100	20				12
16.5	TA-21-257	7	70	28				4	80	16	15
16.6	MDA U				4	250	70				26
16.7	MDA V				6	500	145				24
16.8	MDA A				3	175	51	3	440	103	43
	Total	17	145	56	27	1765	497	12	1460	332	243

TABLE 16.1-IV SUMMARY OF SAMPLE AND ANALYSIS FOR INITIAL INVESTIGATIONS BY SECTION FOR CHAPTER 16.

	16.1	16.2	16.3	16.4	16.5	16.6	16.7	16.8			Total
Field Sample Screening											
Gross Gamma	45	326	228	50	69	100	118	168			1104
Gross Alpha	45	326	228	50	69	100	118	168			1104
Organic Vapor		246	178	50	69	50	118	123			834
Combustible Gas/Oxygen		246	178	50	44	50	118	123			809
Lithological Logging		246	178	50	44	50	118	123			809
Field Laboratory Measurements											
Gross Alpha		6		50	69	8	12	6			151
Gamma Spectrometry		6		50	69	8	12	6			151
Tritium			10	50	69	18	22	6			175
Volatile Organics		6		50	69	8	12	6			151
PCB											
Soil Moisture		246	178			50	118	123			715
Laboratory Analysis											
Gamma Spectrometry	55	365	248	21	30	134	150	232			1235
Tritium	55	365	248	21	30	134	150	232			1235
Total Uranium	55	365	248	21	30	134	150	232			1235
Isotopic Plutonium	55	365	248	21	30	134	150	232			1235
Isotopic Uranium											
Strontium 90	55	365	248	21	30	134	150	232			1235
VOA (SW 8240)		311	207	28	39	87	162	198			1032
Semivolatiles (SW 8270)	60	382	257	24	34	141	156	243			1297
Metals (SW 6010)	60	382	257		34	141	156	243			1273
PCB (SW 8080)											
TCLP Metals											

TABLE 16.1-V SUMMARY OF SUBSEQUENT INVESTIGATIONS BY SECTION FOR CHAPTER 16.

		Survey Areas			Surface	Near Surface Soil Samples	
Section	Description	Land	Radiological	Geophysical	Soil Samples	No. of Locations	No. of Samples
16.2	MDA B		2		30		
16.3	MDA T		2		40		
16.4	TA-21-35						
16.5	TA-21-257						
16.6	MDA U		2		30		
16.7	MDA V	1	2		30		
16.8	MDA A		2		30		
	Total	1	10		160		

		Boreholes									Q A
		Shallow			Vertical			Angled			
Section	Description	Number	Total Footage	No. of Samples	Number	Total Footage	No. of Samples	Number	Total Footage	No. of Samples	
16.2	MDA B				5	375	75				28
16.3	MDA T				8	900	220	11	1690	393	141
16.4	TA-21-35	8	80	32	5	100	20				12
16.5	TA-21-257	10	100	40				4	80	16	12
16.6	MDA U				2	150	40	4	300	80	33
16.7	MDA V				4	300	80	5	925	210	72
16.8	MDA A				5	375	100				27
	Total	18	180	72	29	2200	535	24	2995	699	325

TABLE 16.1-VI SUMMARY OF SAMPLE AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS BY SECTION FOR CHAPTER 16

	16.2	16.3	16.4	16.5	16.6	16.7	16.8				Total
Field Sample Screening											
Gross Gamma	105	553	52	56	110	265	95				1236
Gross Alpha	105	553	52	56	110	265	95				1236
Organic Vapor	75	523	52	56	90	245	75				1116
Combustible Gas/Oxygen	75	523	52	56	90	245	75				1116
Lithological Logging	75	523	52	56	90	245	75				1116
Field Laboratory Measurements											
Gross Alpha		30	52	56	4	8	10				160
Gamma Spectrometry		30	52	56	4	8	10				160
Tritium		26	52	56	4	8	10				156
Volatile Organics		30	52	56	4	8	10				160
PCB											
Soil Moisture	75	523			90	245	75				1008
Laboratory Analysis											
Gamma Spectrometry	120	633	17	18	168	361	144				1461
Tritium	120	633	17	18	168	361	144				1461
Total Uranium	120	633	17	18	168	361	144				1461
Isotopic Plutonium	120	633	17	18	168	361	144				1461
Isotopic Uranium											
Strontium 90	120	633	17	18	168	361	144				1461
VOA (SW 8240)	95	650	25	21	157	366	131				1445
Semivolatiles (SW 8270)	128	661	20	26	176	377	151				1539
Metals (SW 6010)	128	661		21	176	377	151				1514
PCB (SW 8080)											
TCLP Metals											
Sum of Laboratory Analysis by Table	951	5137	130	158	1349	2925	1153				

TABLE 16.1-VII SUMMARY OF GEOHYDROLOGICAL ANALYSES BY SECTION FOR CHAPTER 16.

	16.1	16.2	16.3	16.4	16.5	16.6	16.7	16.8			Total
Hydrogeological and Geochemical											
Gravimetric Water Content											
Bulk Density											
Dry Density											
Porosity											
Porosity (He injection)											
Saturated Hydraulic Conductivity											
Air Water Relative Permeability											
Moisture Characteristic Curve											
Clay Mineral Content		93	67			37	59	62			318
Zeolite Mineralogy		93	67			37	59	62			318
Sulfate Mineral Content		93	67			37	59	62			318
Carbonate Mineral Content		93	67			37	59	62			318
Fe and Mn Content		93	67			37	59	62			318
Total Organic Compound		93	67			37	59	62			318
Cation Exchange Capacity		93	67			37	59	62			318
Slurry Ph		93	67			37	59	62			318
Environmental Isotopes											
Chloride-35/Chloride-37											
Carbon-12/Carbon-13											
Strontium-86/Strontium -87											
Hydrogen/Deuterium											
Oxygen-16/Oxygen-18											
Tritium											
Carbon-14											
Chloride-36											
Pore Gas Sample											
Straddle Packer Tests											
Volatile Organic Coumpounds											
Carbon Dioxide											
Methane											
Carbon-12/Carbon-13											
Relative Humidity											
SF6											

TABLE 16.1-VIII
SUMMARY OF CHAPTER 16 INVESTIGATIONS BY BOREHOLE PURPOSE

Investigation	Liquid Waste MDA 300-ft Hydrogeological Characterization Borehole	Liquid Waste MDA Source Term Borehole Borehole	Solid Waste MDA Migration Characterization
Soil moisture/Tritium (Sec. 16.1.5.6)	every 5-ft interval	every 5-ft interval	every 5-ft interval
Geochemical/Mineralogy (Sec. 16.1.5.7 using Sec. 12.5.1.5 methods)	every 20-ft interval, plus fracture zones	every 20-ft interval, plus fracture zones	every 20-ft interval, plus fracture zones
Contaminant Analysis (Sec. 16.1.5.8)	None	every 5-ft interval, plus fracture zones	every 5-ft interval, plus fracture zones
Lithological Logging (Sec. 16.1.5.4)	Continuous	Continuous	Continuous
Hydrogeological Parameters (Sec. 12.5.1.4)	every 20-ft interval except moisture content and associated calculations (e.g., porosity, bulk, density, K_s) every 5 ft	None	None
Geophysical Logging (Sec. 12.5.1.6)	Continuous	None	None
Stable Isotopes (Sec. 12.5.1.7)	Every 20 ft for first 100 ft; 40-ft intervals thereafter	None	None
Straddle Packer (Sec. 12.5.1.8)	Every 20 ft for first 100 ft; 40-ft intervals thereafter	None	None
Rock properties below contaminant plume for geochemical/mineralogy (Sec. 16.1.5.2 using Sec. 12.5.1.5. methods)	None	Every 10 ft for 50 ft below contaminant plume	None

Table 16.1-IX

SCREENING AND ANALYSIS FOR INITIAL DETAILED DRAINAGE SAMPLING AT MDAS.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging		Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
MDA B																																			
Near Surface Sample	1	0.0 - 6.0 in		X	X			X	X														X	X	X	X		X		X	X				
		6.0 - 12.0 in						X	X														X	X	X	X		X		X	X				
		12.0 - 18.0 in						X	X														X	X	X	X		X		X	X				
	2	0.0 - 6.0 in						X	X														X	X	X	X		X		X	X				
		6.0 - 12.0 in						X	X														X	X	X	X		X		X	X				
		12.0 - 18.0 in						X	X														X	X	X	X		X		X	X				
	3	0.0 - 6.0 in						X	X														X	X	X	X		X		X	X				
		6.0 - 12.0 in						X	X														X	X	X	X		X		X	X				
		12.0 - 18.0 in						X	X														X	X	X	X		X		X	X				
Field Duplicate																							X	X	X	X		X		X	X				
Rinsate Blank																							X	X	X	X		X		X	X				
Field Blank																															X	X				
MDA T																																			
Near Surface Sample	1	0.0 - 6.0 in		X	X			X	X														X	X	X	X		X		X	X				
		6.0 - 12.0 in						X	X														X	X	X	X		X		X	X				
		12.0 - 18.0 in						X	X														X	X	X	X		X		X	X				
	2	0.0 - 6.0 in						X	X														X	X	X	X		X		X	X				
		6.0 - 12.0 in						X	X														X	X	X	X		X		X	X				
		12.0 - 18.0 in						X	X														X	X	X	X		X		X	X				
	3	0.0 - 6.0 in						X	X														X	X	X	X		X		X	X				
		6.0 - 12.0 in						X	X														X	X	X	X		X		X	X				
		12.0 - 18.0 in						X	X														X	X	X	X		X		X	X				
Field Duplicate																							X	X	X	X		X		X	X				
Rinsate Blank																							X	X	X	X		X		X	X				
Field Blank																															X	X				

Table 16.1-IX

SCREENING AND ANALYSIS FOR INITIAL DETAILED DRAINAGE SAMPLING AT MDAS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 8010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals		
MDA U																																			
Near Surface Sample	1	0.0 - 6.0 in		X	X			X	X													X	X	X	X	X	X	X	X	X				
		6.0 - 12.0 in						X	X													X	X	X	X	X	X	X	X	X				
		12.0 - 18.0 in						X	X													X	X	X	X	X	X	X	X	X				
	2	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X				
		6.0 - 12.0 in						X	X													X	X	X	X	X	X	X	X	X				
		12.0 - 18.0 in						X	X													X	X	X	X	X	X	X	X	X				
	3	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X				
		6.0 - 12.0 in						X	X													X	X	X	X	X	X	X	X	X				
		12.0 - 18.0 in						X	X													X	X	X	X	X	X	X	X	X				
Field Duplicate								X	X													X	X	X	X	X	X	X	X	X				
Rinsate Blank								X	X													X	X	X	X	X	X	X	X	X				
Field Blank								X	X													X	X	X	X	X	X	X	X	X				
MDA V																																			
Near Surface Sample	1	0.0 - 6.0 in		X	X			X	X													X	X	X	X	X	X	X	X	X				
		6.0 - 12.0 in						X	X													X	X	X	X	X	X	X	X	X				
		12.0 - 18.0 in						X	X													X	X	X	X	X	X	X	X	X				
	2	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X				
		6.0 - 12.0 in						X	X													X	X	X	X	X	X	X	X	X				
		12.0 - 18.0 in						X	X													X	X	X	X	X	X	X	X	X				
	3	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X				
		6.0 - 12.0 in						X	X													X	X	X	X	X	X	X	X	X				
		12.0 - 18.0 in						X	X													X	X	X	X	X	X	X	X	X				
Field Duplicate								X	X													X	X	X	X	X	X	X	X	X				
Rinsate Blank								X	X													X	X	X	X	X	X	X	X	X				
Field Blank								X	X													X	X	X	X	X	X	X	X	X				

Table 16.1-IX

SCREENING AND ANALYSIS FOR INITIAL DETAILED DRAINAGE SAMPLING AT MDAS.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging		Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
MDA A																																			
Near Surface Sample	1	0.0 - 6.0 in		X	X			X	X														X	X	X	X		X		X	X				
		6.0 - 12.0 in						X	X														X	X	X	X		X		X	X				
		12.0 - 18.0 in						X	X														X	X	X	X		X		X	X				
	2	0.0 - 6.0 in						X	X														X	X	X	X		X		X	X				
		6.0 - 12.0 in						X	X														X	X	X	X		X		X	X				
		12.0 - 18.0 in						X	X														X	X	X	X		X		X	X				
	3	0.0 - 6.0 in						X	X														X	X	X	X		X		X	X				
		6.0 - 12.0 in						X	X														X	X	X	X		X		X	X				
		12.0 - 18.0 in						X	X														X	X	X	X		X		X	X				
Field Duplicate																							X	X	X	X		X		X	X				
Rinsate Blank																							X	X	X	X		X		X	X				
Field Blank																														X	X				

16.2 SWMU 21-015 Material Disposal Area (MDA) B

16.2.1 Site Description

MDA B is the largest solid waste disposal site at TA-21 (SWMU 21-015), with an approximate area of 6.03 acres (24,000 m^2) (Engineering Department 1965). Buried waste pits occupy about 4,650 m^2 with an estimated volume of 21,240 m^3. The location of MDA B at TA 21 is shown in Fig. 16.2-1.

MDA B consists of two areas, an unpaved eastern area and a paved, fenced western area as shown in Fig. 16.2-1. The number of pits in MDA B is unknown; however, Rogers (1977) states that there were at, a minimum, five pits located there.

16.2.1.1 Site History

A chronological sequence of events and data pertaining to MDA B is given in Table 16.2-I. The following discussion of this information provides the basis for identifying information needed to complete characterization and assessment.

In 1945, pits at MDA A were being filled at such a rate that additional waste disposal pits were necessary. MDA B was a favorable location because sufficient space was available. Tyler (1945) suggested that a trench 15-ft wide by 300-ft long be dug at the eastern end of MDA B. Dow (1945) suggested that the excavation of this waste pit was to be continued until a depth of 12 ft was reached or until September 1, 1945, whichever came sooner. It is not known if the completed pit achieved the dimensions of 15 by 300 ft by 12-ft deep or precisely where it was located.

Other memos indicated there were additional pits. Meyer (1952) said that four pits were dug in MDA B by 1945 and that space was exhausted by 1948. The locations of these pits are not precisely known; however, their dimensions and orientations to fence lines are known. Personal testimony and reference to common Laboratory practice at the time suggested that four disposal pits 300-ft long, 15-ft wide, and 12-ft deep were located parallel to the fence line along DP road and that two pits of uncertain length were located in the north-south leg of MDA B at the western end of the site (Rodgers 1977).

Several sources indicated that additional trenches were located at the easternmost part of MDA B for chemical disposal. A 1964 memo (Safety Office 1964) stated that a covered shallow trench 2-

ft wide by 40-ft long by 3-ft deep was located at the extreme eastern end of MDA B. Another source indicated several small slit trenches, 3-ft to 4-ft deep, 2-ft wide, and less than 40-ft long were reportedly dug in this area for chemical disposal (DOE 1987).

The exact number of pits cannot be ascertained with available information. However, one can assume that there were a minimum of four disposal pits parallel to the fence along DP road and at least one trench for chemical disposal at the easternmost end of MDA B.

A fire occurred at MDA B in 1948 (Buckland 1948). The fire was estimated to have lasted two hours, had great intensity, and covered a waste area of 2,500 ft^2 (McCurdy 1973). The probable cause was spontaneous combustion of mixed chemicals in waste probably containing plutonium, americium, and fission products. The location of this fire is not well known. Buckland and Enders had different recollections regarding where the fire occurred (Rogers 1978).

Because of the seriousness of the fire at MDA B and its close proximity to living and working areas, another disposal site location was selected near Ten Site (Rogers 1977). After the fire in 1948, MDA B was no longer used for waste disposal. Shortly after MDA B was closed, subsidence occurred. This was remedied by using the area for disposal of uncontaminated concrete and soil from construction sites (Rogers 1977).

MDA B was probably fenced as early as 1944 as indicated by the Meyer's memo (1952). In 1966, another request was made to replace the then-current fence with an 8-ft chain link fence (The Zia Company 1966).

The western two-thirds of MDA B was fenced and compacted in 1966 per instructions in Hilton (1966) and leased by DOE to Los Alamos County for trailer storage. The storage area is indicated by the paved area in Fig. 16.2-1. Los Alamos County has been asked to vacate use of this site as a trailer storage area by September 30, 1990 (Bohannan 1990).

Surface stabilization of the east end of MDA B began on July 6, 1982 (Emelity 1982a) and was completed by October 15, 1982 (Emelity 1982b). The fence was moved outward by 10 ft, surfaces were decontaminated, vegetation was removed, and the area was covered with soil, compacted, and reseeded. Capping studies were initiated on the east end of Area B in 1987 to evaluate alternative cover designs.

16.2.1.2 Existing Information

16.2.1.2.1 Waste Disposal Information

Nonradioactive Waste. There are some indications that hazardous chemicals may be present at MDA B. For example, Drager (1948), commenting on the 1948 fire, reported that there was some evidence that chemicals had been disposed of in the dump in an unauthorized manner; i.e., in cardboard containers used for the regular disposal of common laboratory waste. In the fire, several cartons of waste caused minor explosions, and on one occasion, a cloud of pink smoke arose from the debris in the dump.

Documented employee interviews (DOE 1987) stated that chemical disposal occurred at the east end of MDA B. Chemicals disposed of included old bottles of organics, perchlorates, ethers, and solvents. A DOE (1987) document also stated that lecture bottles of mixtures, spent chemicals, old chemicals, and corrosive gases may be in the trench(es) at the east end of MDA B.

Radioactive Waste. MDA B contains solid wastes. The principal radioactive contaminants consist of the types of radioactive materials used at the time: plutonium, polonium, uranium, americium, curium, radioactive lanthanum (RaLa), actinium, and waste products from the water boiler (Meyer 1952). However, approximately 90% of the waste consisted of radioactively contaminated paper, rags, rubber gloves, glassware, and small metal apparatus placed in cardboard boxes by the waste originator and sealed with masking tape. The remainder of the material consisted of metal, including air ducts and large metal apparatus. The latter type of material was placed in wood boxes or wrapped with paper (Meyer 1952).

At least one truck contaminated with fission products from the Trinity test is buried in MDA B (DOE 1987).

Generally, the pits contain little plutonium. Meyer (1971) estimated that MDA B contains no more than 100 grams of $^{239/240}Pu$. MDA B probably contains no transuranic waste, in which transuranic waste is defined as waste with a concentration of $^{239/240}Pu$ greater than 100 nCi/g of waste (Walker 1983).

16.2.1.2.2 Historical Surface Sampling Data

Numerous surface soil sampling studies have been undertaken at MDA B, beginning in 1966, and have continued periodically to the present.

1966 Beta-gamma Survey. In 1966, a beta gamma survey conducted 20 in. above the black top in the paved area showed readings above instrument background levels.

1971 Alpha- and Beta-gamma Survey. In November 1971, the asphalt of the DP trailer park was surveyed with an alpha counter, Ludlum Model 139, and a beta-gamma counter Model E-112-B. The results showed no alpha contamination and only background beta counts (Workman 1971).

1977 Soil and Vegetation Sampling. Soil and vegetation samples were collected from the unpaved area from September 1976 through October 1977 (Booth 1978). Sample analyses included radionuclide and gross alpha and beta measurements. The sampling locations are shown in Fig. 16.2-2 and are denoted 1977 Trocki Gamma Survey Soil Samples and 1977 Trocki Transect Soil Samples. The results of soil and vegetation sampling are given in Table 16.2-II. In 1978, additional analyses were performed on these soil samples (Booth 1978). Those data are given in Table 16.2-III.

Tritium results for the soil samples are given in Figs. 16.2-3 and 16.2-4 The tritium concentrations were above background levels of 7,200 pCi/L (Purtymun 1987) but were generally less than 20,000 pCi/L (Gunderson 1981). Several of the samples had higher levels; the maximum observed level was 983,000 pCi/L. The $^{239/240}Pu$ concentrations were generally above 1 pCi/g, which is considerably higher than the maximum worldwide fallout levels of 0.025 pCi/g given by Purtymun et al. (1987). Samples from several locations showed concentrations in the 20-to-40 pCi/g range. Additionally, elevated levels of ^{241}Am, ^{238}Pu, and ^{137}Cs were found (Table 16.2-II).

Tritium and $^{239/240}Pu$ data were used to predict a continuous concentration surface for the total unpaved area using kriging predictors. The resulting contours (Fig. 16.2-5) show elevated concentrations of tritium and $^{239/240}Pu$ in the center of the sampled area. In addition, $^{239/240}Pu$ contours also show several "hot spots" dispersed across the sampling area.

It was Trocki's opinion that contamination in the middle and southern portion of the area was most likely because of late 1940s burial practices. Pieces of contaminated equipment were sometimes stored on the surface until a suitable pit location was available. Lack of adequate pit cover probably accounted for the above-background contamination over the "apparent pit surface."

1979 Perimeter Soil Sampling. Perimeter soils at five locations on the southern edge of MDA B were sampled in November 1979. The locations and data are shown in Figs. 16.2-6 and 16.2-7.

The sample analysis results for selected radionuclides are given in Table 16.2-IV. Contamination above background levels of ^{238}Pu, $^{239/240}Pu$, uranium, tritium, ^{137}Cs, and ^{90}Sr were observed at one or more depths. Only $^{239/240}Pu$ and uranium appeared above background levels at all locations. The degree of contamination was greater for $^{239/240}Pu$. Location B-5 showed the highest levels of contamination. A sample intended to document background concentrations near MDA B was taken approximately 200 ft west of the area. Plutonium-239/240 levels in this sample were eight times the background level.

1980 Vegetation Sampling. Vegetation was sampled in 1980 at the same locations as soil sampled in 1979. Those results are given in Table 16.2-V The plutonium data for control samples collected in Guaje Canyon are also given in Table 16.2-V. In general, higher levels of radionuclides were found in vegetation collected at locations at the eastern unpaved area. However, not all samples at those locations showed elevated levels of contamination. This variability suggests that either contamination was not uniform in the environs of the root systems or that contaminated dust deposition on leaves was not uniform.

The fruit of a peach tree located at the west end of MDA B (see Fig. 16.2-2) was sampled in 1981 and analyzed for tritium, ^{238}Pu, $^{239/240}Pu$, and ^{90}Sr. The fruit was classified into peels, pulp, and pits from the lower, middle, and upper parts of the tree for analysis. The laboratory analysis results are given in Table 16.2-VI. The tritium concentrations were similar to those found in background soil water. Both ^{238}Pu and $^{239/240}Pu$ were detected in the fruit. However, no obvious trend was observed among fruit from the lower, middle, and upper parts of the tree. Strontium-90 was below detectable levels.

1982 Vegetation Sampling. MDA B was scheduled for renovation in the Fall of 1982. Restabilization of the soil surface required the removal of all plants. Therefore, an intense sampling scheme was formulated to collect and analyze samples from various layers within that ecosystem: soil, litter, roots, stems, and leaves (Wenzel et al. 1987). The purpose of the study was to determine whether any trees or shrubs were rooting directly in waste material, to examine rooting patterns in a shallow land burial site, and to study the distribution patterns of different radionuclides by dissecting vegetative samples into representative compartments. Analysis included ^{137}Cs, $^{239/240}Pu$, uranium, and scandium. Sampling locations are given in Fig. 16.2-2 and include some subsurface samples (1982 Excavated Plants and Soils and 1982 Sampled Plants and Soils). The data are given in Table 16.2-VII and are expressed as a mean with a standard deviation and a coefficient of variation (COV). The ratios of soil to wood for the various radionuclides ranged from a high of 8 for plutonium to a low of 5 for cesium indicating that the vegetation is not taking up the elements rapidly. As would be expected, for all elements, both

root and bark measurements generally showed greater concentrations than their corresponding wood measurement. The small number of samples and the variability of the data make statistically significant comparisons impossible.

1982 Soil Sampling. In addition to this intensive ecosystem sampling effort, prior to renovation soil samples were collected along diagonal transects (Fig. 16.2-2). Sample analysis results are given in Table 16.2-VIII are shown in Figs. 16.2-8 and 16.2-9. Samples were collected at depths of 0 -1 cm, 1 - 10 cm, and 10 - 30 cm.

At the 0-1-cm depth, there were 35 samples analyzed for tritium, all having values above background. The values ranged from 13,400 pCi/l up to 25,600,000 pCi/l (Fig. 16.2-8). At sampling depths of 1-10 cm and 10-30 cm, the tritium was also above-background, with high values of 7,050,000 pCi/l and 4,740,000 pCi/l, respectively. Within the top foot, the levels decreased with depth . The 1982 tritium levels were much higher than those observed in 1977, possibly indicating a tritium source external to MDA B. At 0-1 cm, there were 40 samples analyzed for $^{239/240}$Pu, 97% of which were above background level. They ranged from background to 58 pCi/l (Fig. 16.2-9). At 1-10 cm, all results were above the background level , while at 10-30 cm, 87% were above the background level. The extreme values for $^{239/240}$Pu at both of these depths were comparable to the extreme values at the 0-1-cm depth.

For all three sampling depths, concentration contours derived from prediction surfaces using kriging show high tritium levels at the center of MDA B along the southern fence (Fig. 16.2-10) . The concentration of $^{239/240}$Pu is predicted to be high in several regions (Fig. 16.2-11), showing a pattern of high concentration similar to that of the 1977 data. The different depths show slightly different patterns, but the general pattern of the highest values occurring along a line from the northeastern corner to the southwestern corner is evident in all three depths. Due to the uncertainties involved in predicting these concentration surfaces, the patterns at the different depths should be regarded as quite similar.

1982 Post Renovation Soil Sampling. After MDA B was renovated in 1982, soil samples were taken at four locations on the perimeter of MDA B in October 1982. The first three locations are shown in Fig. 16.2-12. The location of a fourth sample (B-4) is not known. These samples were taken outside the area of renovation. The results (tritium, uranium, and plutonium) are given in Table 16.2-IX and, while above background levels, they are typical of local contaminant levels at TA-21.

1983 Baseline Soil Sampling. In 1983, surface soil samples were collected for radionuclide analysis. The data from these samples were to serve as baseline data (Mayfield 1985b). The

baseline data are given in terms of north (N), south (S), and east (E) coordinates. However, it should be noted that the reference location was not documented in the field notebook (Mayfield 1985b). This set of data is important in that it serves as a baseline for monitoring future contamination after bringing in new soil as part of the MDA B renovation. The coordinates of the location of collected soil samples appear to fit the unpaved eastern portion of MDA B, if it is assumed that the reference location is the southwest corner and that each coordinate unit represents 10 meters (Fig. 16.2-13) (Mayfield 1985b). If those assumptions are correct, then not only is the fenced area covered (N0, E_ to N3, E_) but also the north (N4, E_) and south (S1, E_) unfenced areas. Although the documentation of the reference location of the coordinate system could not be found, the baseline data are recorded here with the apparent reference location because of their importance to future monitoring.

Three sampling depths were again used, 0 -1 cm, 1 - 10 cm, and 10 - 30 cm. The laboratory results are given in Table 16.2-X and shown in Figs. 16.2-13 through 16.2-16 (Mayfield 1985b). Within the fenced area, tritium concentrations were 35,000 pCi/L or less, with most locations being less than 20,000 pCi/L. In a number of cases the concentrations at or outside the fence line were higher than the concentrations inside the fence. The predicted concentration contours for tritium showed the highest concentrations at the corners of the area, especially the southwestern corner beyond the fence line (Fig. 16.2-17).

Plutonium-239/240 concentrations are generally within background levels (<0.025 pCi/g) inside the fenced area with several exceptions. However, the concentrations on or outside the fence line are above background levels. The concentrations outside the fenced area are similar to concentrations observed in previous sampling. The predicted concentration contours for $^{239/240}Pu$ (Fig. 16.2-18) also show the highest concentrations at the corners of the area beyond the fence.

Uranium concentrations slightly exceed the maximum background level of 3.4 µg/g. These concentrations are essentially background levels. Plutonium-238 concentrations are undetectable below background level with only a few exceptions. Those exceptions are either on the fence line or outside the fence line.

Radionuclide concentrations are low inside the fence because MDA B was covered with clean soil in 1982 prior to this sampling. However, new cover soil was not put outside the fence. Elevated levels outside the MDA B fence may be typical of local contaminant levels at the TA-21 OU.

1984 Soil Sampling. Soil samples were collected in May 1984 at three locations. These locations were described in a field notebook (Mayfield 1985b) as follows: B-1, southern end of the western-fenced unpaved area; B-2, southern end of MDA B near the western corner of the unpaved eastern area; and B-3, north side near DP Road at the northwestern corner of the eastern unpaved area of MDA B. Without additional information, these locations cannot be accurately placed on a site map. The laboratory results are given in Table 16.2-XI. Tritium concentrations are within background levels. Plutonium-238 concentrations are very low at the three locations, exceeding background level only at location B-3. Plutonium-239/240 exceeded background levels and ranged from 0.4 to 7.4 pCi/g. These plutonium concentrations may be indicative of local contaminant levels in the vicinity of TA-21.

16.2.1.2.3 Historical Subsurface Sampling Data

1966 Borehole Sampling. In 1966, 13 boreholes 25- to 50-ft deep were drilled in the vicinity of the outer edges of the waste pit at MDA B (Kennedy 1966; Purtymun and Kennedy 1966). See Fig. 16.2-19 for borehole locations. This study was conducted jointly by LANL and the USGS to determine if seepage of water from precipitation had caused migration of radioactive contamination from the pit into the adjacent land and tuff because the surface of the pit and adjacent land were being considered for commercial use. The depth of soil varied from 1 to 4 ft, and the holes showed no evidence of previously disturbed material, indicating that the pit was not penetrated. Samples of drill cuttings of soil and tuff were analyzed for gross alpha and gross beta-gamma radioactivity, plutonium, and uranium. These data are given in Tables 16.2-XII through 16.2-XVI. The data indicate no radioactive contamination when compared with the following upper background limit of these constituents: 16 dpm/g gross alpha, 20 dpm/g gross beta, and 3.4 μg/g total uranium. Plutonium analysis results were below the detection limit of 0.4 dpm/g.

The moisture content in the soil and tuff adjacent to the walls of the boreholes was determined with a neutron moisture probe. The results are given in Figs. 16.2-20 and 16.2-21. A report from Rogers contains the following:

> Distribution of moisture in five test holes indicated some lateral movement of water, probably from the contaminated waste pit. The amount of water moving through the tuff was well below the estimated effective porosity of the tuff. Radiochemical analyses of the soil and tuff from the test holes showed no indication of radioactive contamination. A much larger amount of water than occurs from precipitation would be required to move radioactive contaminants from the water pit into the adjacent soil and tuff. An asphalt covering on the

pit with adequate drainage could prevent any movement of radioactive contaminants from the waste pit.

1982 Subsurface Soil Samples. The 1982 intensive ecological study (Table 16.2-VII) included soil samples to a depth of 160 cm. These data show a possible decrease in soil contamination with depth for plutonium and cesium. The variability for plutonium is too great for a statistically significant result. However, uranium and scandium show no apparent decrease in concentration with depth.

1983 Borehole Sampling. In 1983, subsurface soil samples were collected at two locations outside the fenced area (Fig. 16.2-12) to a depth of 58 ft. Samples were analyzed for tritium, uranium, ^{238}Pu, $^{239/240}Pu$, and ^{137}Cs. Sample analysis results are given in Table 16.2-XVII. Cesium and ^{238}Pu, $^{239/240}Pu$ concentrations were all within background levels. Uranium was slightly higher than the background range. Two exceptions were the $^{239/240}Pu$ levels in the 0-ft to 3-ft interval of hole B-1 (0.21 pCi/g) and the 3-ft-to-8-ft interval for hole B-2 (0.25 pCi/g). However, those concentrations were within the range of surface contamination levels observed at TA-21.

Tritium concentrations, on the other hand, generally increased with depth (Table 16.2-XVII; Fig. 16.2-22). Tritium data are available only to a depth of 23 ft. The concentrations range from 7,500 pCi/L to 36,000 pCi/L.

16.2.1.2.4 Summary of Historical Data

Considerable sampling data are available indicating that the surface soil at MDA B was contaminated with radionuclides (e.g., tritium, $^{239/240}Pu$). Data from subsurface soil sampling indicate elevated tritium concentrations. These concentrations appeared to increase with depth. The source of this contamination (e.g., soil surface, trench waste at MDA B, waste from other areas such as MDA V) is not known.

In 1982, the surface soil inside the MDA B fence was replaced with clean cover. Subsequent sampling has indicated background levels of contaminants with a few exceptions. The data show that the elevated levels of contaminants are located on and outside the fence line where clean soil was not placed. Elevated levels of contaminants outside the MDA B fence may be more typical of local contaminant levels at the TA-21 OU.

16.2.1.3 Source Term

MDA B contains principally radioactively contaminated solid waste, with the exception of chemical disposal that has occurred in at least one trench at the eastern end of MDA B. No data exist on source concentrations.

No subsurface sampling within the MDA B fence has been done. In boreholes outside of MDA B, most radionuclides were at background concentrations, indicating minimal lateral migration. However, in one borehole, tritium concentration increased with depth to 23 ft, the maximum depth of available data. The source of tritium is unknown. No nonradionuclide data are available.

16.2.2 Objectives and Data Needs

The objective of this investigation is to confirm the absence of contaminant migration from MDA B. Specific data required to evaluate contaminant migration at MDA B include the following:

1. Confirm the absence of contaminant migration by identifying the contaminants present both in the surface and subsurface. Analyses for contaminants other than radionuclides are required, because it is known that chemical disposal occurred at the eastern end of MDA B. Since the objective is to confirm the absence of contamination, Level III/IV analyses are required.

2. Determine the vertical and lateral distribution of surface and subsurface contaminants both within and beyond the MDA B fence, as necessary, using Level II/III data.

3. If contaminant migration is identified, determine the geologic stability of the site, particularly with respect to erosion because MDA B is adjacent to an auxiliary canyon to Los Alamos Canyon.

4. If contaminant migration is identified, determine the primary migration pathways through evaluation of sample analysis results.

16.2.3 Sampling/Investigation rationale

MDA B surface sampling on a 10- by 10-m grid within the fenced area was conducted in October 1990. At this time, analytical results are unavailable. Additional sampling from the MDA B fence to the canyon rim will be conducted to identify contaminant levels and evidence of surface run-off driven migration. This sampling will be coordinated with the TA-21 OU surface sampling (see Chapters 12 and 13). In addition, detailed sampling of the drainages as described in Sec. 16.1.4 will be conducted. Whether additional surface sampling at MDA B is required will be determined by evaluating these combined data.

These data will be used to determine spatial prediction surfaces such as kriging surfaces for MDA B and the surrounding area. These surfaces will be used to determine radionuclide contaminant levels and study migration patterns and erosion effects. Requirements for additional radionuclide sampling and the numbers and locations of those additional sample units will be dictated by the accuracy requirements for the prediction surfaces. These accuracy requirements reflect the degree of uncertainty that will be acceptable for comparisons to action levels, for the risk assessments, and for migration and erosion modeling.

Because MDA B was a solid waste disposal area, subsurface sampling will focus on identifying migration beneath the site and not on source term definition. The rationale for this approach is discussed in Sec. 16.1.1. Emphasis will be on angle drill holes reaching beneath MDA B. However, vertical drill holes on the south side of the site will assess possible lateral migration of contaminants toward the canyon. These holes will be placed near holes drilled for the same purpose in 1966. A comparison to the earlier data may allow an evaluation of changes over time. Depending on the results of initial sampling, this approach to subsurface contaminant migration characterization may need to be modified to include source term definition or expanded to include a larger area.

Because contaminant species present in MDA B are unknown, a full analytical suite will be specified for initial sampling. However, in any necessary additional investigations, the analytical suite will be focused to specific contaminants identified in the initial sampling.

16.2.4 Sampling Plan

Detailed tables identifying the sample screening and analysis required for each investigation planned at MDA B have been prepared. However, due to the large number of pages these tables have been placed in Section F.2 of Appendix F, Analytical Tables.

16.2.4.1 Surface Sampling Plan

16.2.4.1.1 1990 Surface Sampling

MDA B was sampled intensively for surface radionuclide contamination in October 1990. Soil samples are being analyzed for the following radionuclides: $^{239/240}Pu$, ^{238}Pu, ^{137}Cs, ^{90}Sr, tritium, ^{241}Am, and total uranium. No vegetation samples were taken. This sampling effort is part of the Environmental Surveillance Group's environmental surveillance of low-level radioactive waste sites. Sample locations are on a 10- by 10-m grid. As shown in Fig. 16.2-23, two areas

have additional sample locations based on a 3- by 3-m grid, and the samples around the perimeter are more closely spaced. These additional samples allow for characterization of the local variability, increasing the precision for the prediction of contaminant concentration distributions. Phoswich and gamma exposure rates (μR) counts will be determined for each sample location, and samples will be analyzed in the analytical laboratory for radionuclide contamination.

In 1982, MDA B underwent site stabilization activities, removing surface contamination, adding cover material, recontouring, and reseeding. The data collected in 1990 should help determine the effectiveness of this stabilization activity.

16.2.4.1.2 Initial Investigation

Sixty-four samples will be collected from the MDA B fence to the canyon rim. These samples will be spaced approximately 20-m apart. Six off-grid samples will also be collected approximately 5 m from the original sampling location as shown in Fig. 16.2-24. In addition, samples in drainages will be collected as described in Sec. 16.1.4. Radiation survey instruments will be used within the 20- by 20-m gridded area to confirm that no areas of elevated radioactivity are present between the grid points. Up to 10 samples will be taken to further characterize any such areas detected.

Samples will be analyzed in an analytical laboratory for radionuclides, metals, and semivolatiles. The exception is that all surface samples taken near the approximate location of the chemical waste disposal pit at the southwestern end of MDA B will also be analyzed for volatile organics in an analytical laboratory. Table F.2-I (see Appendix F) presents the sample screening and analysis requirements.

16.2.4.1.3 Subsequent Investigation

For planning purposes, it is assumed that 30 surface samples on a 10- by 10-m grid surrounding MDA B will be required in the subsequent investigation. As much as possible, a reduced analytical suite will be used, based on results of the initial investigation. However, for planning purposes, it is assumed that a full analytical suite will be used. Table F.2-II (see Appendix F) presents the assumed sample screening and analysis requirements for the subsequent investigations.

16.2.4.2 Subsurface Sampling Plan

16.2.4.2.1 Initial Investigation

Because MDA B was a solid waste disposal site, drilling initially will be around the perimeter; no holes will be drilled into the site. Sample locations for MDA B are those locations determined to have the greatest probability of detecting a migration plume if such a plume exists. Five drill holes inclined 10 to 20° from horizontal beneath the site will show with higher confidence whether the hypothesis that wastes have not migrated is correct (Figs. 16.2-25 and 16.2-26). Three vertical drill holes are located on the south side of the site to detect possible lateral migration of contaminants towards the adjacent canyon. Two of the vertical drill holes will be drilled next to boreholes drilled by the USGS in 1966 to determine if contaminant transport has occurred during the 25 years since the earlier holes were drilled. A third vertical hole will be drilled adjacent to the small pit used to dispose of hazardous chemicals.

The nominal depth of the drill holes is given in Fig. 16.2-25. The borehole stopping criteria in Sec. 11.5.3 will be applied only to vertical boreholes and the field laboratory will be used to make these determinations. Samples for contaminant characterization in initial investigation holes along with samples for soil moisture determination will be collected at 5-ft intervals. In the initial investigation, the full suite of analyses in an analytical laboratory will be conducted on all core samples. The screening and analysis requirements are presented in Table F.2-III (see Appendix F).

An important objective of this investigation is to evaluate the importance of fractures as potential preferential transport pathways; therefore, if fractures are encountered (particularly in shallow angle boreholes), they will be preferentially sampled. If a fracture is encountered over a 5-ft sampling interval, two samples will be taken from that sampling interval to compare analytical results for fracture and nonfracture intervals. A five-sample contingency is allowed for each borehole in Table F.2-III (see Appendix F) for fracture sampling.

Geochemical parameters and mineralogy (as detailed in Sec. 12.5.1.5.1) will be characterized systematically on 20-ft intervals of core, and in contaminant zones to define the geochemical parameters associated with particular contaminants. For planning purposes it is assumed that 20% additional sampling within contaminant zones will be needed to define mineralogical and geochemical control on contaminants. Geochemical analysis are detailed in Table F.2-IV (see Appendix F).

16.2.4.2.2 Subsequent Investigation

If the hypothesis is correct that no migration is occurring, then no subsequent investigation is expected. However, if initial boreholes and/or modeling suggest migration is occurring, then additional boreholes may be required.

The necessity for additional characterization will be determined after results from the initial drilling program are evaluated in conjunction with modeling predictions. Placement of additional drill holes will be based on these results from the initial drill holes. If initial drilling results indicate a need for more detailed source term characterization, surface geophysics will be used to locate the buried solid waste disposal pits, employing methods previously used at MDA A (Gerety et al. 1989).

For planning purposes, it is assumed that five 75-ft vertical boreholes will be required to further define the source term and its lateral and vertical extent. Additionally, three additional 30-ft boreholes are assumed to be necessary around the chemical disposal pit (see Fig. 16.2-27). In any subsequent sampling, a reduced analytical suite will be used based on results from the initial investigation. However, for planning purposes, it is assumed that a full analytical suite will be used. Table F.2-V (see Appendix F) details the assumed screening and analysis requirements for the subsequent investigations.

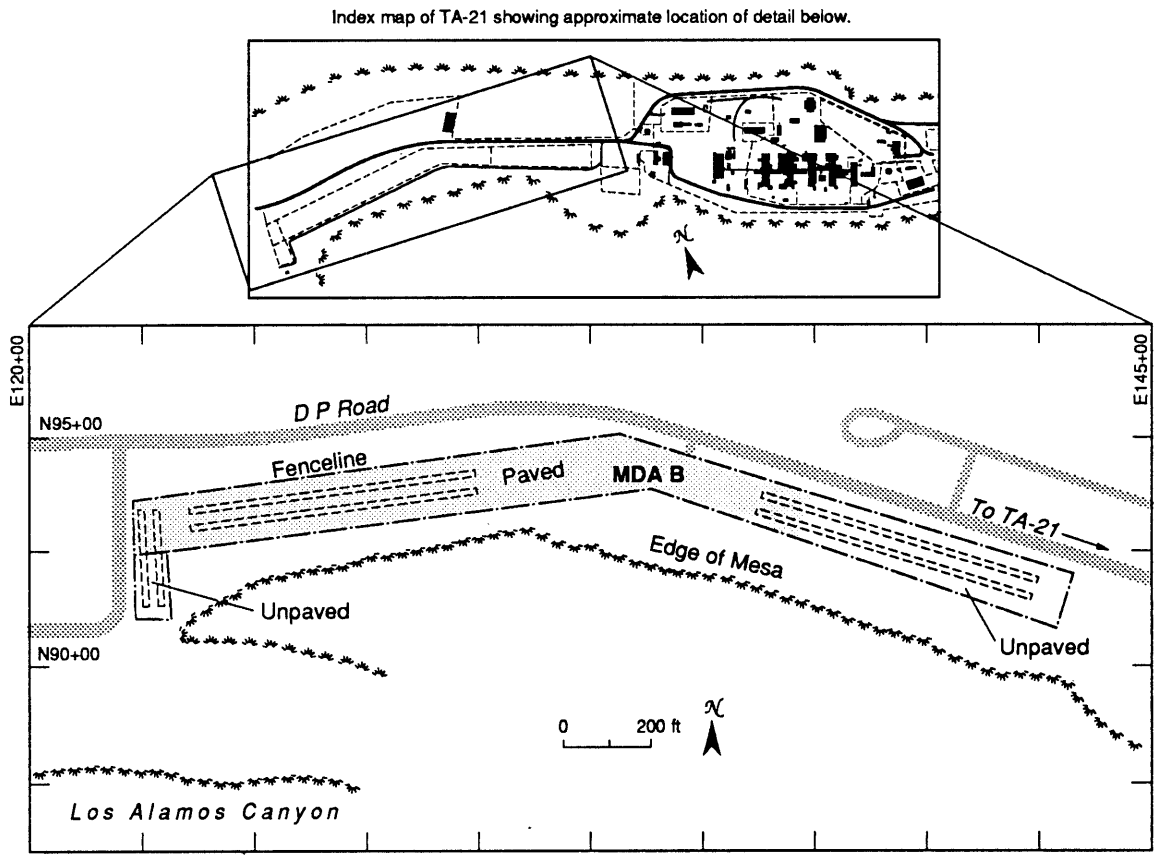


Fig. 16.2-1 Base map of MDA B showing estimated locations (from Rodgers 1977) of pits and trenches.

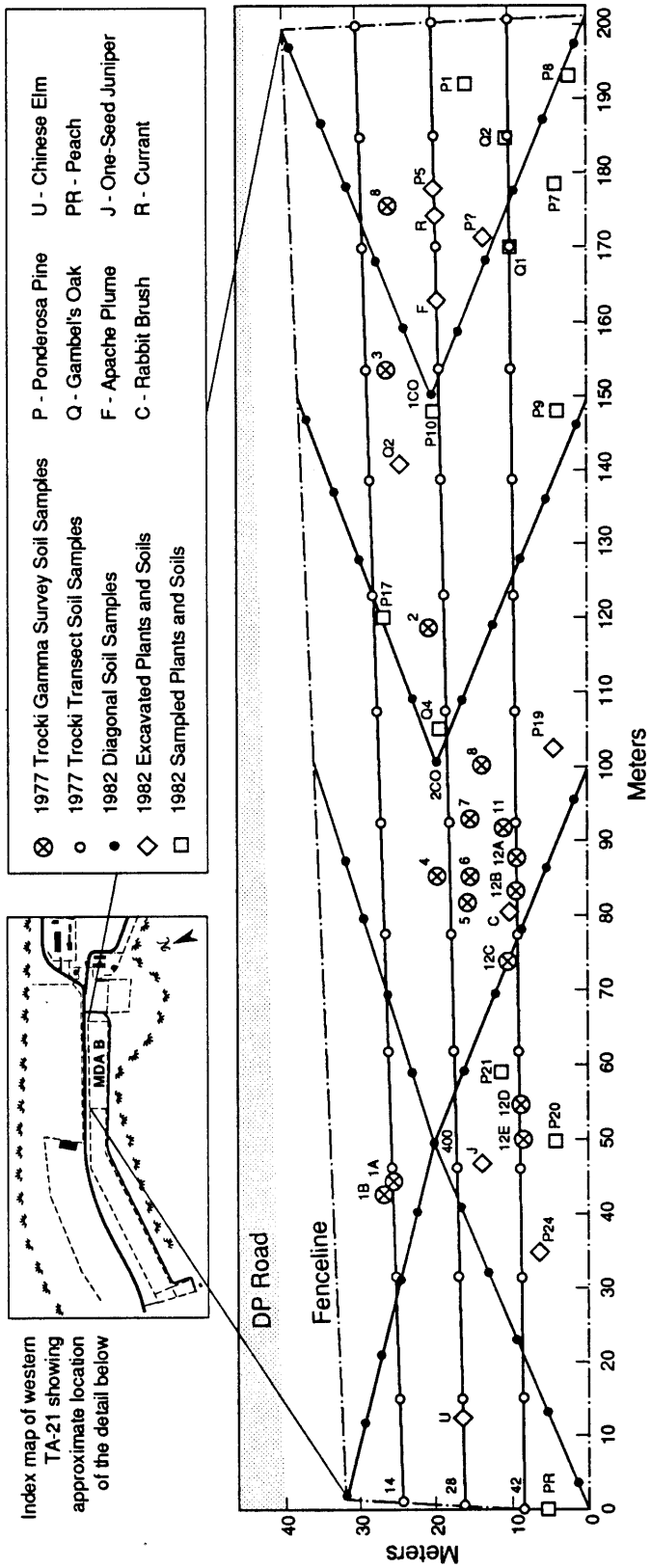


Fig. 16.2-2 MDA B sampling and excavation sites.

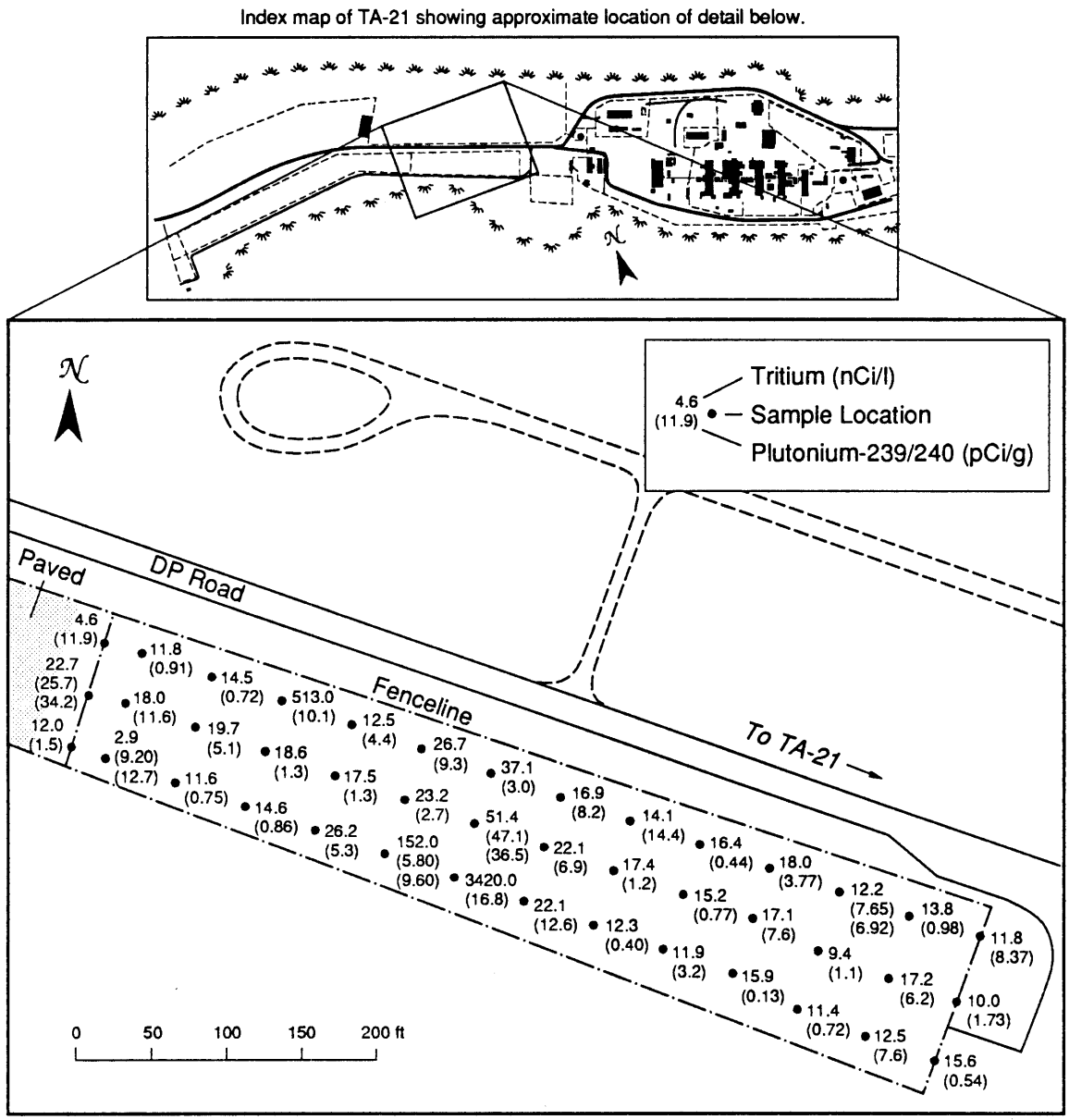


Fig. 16.2-3 Surface soil sampling locations for 1977 Trocki transect sample at MDA B.

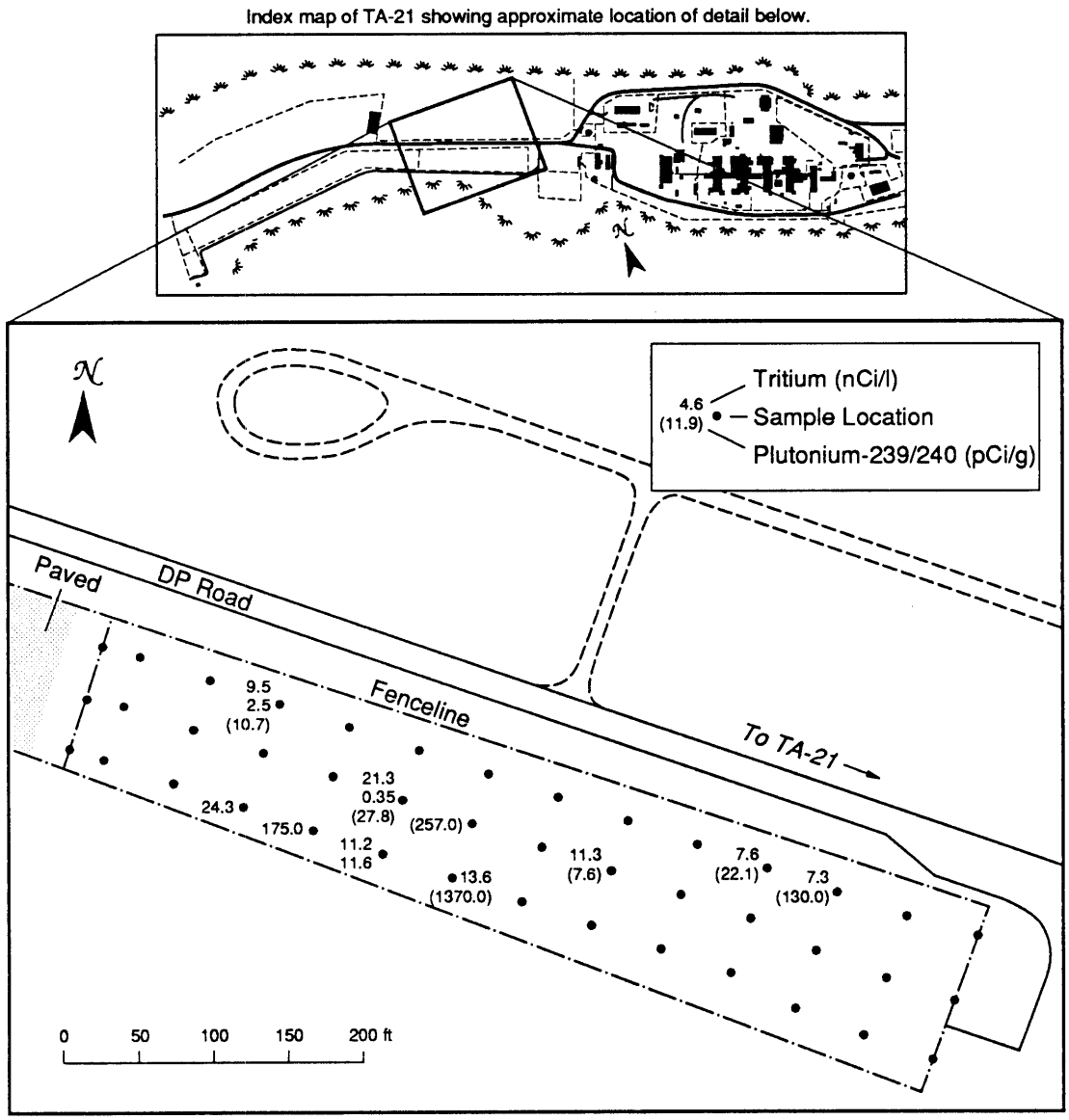


Fig. 16.2-4 Surface soil sampling locations from 1977 Trocki gamma survey at MDA B.

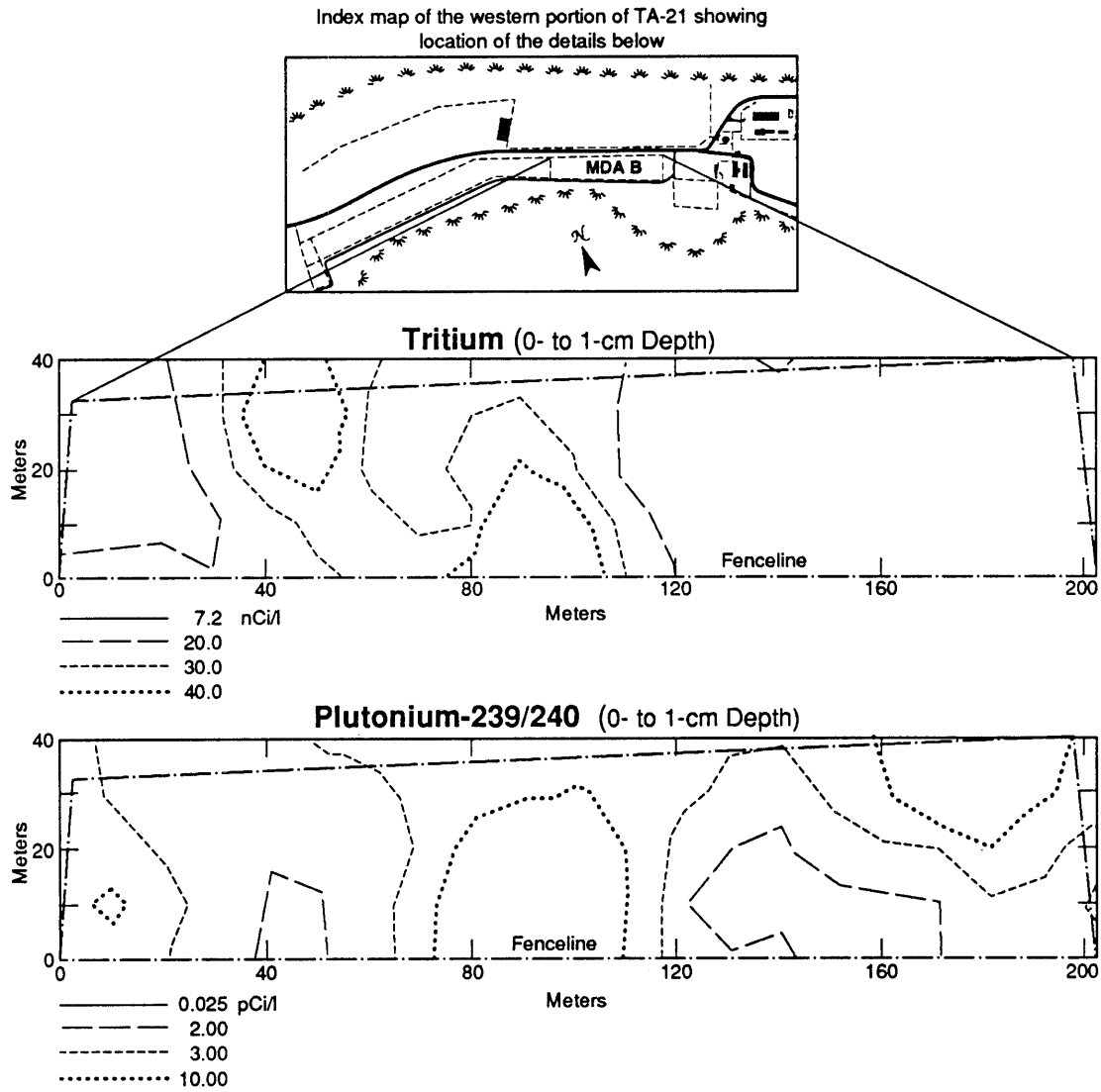


Fig. 16.2-5 Concentration contours for tritium and plutonium-239/240 from the 1977 soil samples on the unpaved section of MDA B.

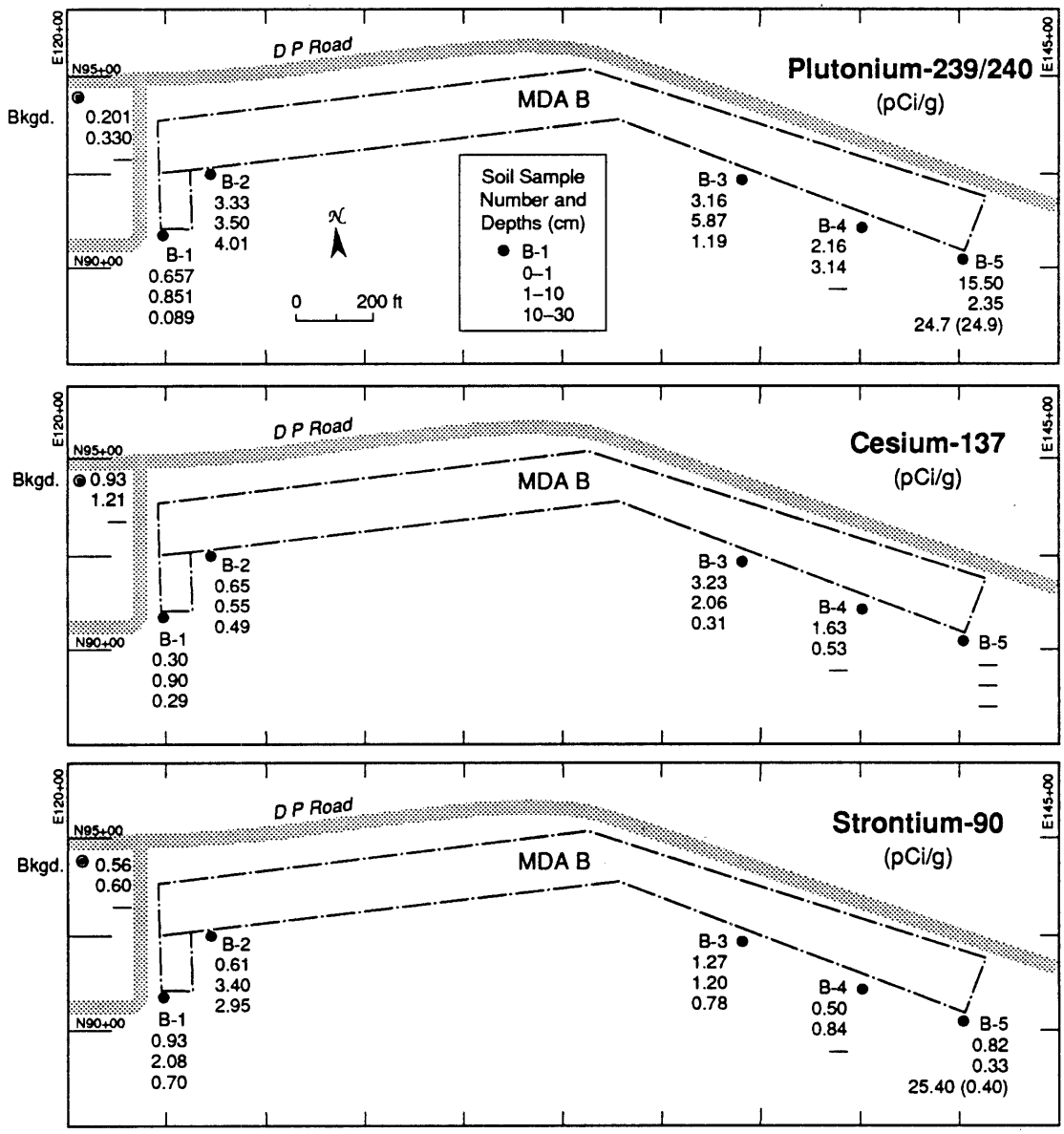


Fig. 16.2-6 Concentrations of plutonium-239/240, cesium-137, and strontium-90 in soils sampled in MDA B in 1979. (Background location not to scale)

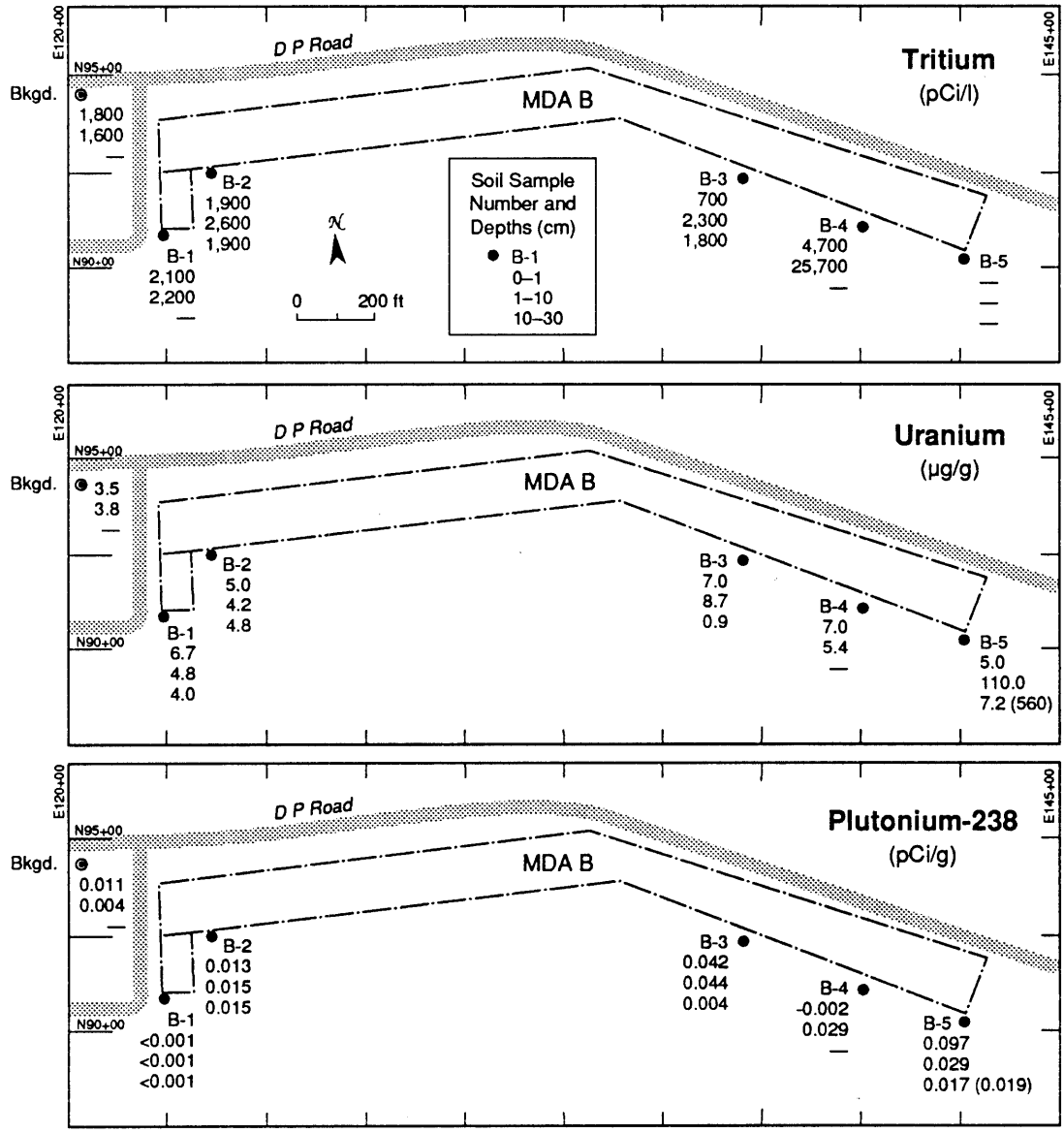


Fig. 16.2-7 Concentrations of tritium, uranium, and plutonium-238 in soils sampled in MDA B in 1979.

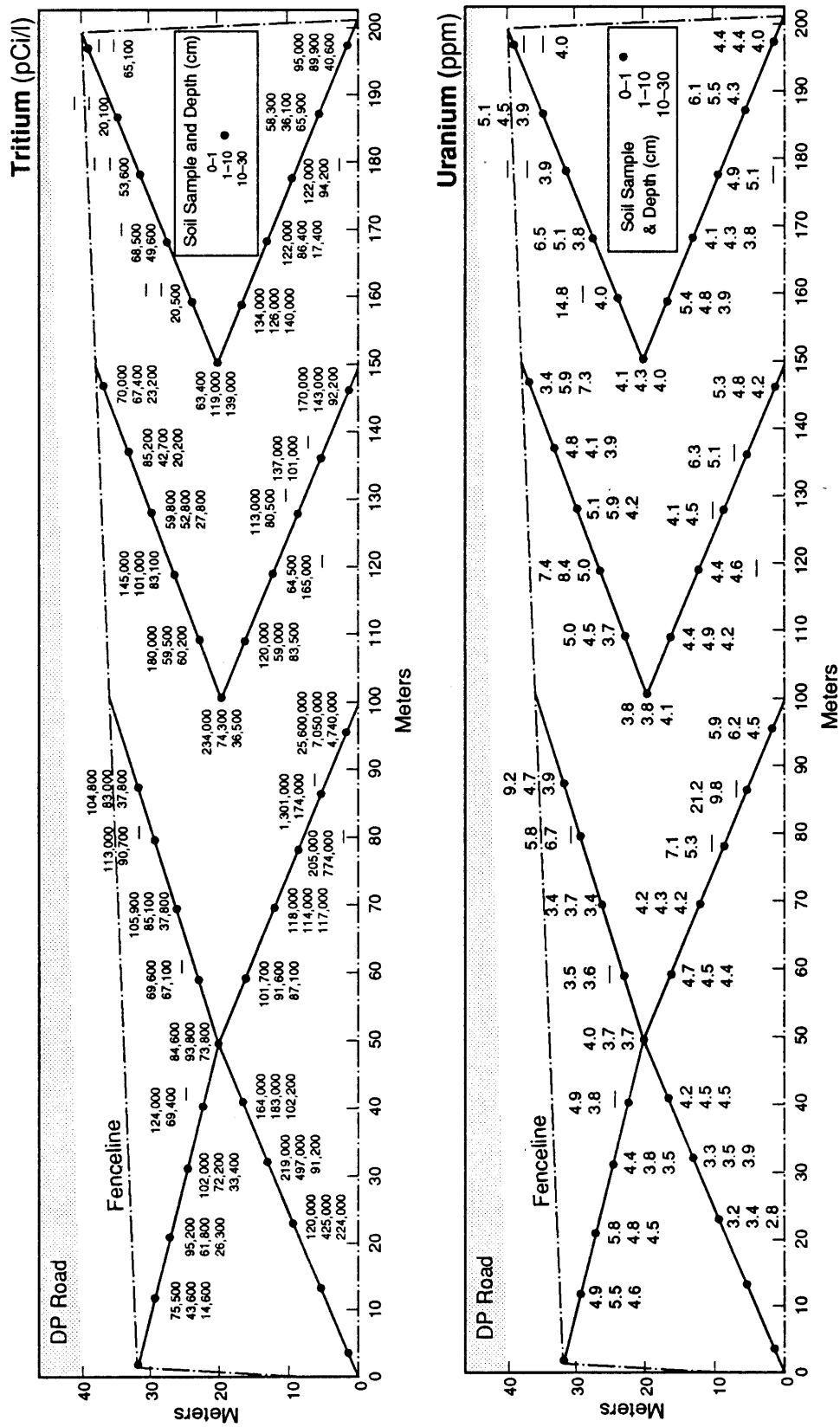


Fig. 16.2-8 Tritium and uranium concentrations in surface soils sampled in 1982 at MDA B before renovation.

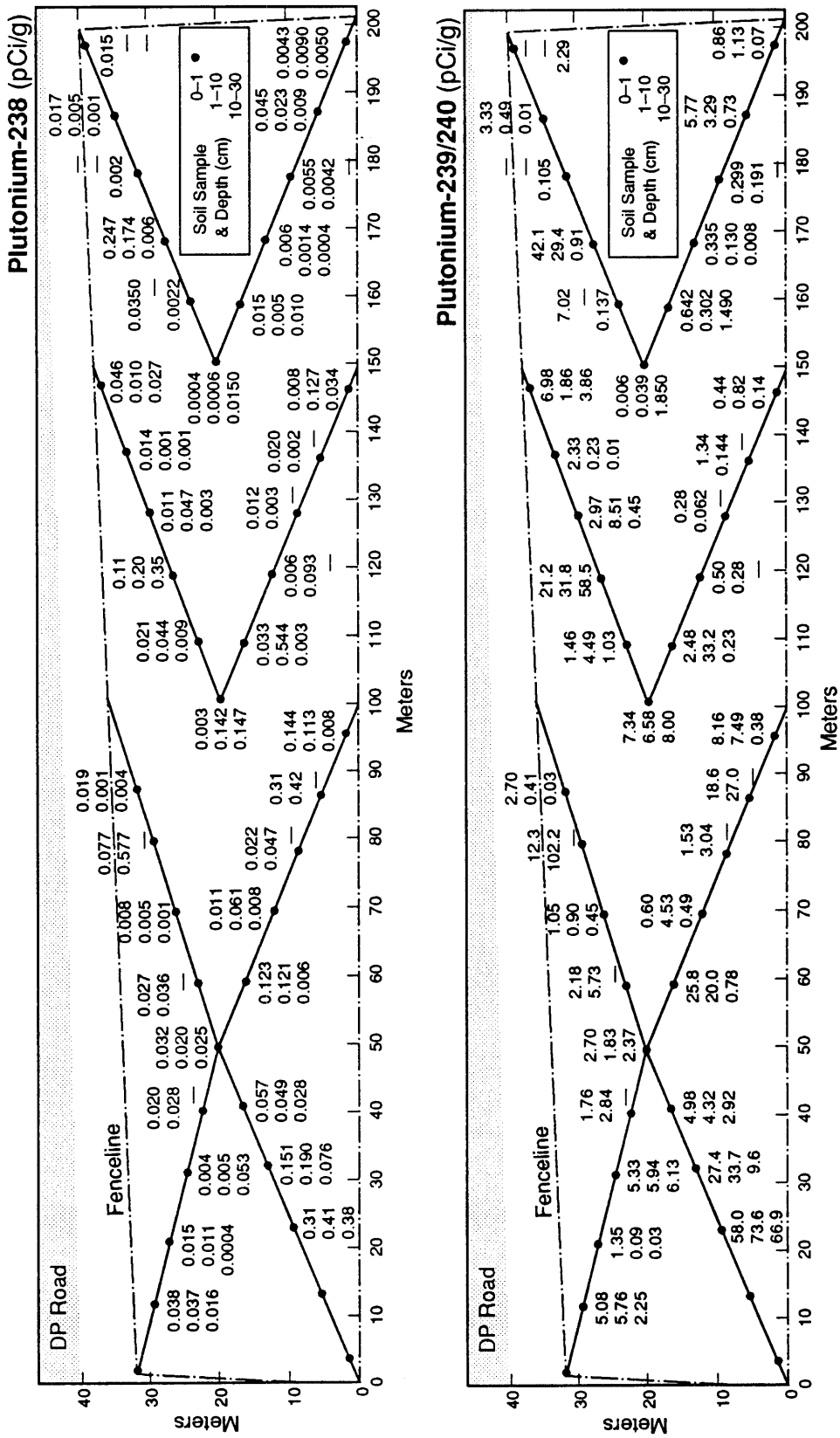


Fig. 16.2-9 Plutonium-238 and -239/240 concentrations in surface soils sampled in 1982 at MDA B before renovation.

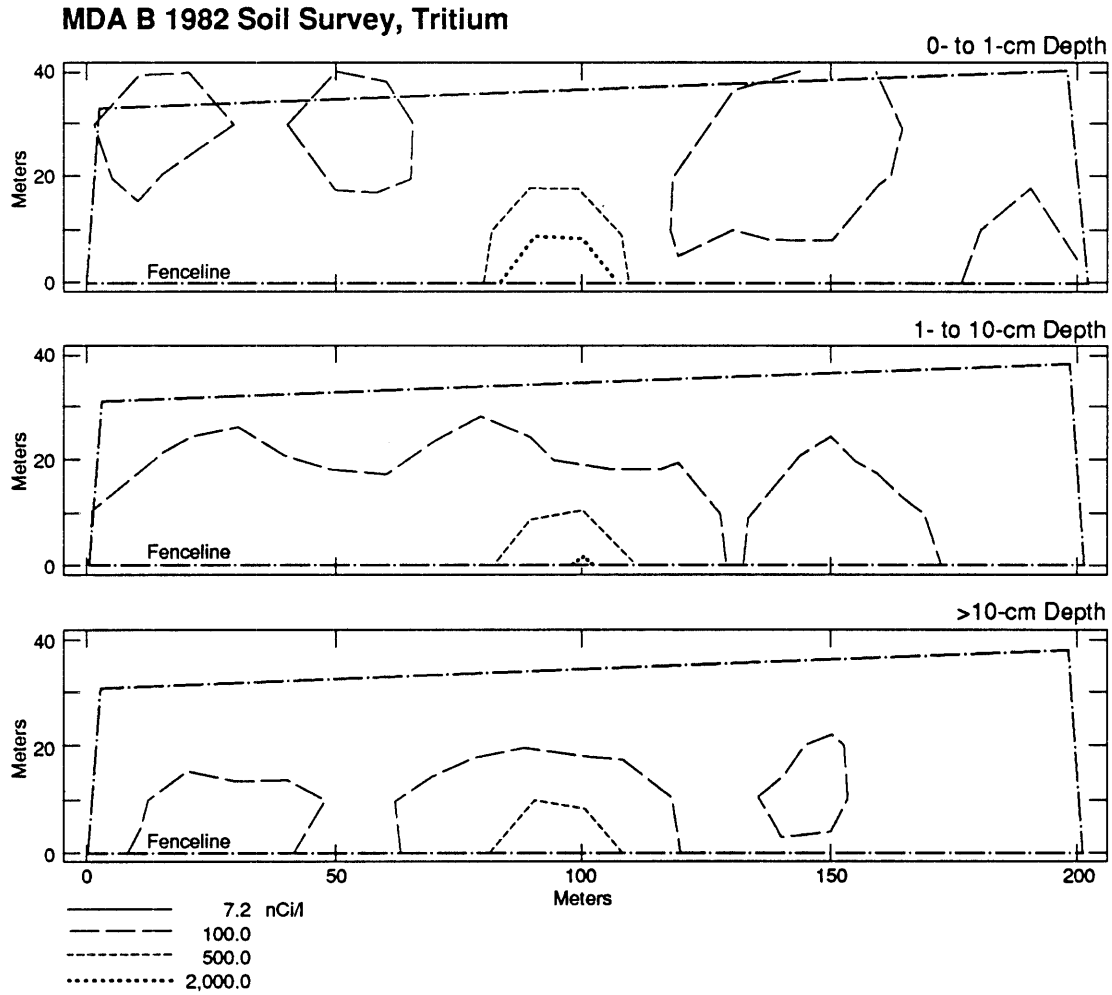


Fig. 16.2-10 Concentration contours for tritium from 1982 soil samples at MDA B.

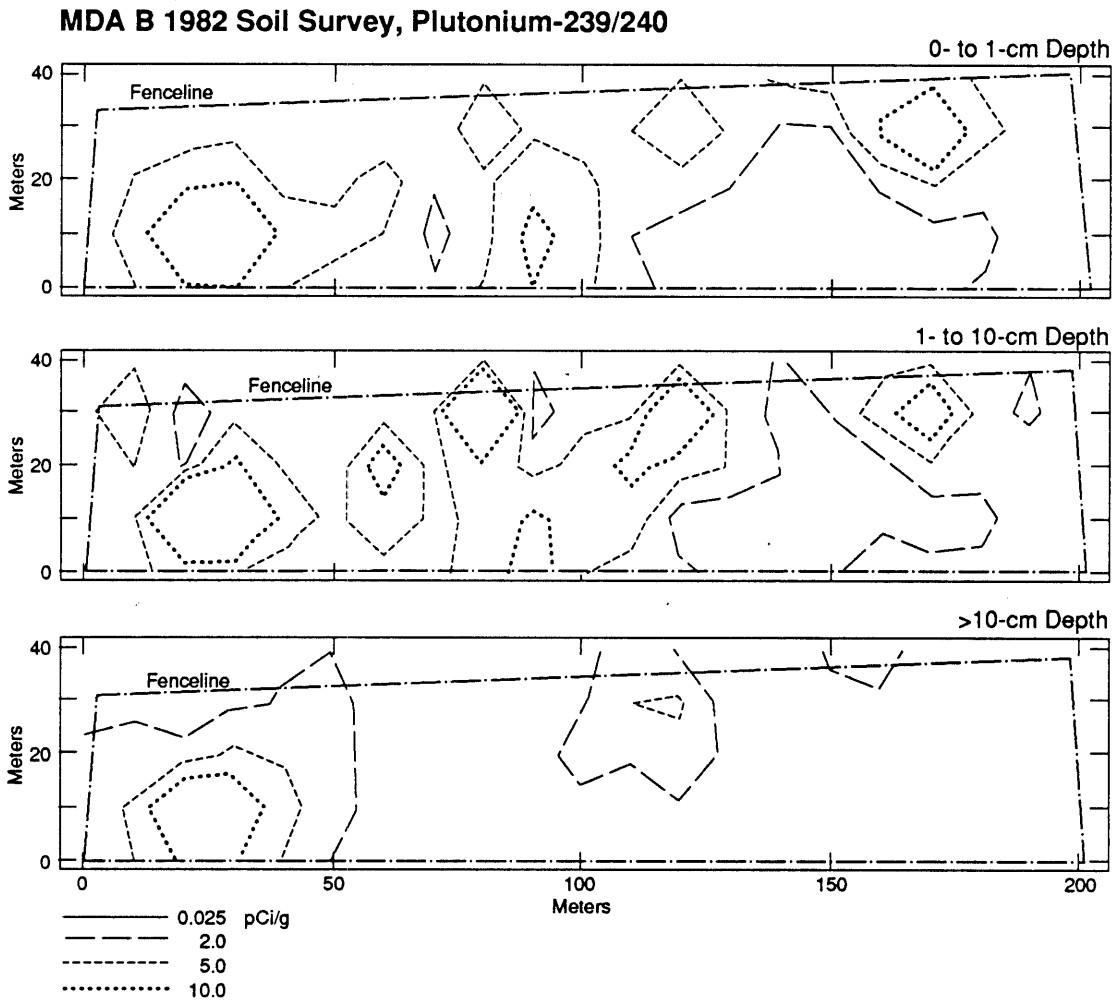


Fig. 16.2-11 Concentration contours for plutonium-239/240 from 1982 soil samples at MDA B.

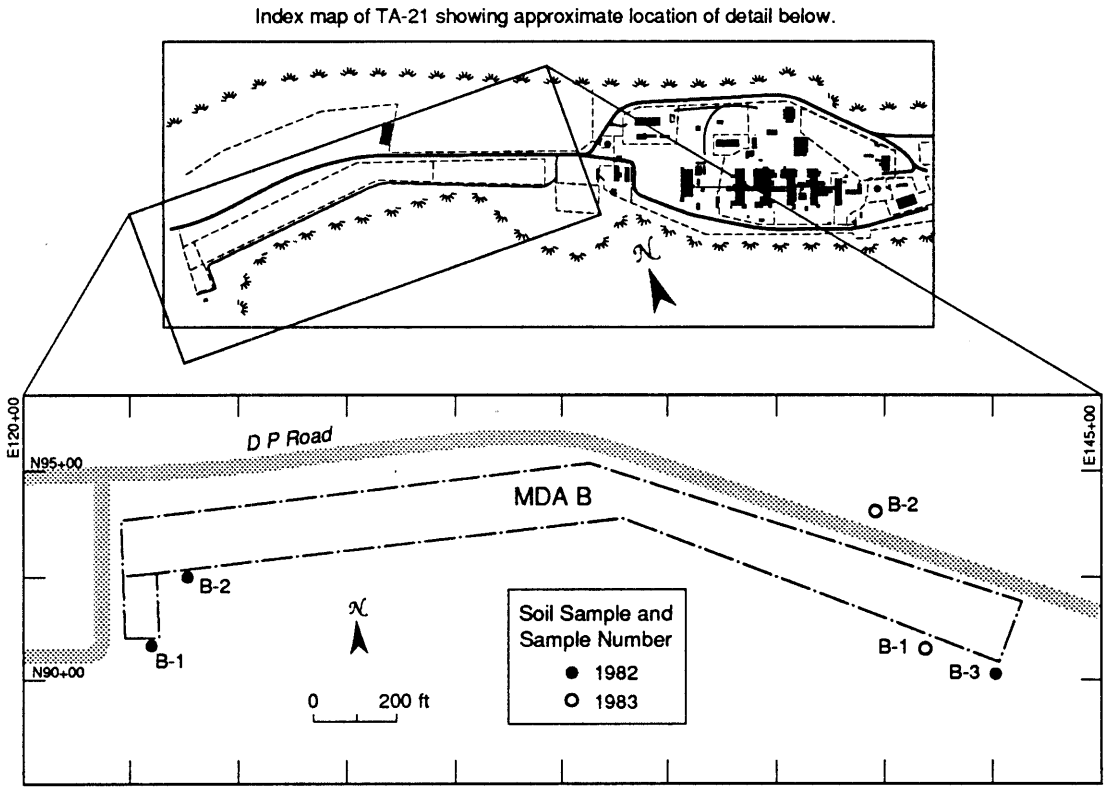


Fig. 16.2-12 Location of perimeter soil sampling in 1982 and 1983 at MDA B.

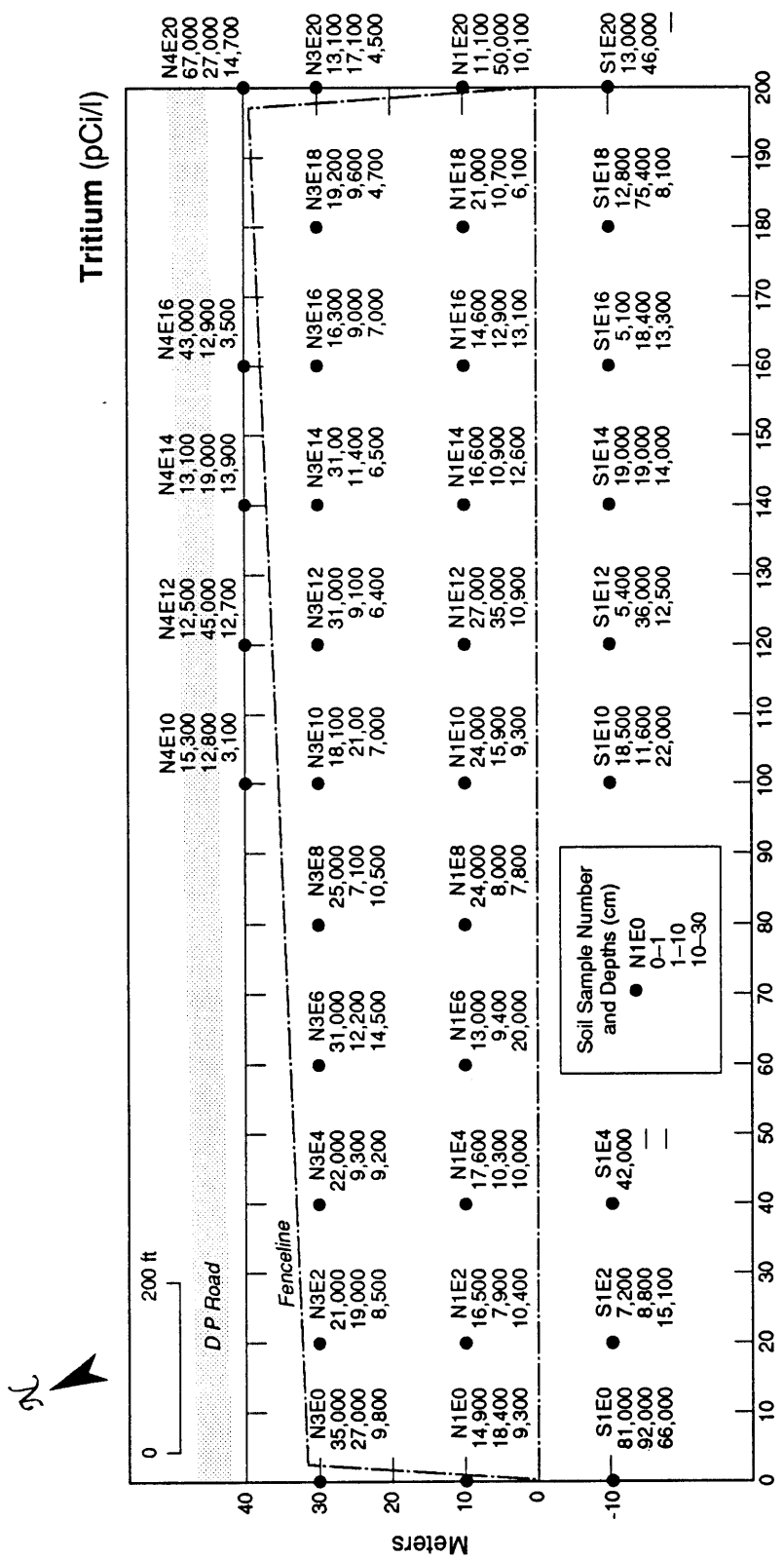


Fig. 16.2-13 Tritium concentrations for MDA B surface soil samples. (Mayfield 1985b)

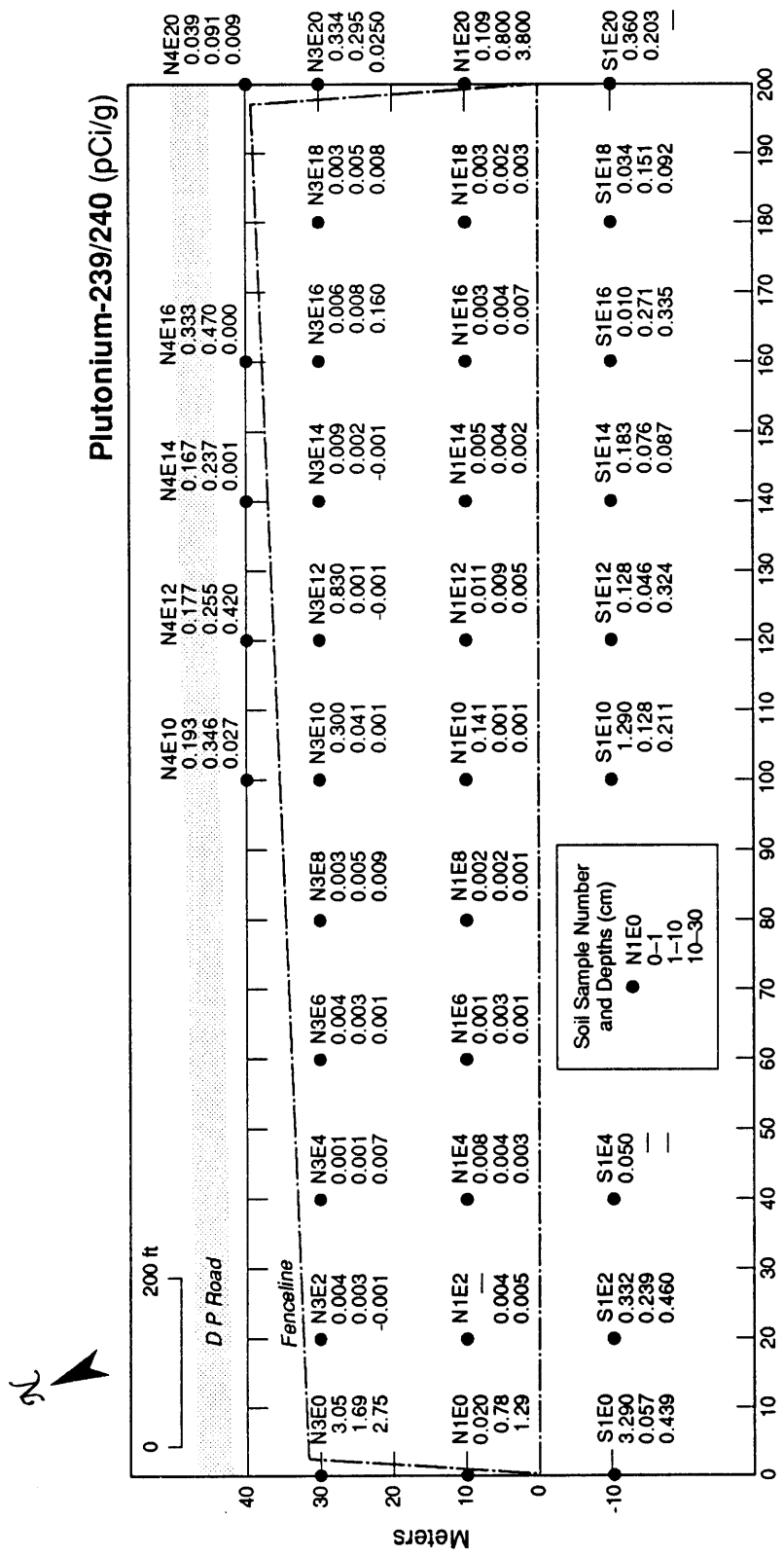


Fig. 16.2-14 Plutonium-239/240 concentrations for MDA B surface soil samples. (Mayfield 1985b)

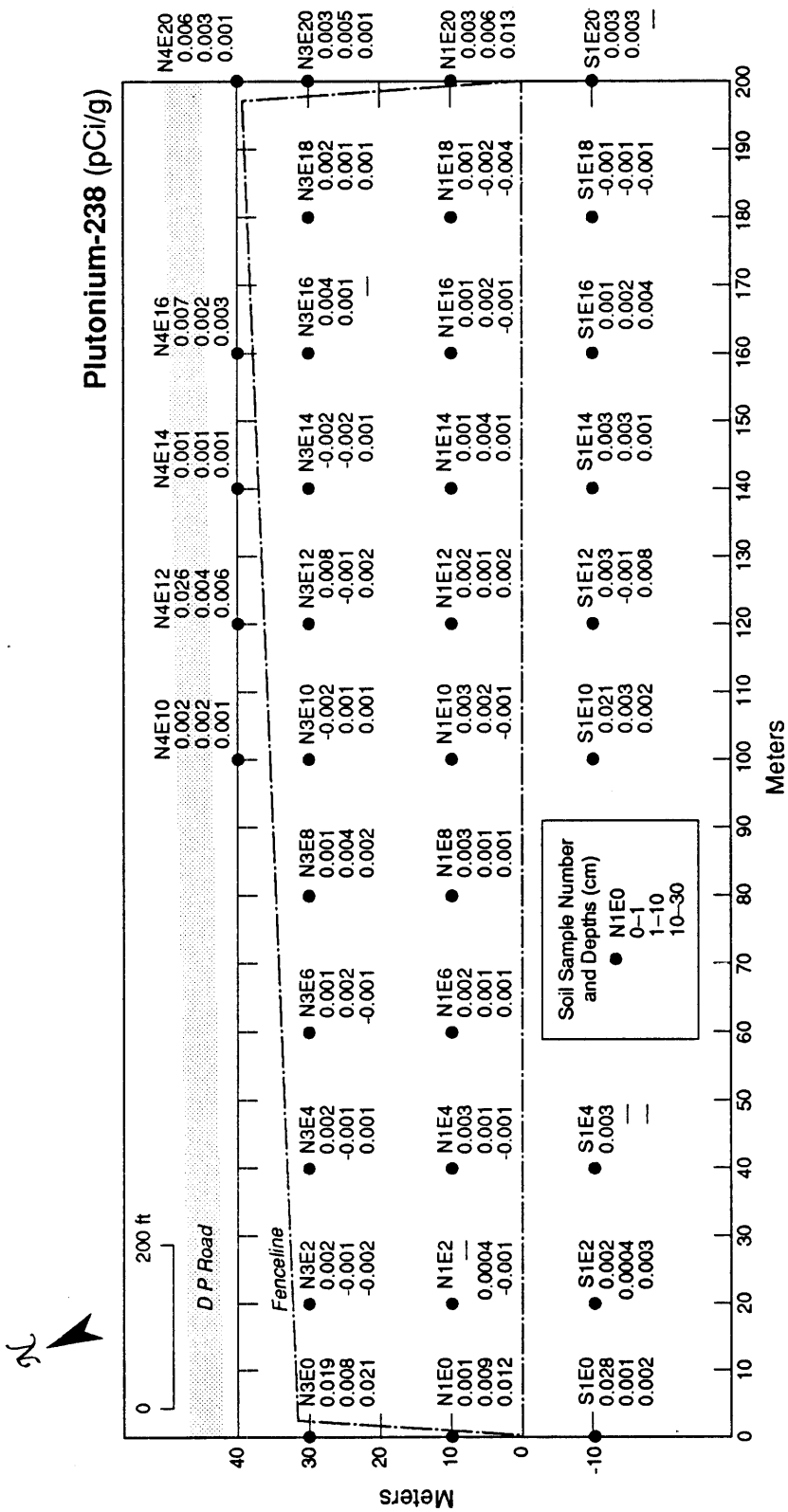


Fig. 16.2-15 Plutonium-238 concentrations for MDA B surface soil samples. (Mayfield 1985b)

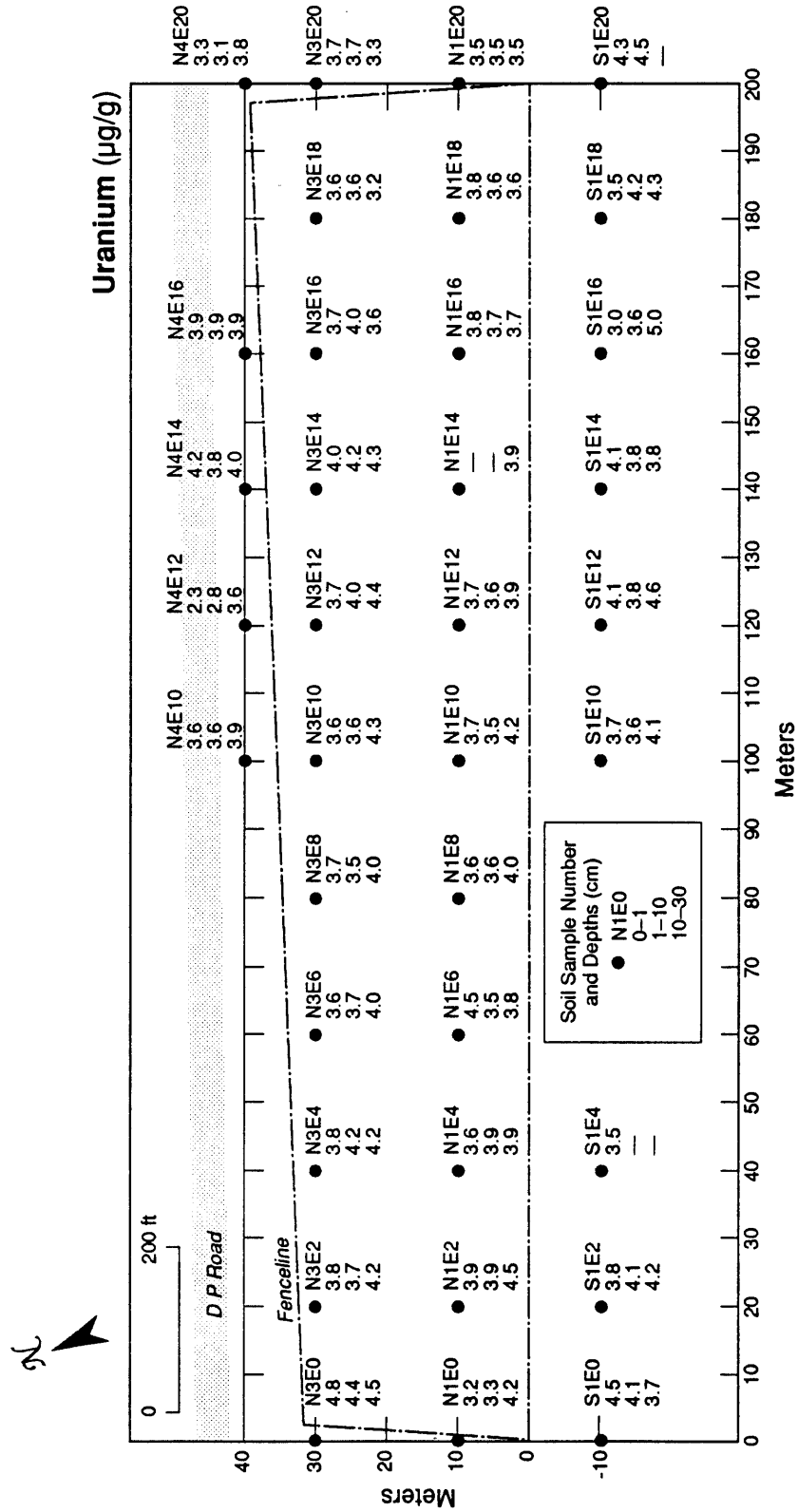


Fig. 16.2-16 Uranium concentrations for MDA B surface soil samples. (Mayfield 1985b)

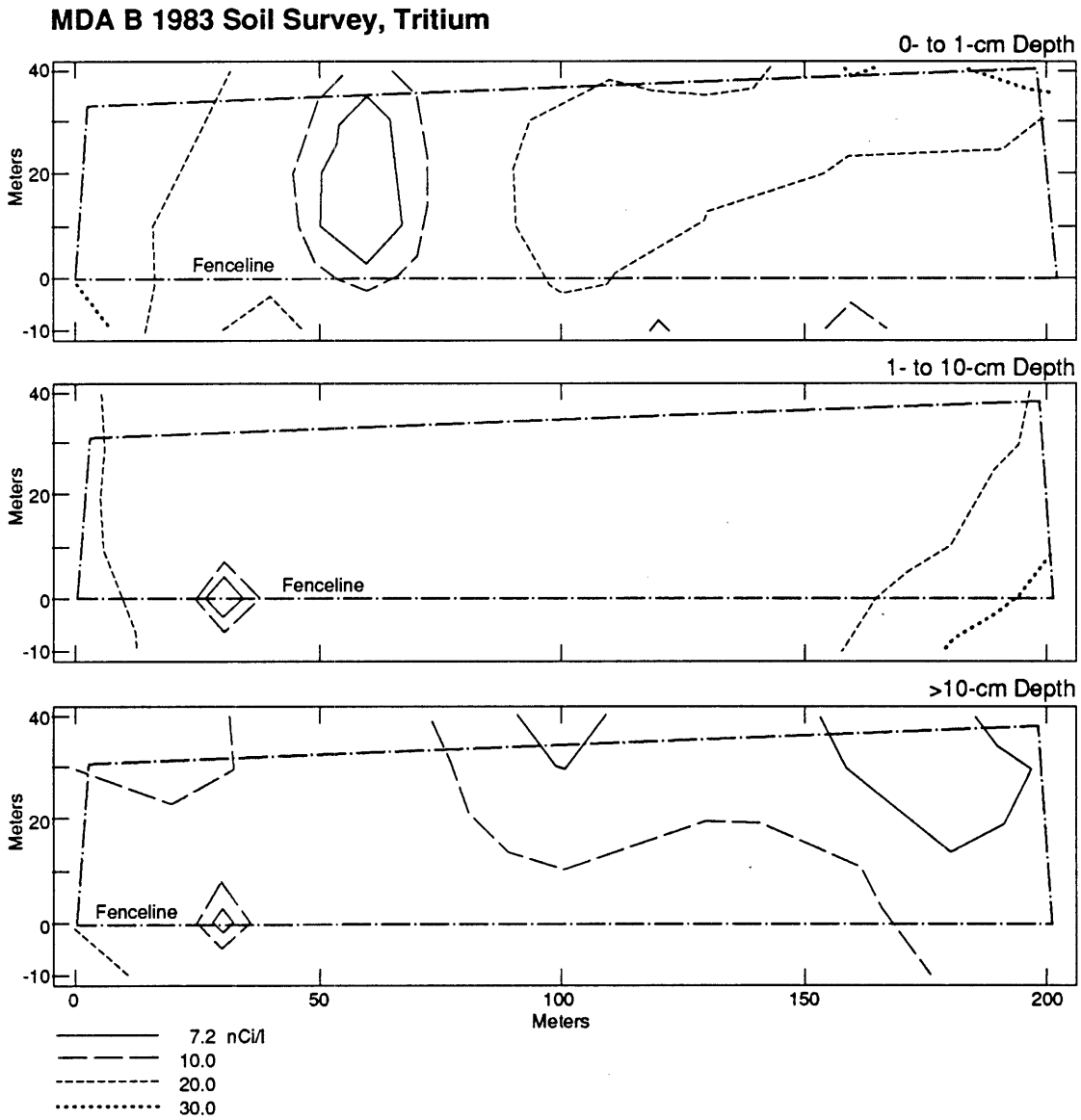


Fig. 16.2-17 Concentration contours for tritium from 1983 soil samples at MDA B. These samples were collected after the area was renovated.

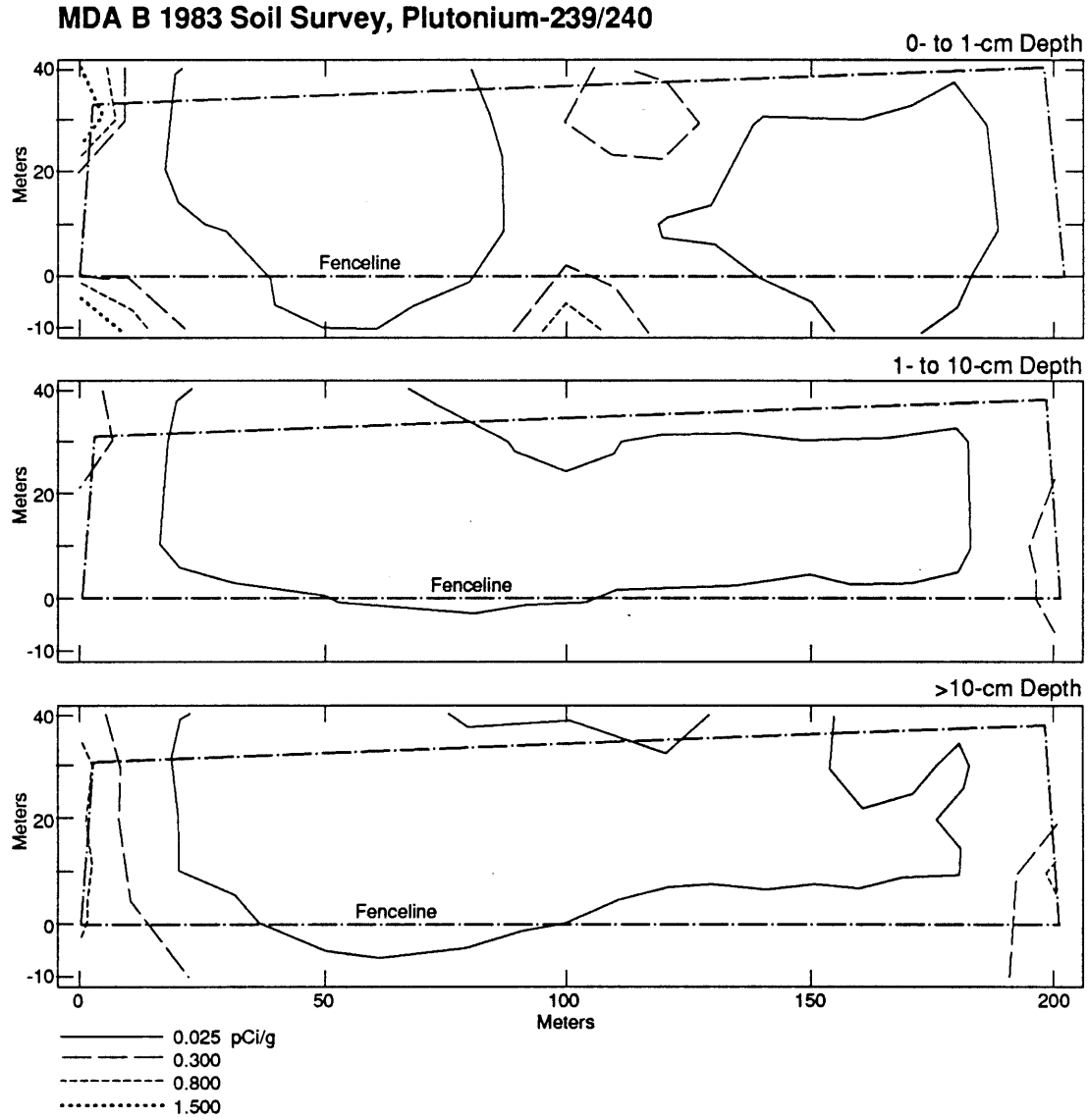


Fig. 16.2-18 Concentration contours for plutonium-239/240 from 1983 soil samples at MDA B. These samples were collected after the area was renovated.

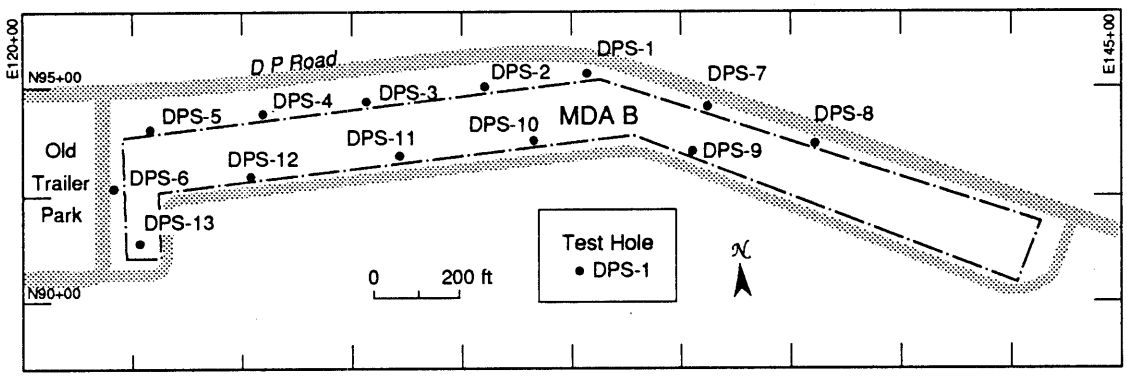


Fig. 16.2-19 Map of MDA B showing location of test holes drilled in 1966.

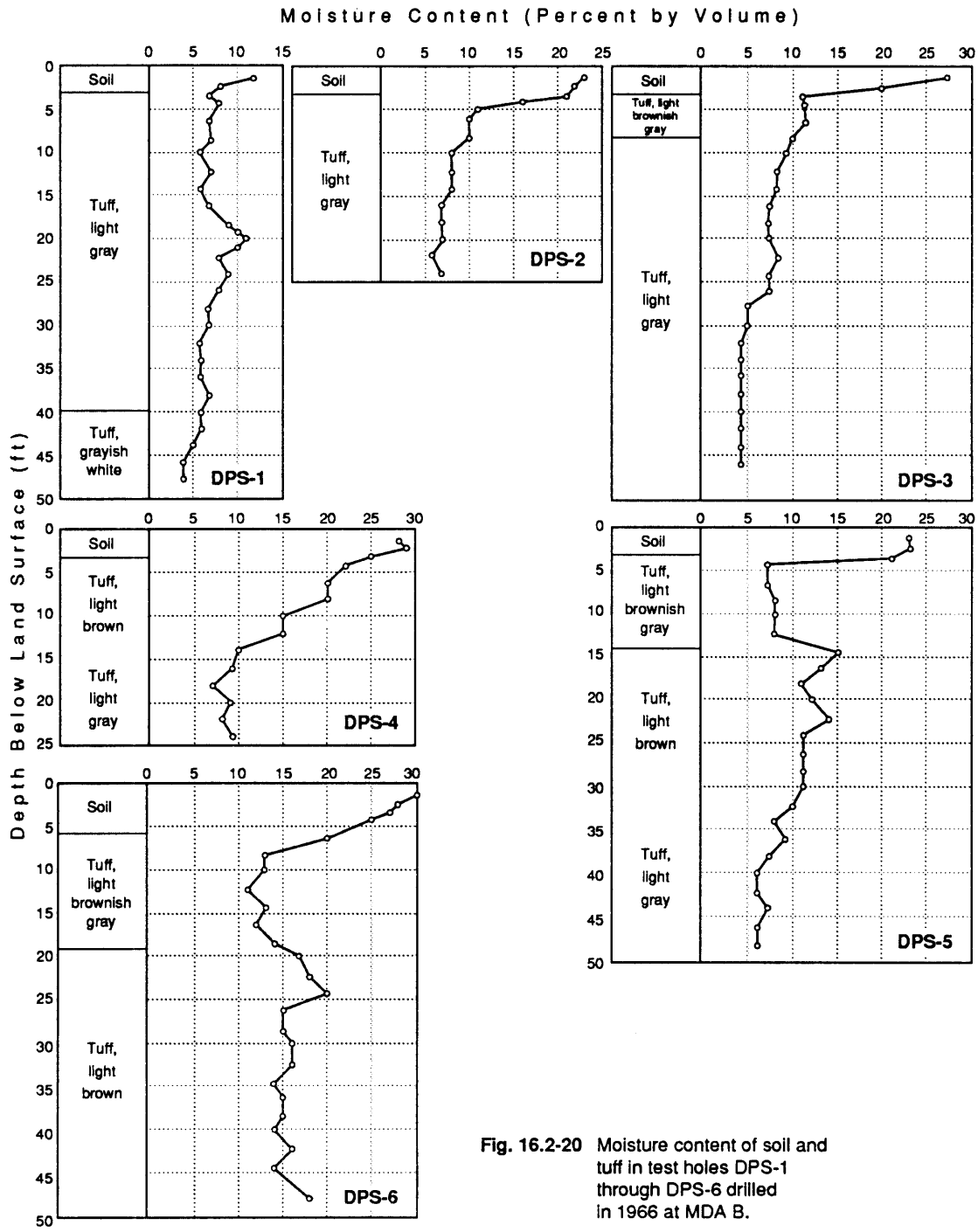


Fig. 16.2-20 Moisture content of soil and tuff in test holes DPS-1 through DPS-6 drilled in 1966 at MDA B.

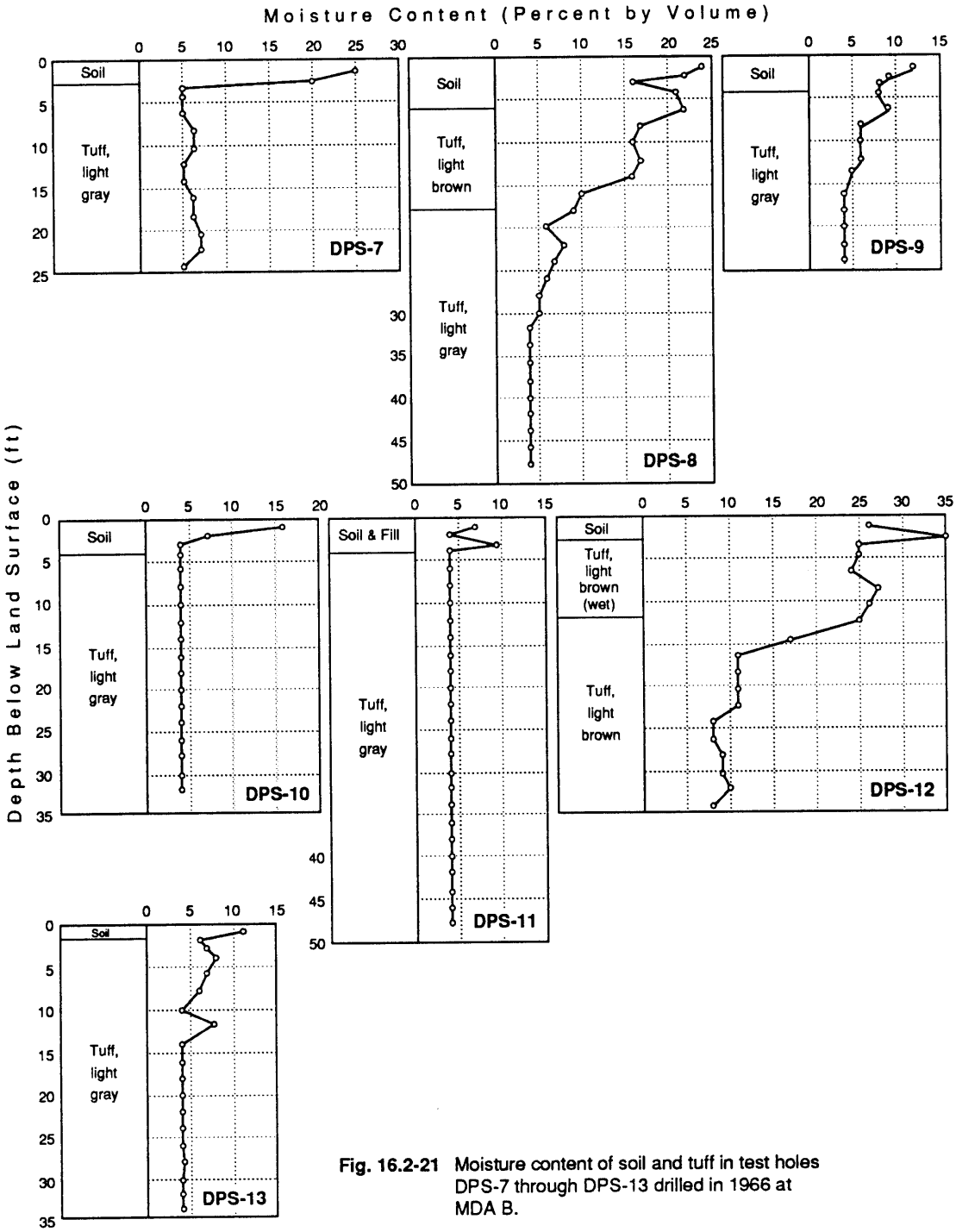


Fig. 16.2-21 Moisture content of soil and tuff in test holes DPS-7 through DPS-13 drilled in 1966 at MDA B.

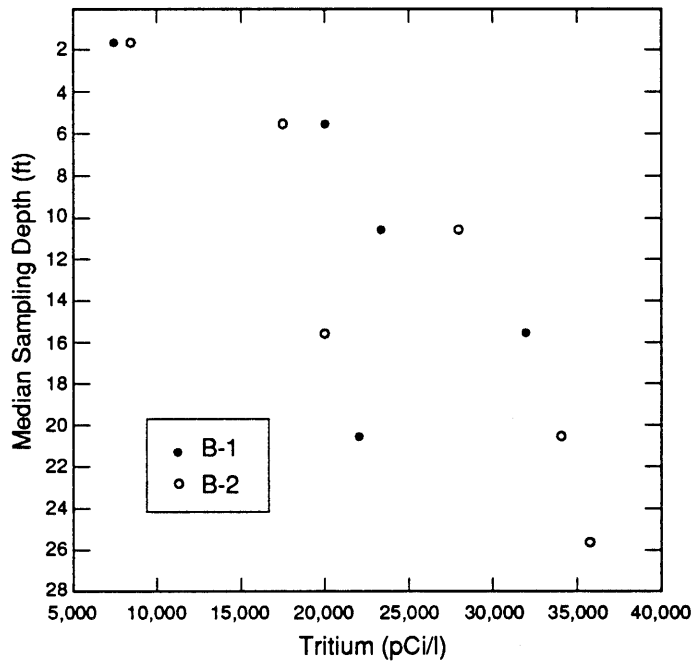


Fig. 16.2-22 Depth vs. tritium concentration in soils sampled at MDA B during 1983. Note that tritium concentrations increase with depth.

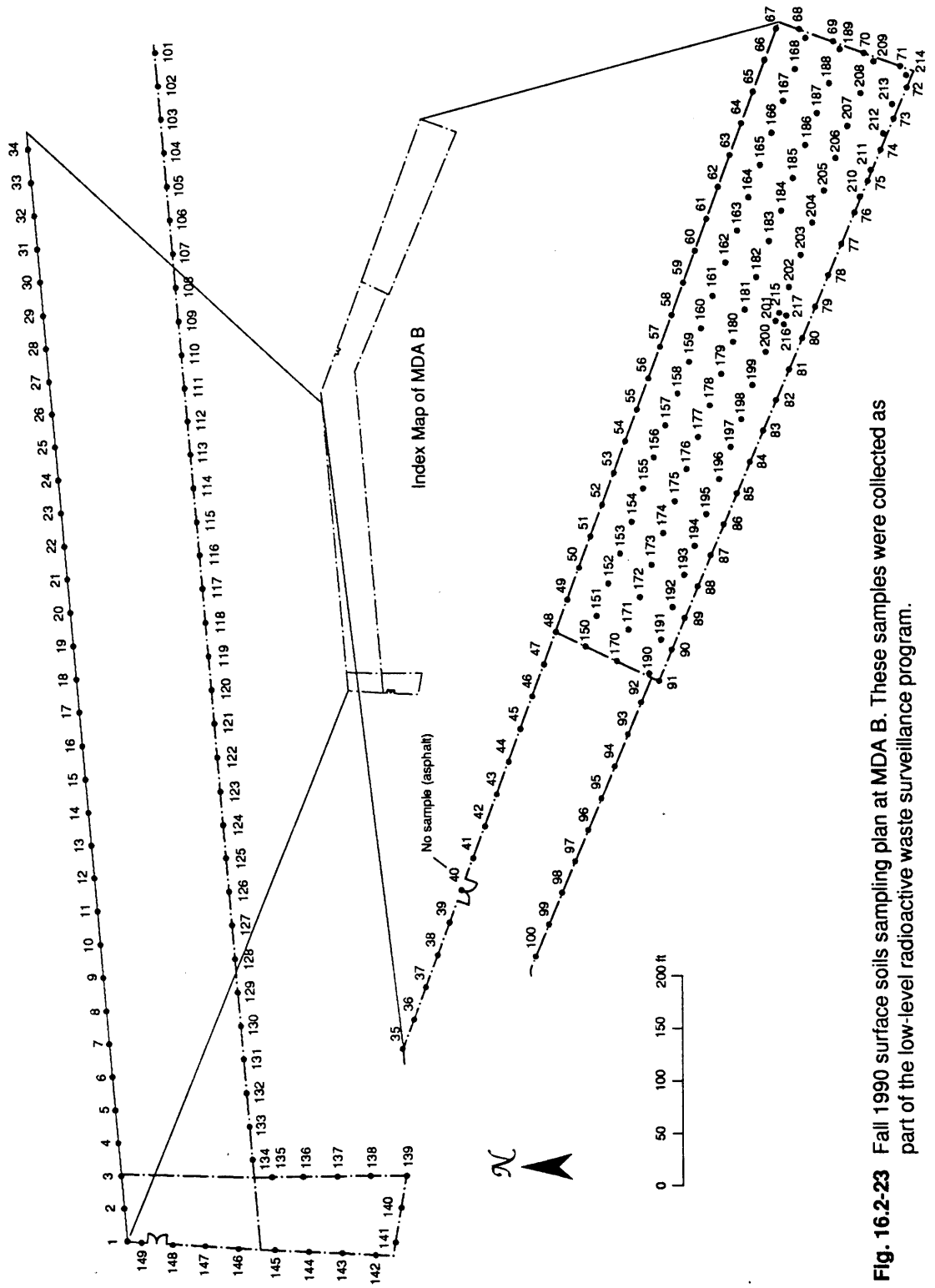


Fig. 16.2-23 Fall 1990 surface soils sampling plan at MDA B. These samples were collected as part of the low-level radioactive waste surveillance program.

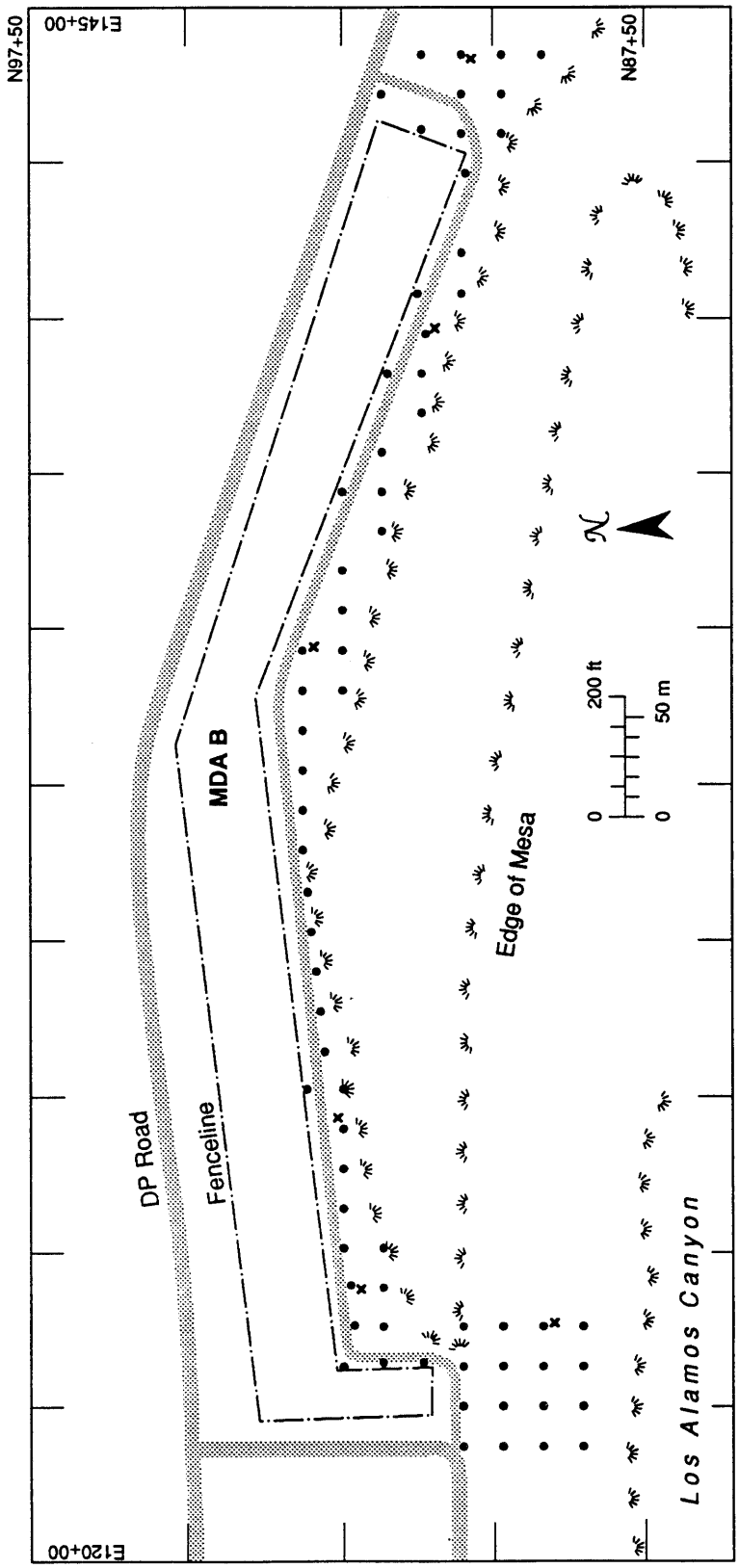


Fig. 16.2-24 Approximate 20-m by 20-m spacing of surface samples from fence to canyon rim for MDA B. The x's indicate possible replicate samples.

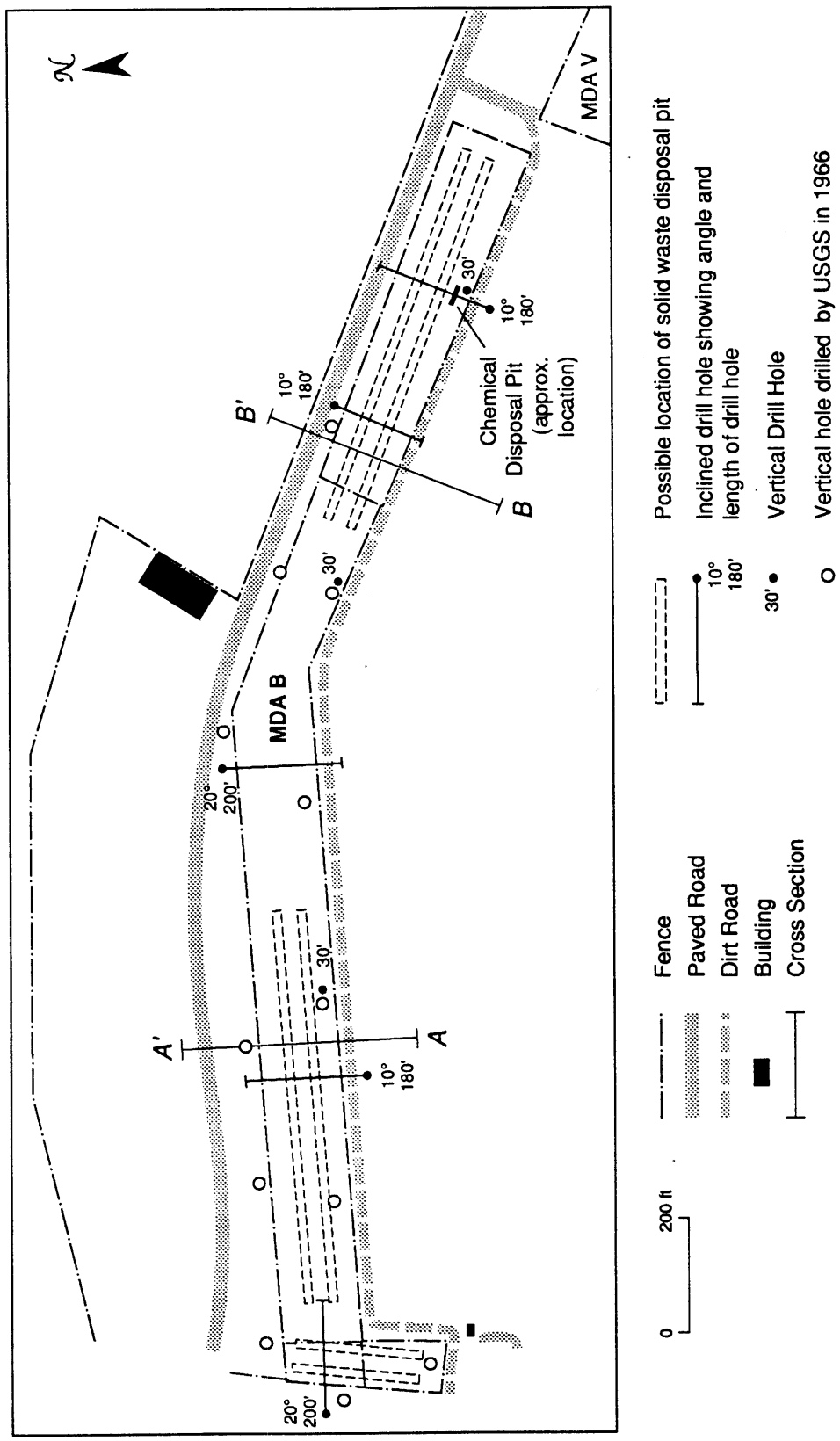


Fig. 16.2-25 Map of MDA B showing possible layout of disposal beds and locations of initial investigation drill holes.

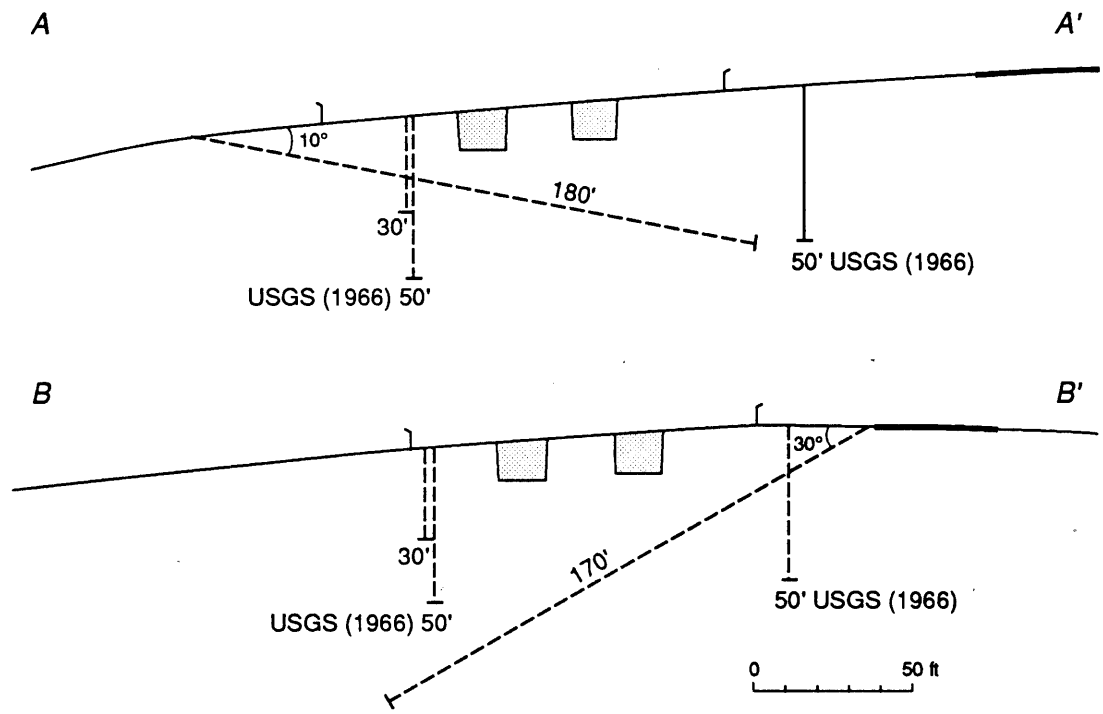


Fig. 16.2-26 Cross sections for MDA B showing schematic layout of the disposal beds and locations of initial characterization drill holes. Drill holes outside the plane of the section are dashed.

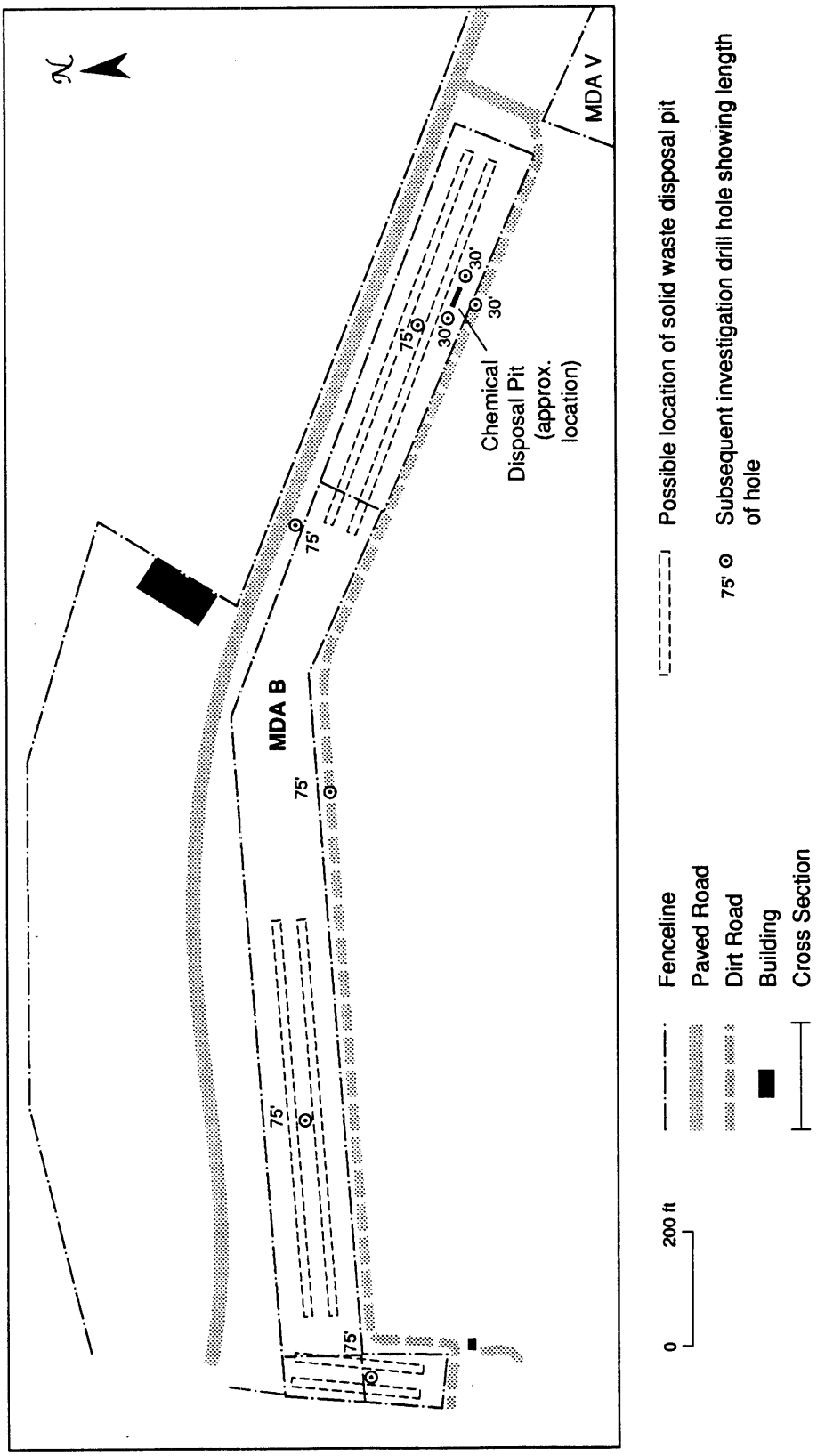


Fig. 16.2-27 Map of MDA B showing possible layout of disposal beds and locations of subsequent investigation drill holes.

TABLE 16.2-I CHRONOLOGICAL EVENTS AT MDA B

Date	Location	Reference	Event
1944-1952	MDA B	N/A	Construction of pit(s) and disposal of solid waste. Exact dimensions and number of pits not known.
1948	MDA B	N/A	On May 3, fire occurred in 60% of the open pit. Fire extinguished within two hours.
1948 (?) fence.	MDA B	N/A	Hog wire fence was replaced with chain link
1953 (June)	MDA B In caisson down-gradient of MDA B	LA-6848-MS Vol. I, 1963 USGS Administrative Release	Gross alpha in soil.
1966 asphalt	MDA B	N/A	Western two-thirds of the area paved with and then leased to the County of Los Alamos for the storage of RV-type vehicles.
1966 Alpha, (February)	MDA B	USGS Open File Report	Moisture content, Uranium, Plutonium, Gross
		LA-6848-MS Vol. I	Gross Alpha, Gross Beta-Gamma.
1966 September (?)	MDA B	LA-6848-MS Vol. I	Beta-Gamma Survey (Geiger counter).
1971 (November)	MDA B	LA-6848-MS Vol. I	Gross alpha (alpha counter) Gross beta-gamma (beta-gamma counter).
1976 (August)	MDA B (asphalt portion)	LA-6848-MS Vol. I	Visual observation for maintenance and repair measures.

TABLE 16.2-I CHRONOLOGICAL EVENTS AT MDA B

Date	Location	Reference	Event
1977	MDA B (unpaved portion)	Unpublished data (Discussed in report that is in preparation)	Surface Phoswich gamma survey surface soil samples (Uranium, Plutonium, Gross alpha, Gross beta, and tritium).
1979 ^{90}Sr,	MDA B.	Los Alamos Notebook	^{3}H, ^{238}Pu, ^{239}Pu, ^{241}Am, ^{137}Cs, ^{226}Ac,
	5 sampling locations plus background Depth: 0-1, 1-10, and 10-30 cm	A411 Files	^{226}Ra, and total U in soils (surface).
1980	MDA B. 5 sampling locations	Los Alamos Notebook A411 Files	^{3}H, ^{235}U, $^{235}U/^{238}U$, ^{238}Pu, ^{239}Pu in plants.
1980	One location at MDA B Depth: 0-1, 1-10, and 10-30 cm	Los Alamos Notebook A411 Files	Gross gamma in soil.
1981 and	MDA B.	N/A	A decontamination crew removed some U-233 Pu-239 contaminated soil to an active waste disposal site.
1981	MDA B. Peaches (1 location) location not identified	Los Alamos Notebook A411 Files	^{3}H, ^{238}Pu, ^{239}Pu, and ^{90}Sr in peels, pulp, and pits of peaches.
1981	MDA B, exact location not identified (excavation samples) new sewer ditch Depth: 110-120; 100-130; 90-113 etc.	Los Alamos Notebook A411 Files	Moisture content, U, and ^{239}Pu, in soil from new sewer ditch.

TABLE 16.2-I CHRONOLOGICAL EVENTS AT MDA B

Date	Location	Reference	Event
1981	MDA B, 12 locations. Depths not identified nor location identified		^{3}H, ^{238}Pu, ^{239}Pu and Gross gamma in soil.
1982-1987 evaluate	MDA B	N/A	A series of experiments was initiated and implemented on the unpaved portion to trench cap design on moisture and vegetative penetration into buried waste.
1982	MDA B	N/A	The surface of the unpaved eastern area was renovated because of the presence of exposed waste and of surface contamination. The fence was moved outward ten feet. All vegetation was removed, a soil cover added, compacted and reseeded.
1982	MDA B. 4 locations for soil Depths: 0-1, 1-10, 10-30 cm	Los Alamos Notebook A411 Files	^{3}H, U, ^{238}Pu, ^{239}Pu in soil (surface).
1982	MDA B, location not identified	Los Alamos Notebook	Gamma spectrum analysis in peels, pulp, and pits of peaches.
1982	MDA B, 23 locations	Los Alamos Notebook No. 23820	TLD data.
1982	MDA B, research plots	LA-10573-MS	Soil Moisture.
1983	MDA B. Sampling depths: 0-1, 1-10, and 10-30cm; Sampling location: special grid	Los Alamos Notebook A411 Files	Soil, Special grid, ^{3}H, U, ^{238}Pu, ^{239}Pu and Sc.

TABLE 16.2-I CHRONOLOGICAL EVENTS AT MDA B

Date	Location	Reference	Event
1983 ^{238}Pu,	MDA B. Locations: B2	Los Alamos Notebook	Soil (B1 and B2) ^{3}H, total U, $^{235}U/^{238}U$,
	and B2 subsurface, Depths: 0-3, 3-8, 8-13, 13-18, etc. ft)		^{239}Pu, ^{137}Cs.
1983	MDA B. Location: Baseline Depths: 0-1, 1-10, 10-30 cm	Los Alamos Notebook A411 Files	Soil ^{3}H, U, ^{238}Pu, ^{239}Pu, ^{137}Cs.
1983	MDA B	N/A	Animal pelt and shelter ^{238}Pu, ^{239}Pu.
1983	MDA B, 23 locations	Los Alamos Notebook No. 23820	TLD data.
1983	MDA B, research plots	LA-10573-MS	Soil moisture.
1984	MDA B, 3 locations B1, B2, B3, soil depths 01-, 1-10, 10-14,	Los Alamos Notebook A411 Files	Vegetation ^{3}H, U, ^{238}Pu, gamma spectrum. Soil (surface) ^{3}H, ^{238}Pu, ^{239}Pu gamma
spectrum.	10-18, 10-25 cm		Field survey: Gamma uR-meter, Phoswich.
1984	MDA B, research plots	LA-10573-MS	Soil moisture.
1984	MDA B, 21 locations, soil subsurface	Los Alamos Notebook A4II Files	Soil (subsurface) (BI and B2), ^{238}Pu, ^{239}Pu.
1984	MDA B, 23 locations	Los Alamos Notebook No. 23820	TLD data.
1985	MDA B.	Los Alamos Notebook A411 Files	Annual site inspection: breach of confinement, condition of cap, intrusion, other.

TABLE 16.2-I CHRONOLOGICAL EVENTS AT MDA B

Date	Location	Reference	Event
1985	MDA B, research plots	LA-10573-MS	Soil moisture.
1985	MDA B, 23 locations	Los Alamos Notebook No. 23820	TLD data.
1986	MDA B	Los Alamos Notebook	Surface Reconnaissance.
1986	MDA B, 23 Locations	Los Alamos Report LA-10992-ENV	TLD data.

TABLE 16.2-II
MDA B SOIL SURVEY SAMPLES (1977)

Lab. Sample Number	I.D. Number	Gross a pCi/g	Gross c pCi/g	Tritium nCi/l	TOTAL Uranium mg/g	241Am pCi/g	238Pu pCi/g	239/240Pu pCi/g	137Cs pCi/g
BKGD.[a,b]				7.20[a]	3.4[a]	0.023[b]	0.005[a]	0.025[a]	1.09[a]
77.06540	BS-1	4.40	3.70	11.80[c]					
77.06541	BS-2	4.30	4.30	13.80[c]					
77.06542	BS-3	16.00[c]	5.70	12.20[c]					7.65[c]
77.06543	BS-4	8.60	8.60[c]	18.00[c]					
77.06544	BS-5	5.10	3.20	16.40[c]					
77.06545	BS-6	8.80	6.40	14.10[c]					
77.06546	BS-7	9.10	5.40	16.90[c]					
77.06547	BS-8	7.30	7.30	37.10[c]					
77.06548	BS-9	11.00[c]	6.50	26.70[c]					
77.06549	BS-10	6.20	4.30	12.50[c]					
77.06550	BS-11	46.00[c]	5.40	513.00[c]			1.40[c]	0.01	10.10[c]
77.06551	BS-12	4.40	5.10	14.50[c]					
77.06552	BS-13	11.00[c]	4.30	11.80[c]					
77.06553	BS-14	5.80	7.00	4.60					
77.06554	BS-15	5.30	4.50	10.00[c]					
77.06555	BS-16	5.10	4.60	17.20[c]					
77.06556	BS-17	6.40	6.60	9.40[c]					
77.06557	BS-18	3.00	4.10	17.10[c]					
77.06558	BS-19	5.80	6.10	15.20[c]					
77.06559	BS-20	6.10	5.70	17.40[c]					
77.06560	BS-21	5.70	6.50	22.10[c]					
77.06561	BS-22	27.00[c]	6.50	51.40[c]	7.70[c]		0.63[c]	47.60[c]	0.07
77.06562	BS-23	6.20	3.80	23.20[c]					
77.06563	BS-24	3.80	3.80	17.50[c]					
77.06564	BS-25	4.50	5.40	18.60[c]					
77.06565	BS-26	6.20	4.20	19.70[c]					

TABLE 16.2-II
MDA B SOIL SURVEY SAMPLES (1977)

Lab. Sample Number	I.D. Number	Gross a pCi/g	Gross c pCi/g	Tritium nCi/l	TOTAL Uranium mg/g	^{241}Am pCi/g	^{238}Pu pCi/g	$^{239/240}Pu$ pCi/g	^{137}Cs pCi/g
	BKGD.[a,b]			7.20[a]	3.4[a]	0.023[b]	0.005[a]	0.025[a]	1.09[a]
77.06566	BS-27	15.00c	2.70	18.00[c]	2.70	1.12[c]			0.11
77.06567	BS-28	30.00c	3.90	22.70[c]	2.70	0.90[c]	0.06c	25.70[c]	0.53
77.06568	BS-29	3.90	4.40	15.40[c]	5.00[c]				0.87
77.06569	BS-30	8.40	31.00[c]	12.50[c]	5.70[c]	0.45[c]			1.31[c]
77.06570	BS-31	3.80	3.40	11.40[c]					
77.06571	BS-32	1.30	2.80	15.90[c]					
77.06572	BS-33	8.50	9.00[c]	11.90[c]	0.01				2.04[c]
77.06573	BS-34	5.90	5.50	12.30[c]					
77.06574	BS-35	13.00c	8.60[c]	22.10[c]	14.00c	2.10[c]			1.45[c]
77.06575	BS-36	26.00c	7.70	3420.00[c]	0.00	1.76c	0.14c	16.80[c]	1.11[c]
77.06576	BS-37	15.00c	7.40	152.00[c]	4.60[c]	3.70[c]		5.80[c]	1.60[c]
77.06577	BS-38	9.20	7.00	26.20[c]					
77.06578	BS-39	4.00	4.50	14.60[c]					
77.06579	BS-40	2.90	4.30	11.60[c]					
77.06580	BS-41	12.00c	3.30	2.89	3.40	1.40[c]	0.00	9.20[c]	0.42
77.06581	BS-42	3.30	4.60	12.00[c]					
77.08455	BS-43			12.10[c]	5.10[c]				0.60
77.08456	BS-44			13.80[c]	4.30[c]				0.89
77.08457	BS-45			13.40[c]	8.80[c]				1.59[c]
77.08458	BS-46			11.20[c]	7.40[c]				2.50[c]
77.08459	BS-47			.780	4.00[c]				0.56
77.08460	BS-48			.880	5.10[c]				1.65[c]
77.08461	BS-49			18.60[c]	7.90[c]				1.38[c]
77.08462	BS-50			14.50[c]	8.30[c]				0.37
77.08463	BS-51			8.50	6.60[c]				1.49[c]
77.06582	BPS-1A	6.30	4.30	10.70					
77.06583	BPS-1B	240.00[c]	350.00[c]	9.50				-0.04	2.50[c]
77.07684	BPS-2	1600.00[c]	137.00[c]	11.30[c]	79.00[c]		0.02[c]	7.61[c]	0.80

TABLE 16.2-II
MDA B SOIL SURVEY SAMPLES (1977)

Lab. Sample Number	I.D. Number	Gross a pCi/g	Gross c pCi/g	Tritium nCi/l	TOTAL Uranium mg/g	^{241}Am pCi/g	^{238}Pu pCi/g	$^{239/240}Pu$ pCi/g	^{137}Cs pCi/g
	BKGD.[a,b]			7.20[a]	3.4[a]	0.023[b]	0.005[a]	0.025[a]	1.09[a]
77.06585	BPS-3	370.00[c]	560.00[c]	7.7	835.00[c]		0.03[c]	22.10[c]	0.89
77.06586	BPS-4	7.10	6.40	983.00[c]					
77.06587	BPS-5	10.00[c]	152.00[c]	21.30[c]	13.00[c]		-0.03	27.80[c]	127.00[c]
77.06588	BPS-6	3.10	99.00[c]	.345			0.79[c]		
77.06589	BPS-7	200.00[c]	5.60	24.80[c]	5.40[c]	71.00[c]	5.00[c]	257.00[c]	0.48
77.06590	BPS-8	6200.00[c]	-15.00	7.30	9.70[c]	233.00[c]		130.00[c]	1.03
77.06591	BPS-9	17.00[c]	8.50[c]	24.80[c]	6.30[c]	52.20[c]	0.78[c]	51.90[c]	0.92
77.06592	BPS-11	2000.00[c]	18.00[c]	31.70[c]	8.10[c]		27.10[c]	1370.00[c]	0.71
	BPS-12A			43.60[c]			20.00[c]	0.00	0.00
	BPS-12B			11.62[c]	100.00[c]	0.00	0.00	0.00	6.00[c]
	BPS-12C			11.20[c]			0.00	0.00	0.00
	BPS-12D			175.00[c]	1.90		0.00	0.00	0.43
	BPS-12E			24.30[c]				0.00	0.00
	BPS-13			58.20[c]					

[a]Upper limit background levels from Purtymun (1987).
[b]Upper limit background levels from The Environmental & Surveillance Group (1980).
[c]Above background activity.

TABLE 16.2-III
MDA B SOIL SURVEY SAMPLES (1978)

Loc.	$^{239,240}Pu$ pCi/g	^{90}Sr pCi/g	^{226}Ra pCi/g	Th mg/g	Other
BKGD.[a]	.025[a]	.88[a]	.005[b]		
BS-1	8.37±0.03	0.72±0.08	1.2±0.3	10.8±.6	0.53±0.07 ^{137}Cs -0.3±0.4 ^{227}Ac
BS-2	0.975±0.017		0.9±0.5	10.8±6	0.71±0.10 ^{137}Cs -0.9±0.4 ^{227}Ac
BS-3	6.92±0.07	0.53±0.07	0.9±0.3	11.3±.6	1.30±0.13 ^{137}Cs 0.1±0.9 ^{227}Ac
BS-4	3.77±0.05		1.4±0.3	11.7±.6	1.06±0.08 ^{137}Cs 0.0±0.2 ^{227}Ac
BS-5	0.438±0.013	1.66±0.11	1.3±0.2	11.6±.6	0.20±0.05 ^{137}Cs 0.0±0.5 ^{227}Ac
BS-6	14.36±0.12		1.19±0.17	10.2±.6	0.92±0.08 ^{137}Cs -0.5±0.5 ^{227}Ac
BS-7	8.19±0.08	1.27±0.11	0.73±0.13	11.8±.6	0.80±0.08 ^{137}Cs 0.1±0.5 ^{227}Ac
BS-8	3.03±0.04		1.3±0.3	13.0±6	1.39±0.14 ^{137}Cs 0.3±0.9 ^{227}Ac
BS-9	9.34±0.10	0.70±0.09	1.7±0.4	11.3±.6	1.14±0.14 ^{137}Cs -2.0±1.1 ^{227}Ac
BS-10	4.42±0.04		1.7-0.4	10.3±.6	0.49±0.07 ^{137}Cs 0.8±0.5 ^{227}Ac
BS-11			1.6±0.2		1.03±0.07 ^{137}Cs pci/g
					0.80±0.20 ^{241}Am pci/g
BS-12	0.718±0.015	1.54±0.10	1.54±0.18	13.4±.6	1.25±0.14 ^{137}Cs -0.8±1.0 ^{227}Ac
BS-13	0.908±0.018		1.23±0.11	12.4±.6	0.78±0.05 ^{137}Cs 0.2±0.2 ^{227}Ac
BS-14	11.91±0.12	1.73±0.11	1.07±0.10	10.2±.6	1.06±0.08 ^{137}Cs -0.1±0.4 ^{227}Ac
BS-15	1.73±0.03		1.09±0.14	13.2±.6	0.84±0.07 ^{137}Cs 0.0±0.4 ^{227}Ac
BS-16	6.19±0.06	0.55±0.13	1.39±0.12	13.3±.6	1.06±0.06 ^{137}Cs 0.2±0.2 ^{227}Ac
BS-17	1.12±0.03		1.34±0.10	12.0±.6	1.87±0.11 ^{137}Cs -0.5±0.5 ^{227}Ac
BS-18	7.59±0.08	0.78±1.2	1.15±0.14	13.3±.6	0.79±0.06 ^{137}Cs 0.2±0.2 ^{227}Ac
BS-19	0.765±0.018		1.30±0.11	12.5±.6	0.85±0.07 ^{137}Cs -0.7±0.6 ^{227}Ac
BS-20	1.16±0.03		1.0±0.3	11.9±.6	1.00±0.08 ^{137}Cs -0.4±0.5 ^{227}Ac
BS-21	6.9±0.1		1.1±0.3	12.4±.6	1.69±0.10 ^{137}Cs 0.4±0.3 ^{227}Ac
BS-22	36.5±0.8		1.2±0.4	10.8±.6	0.27±0.05 ^{137}Cs -0.5±0.4 ^{227}Ac
BS-23	2.69±0.04		1.25±0.13	11.3±.6	0.49±0.06 ^{137}Cs -0.2±0.5 ^{227}Ac
BS-24	1.27±0.03		1.7±0.4	12.4±.6	0.80±0.08 ^{137}Cs 0.1±0.6 ^{227}Ac
BS-25	1.27±0.02		1.2±0.3	10.9±.6	0.94±0.07 ^{137}Cs 0.3±0.3 ^{227}Ac
BS-26	5.09±0.06		1.3±0.3	12.8±.6	0.53±0.07 ^{137}Cs 0.0±0.5 ^{227}Ac
BS-27	11.64±0.11	0.7±0.1	0.5±0.3	9.8±.6	0.29±0.05 ^{137}Cs 0.0±0.5 ^{227}Ac
BS-28	34.2±0.6		1.0±0.3	8.1±.6	0.49±0.06 ^{137}Cs -0.6±0.6 ^{227}Ac
BS-29	0.536±0.018		0.85±0.11	15.1±.6	1.01±0.10 ^{137}Cs -0.4±0.6 ^{227}Ac
BS-30	7.60±0.07		1.7±0.3	14.2±.6	1.30±0.08 ^{137}Cs 0.1±0.3 ^{227}Ac
BS-31	0.718±0.017	2.24±0.13	1.06±0.10	13.0±.6	1.31±0.09 ^{137}Cs -0.5±0.6 ^{227}Ac
BS-32	0.131±0.008		1.9±0.3	13.1±.6	0.45±0.05 ^{137}Cs 0.7±0.4 ^{227}Ac
BS-33	3.21±0.04	0.74±0.09	1.4±0.3	14.3±.6	2.29±0.13 ^{137}Cs -0.5±0.5 ^{227}Ac
BS-34	0.399±0.013		0.6±0.2	11.3±.6	1.24±0.10 ^{137}Cs 0.2±0.3 ^{227}Ac
BS-35	12.6±0.3		1.8±0.4	10.3±.6	1.82±0.11 ^{137}Cs -0.7±0.6 ^{227}Ac
BS-36	16.9±0.2		1.1±0.4	12.4±.6	1.13±0.07 ^{137}Cs 0.0±0.3 ^{227}Ac
BS-37	9.56±0.19		1.17±0.13	10.9±.6	1.65±0.12 ^{137}Cs -0.4±0.5 ^{227}Ac
BS-38	5.25±0.07		1.13±0.14	12.0±.6	0.72±0.06 ^{137}Cs -0.3±0.5 ^{227}Ac
BS-39	0.86±0.02	1.51±0.12	1.33±1.5	23.0±.6	0.68±0.07 ^{137}Cs 0.0±0.5 ^{227}Ac
BS-40	0.751±0.018		1.6±0.3	14.8±.6	0.43±0.05 ^{137}Cs -0.4±0.5 ^{227}Ac
BS-41	12.67±0.12	1.5±0.1	1.19±0.14	10.1±.6	0.57±0.04 ^{137}Cs 0.1±0.2 ^{227}Ac

TABLE 16.2-III
MDA B SOIL SURVEY SAMPLES (1978)

Loc.	$^{239,240}Pu$ pCi/g	^{90}Sr pCi/g	^{226}Ra pCi/g	Th mg/g	Other
BKGD.[a]	.025[a]	.88[a]	.005[b]		
BS-42	1.50±0.03		0.8±0.2	11.0±.6	0.83±0.06 ^{137}Cs 0.3±0.4 ^{227}Ac
BS-43	0.751±0.019	0.77±0.1	1.0±0.3	11.7±.6	0.71±0.07 ^{137}Cs 0.1±0.5 ^{227}Ac
BS-44	0.089±0.006		0.46±0.11	8.7±.6	0.91±0.06 ^{137}Cs -0.3±0.4 ^{227}Ac
BS-45	1.051±0.018	1.0±0.1	1.4±0.4	12.1±.6	1.95±0.12 ^{137}Cs -0.2±0.4 ^{227}Ac
BS-46	2.874±0.018		0.2±0.6	10.9±.6	2.80±0.19 ^{137}Cs -0.4±0.7 ^{227}Ac
BS-47	0.189±0.008	0.5±0.1	0.8±0.2	10.8±.6	0.52±0.08 ^{137}Cs -0.2±0.6 ^{227}Ac
BS-48	0.198±0.007		1.4±0.3	12.2±.6	1.67±0.10 ^{137}Cs 0.7±0.5 ^{227}Ac
BS-49	1.65±0.02	1.68±0.14	0.99±0.06	10.0±.6	1.56±0.09 ^{137}Cs -0.2±0.3 ^{227}Ac
BS-50	3.60±0.05		1.30±0.14	12.8±.6	0.42±0.05 ^{137}Cs 0.3±0.3 ^{227}Ac
BS-51	1.64±0.03	2.04±0.17	1.2±0.4	12.7±.6	1.67±0.10 ^{137}Cs -0.5±0.5 ^{227}Ac
BPS 2			12.9±.08		0.60±0.05 ^{137}Cs pci/g 0.00±0.50 ^{241}Am pci/g
BPS 5			17.5±1.3		131 ±9.00 ^{137}Cs pci/g 0.40±0.20 ^{241}Am pci/g
BPS 8			1.4±0.3		0.98±0.08 ^{137}Cs pci/g 240.0±12.0 ^{241}Am pci/g

[a]Upper limit background levels from Purtymun (1987).
[b]The upper limit background level for ^{226}Ra is the same as that for ^{238}U which is from Purtymun (1987).

TABLE 16.2-IV
MDA B PERIMETER SOIL SURVEY SAMPLES (1979)[a]

Sample Number (cm)	Sample Location	Sample Depth	Tritium Value (pCi/l)	+/-	Uranium Value (µg/g)	+/-	^{238}Pu Value (pCi/g)	+/-	$^{239/240}Pu$ Value (pCi/g)	+/-	^{137}Cs Value (pCi/g)	+/-	^{227}Ac Value (pCi/g)	+/-
BKGD.[b,c]			720[b]		3.4[b]		0.0050[b]		0.025[b]		1.09[b]		0.04[c]	
79.04417	BKGD.[d]	0-1	800	300	3.5	0.4	0.0110	0.0020	0.201	0.008	0.93	0.06	-0.3	0.3
79.04418	BKGD.[d]	1-10	1600	400	3.8	0.4	0.0037	0.0014	0.330	0.010	1.21	0.08	0.1	0.3
79.04419	BS-1	0-1	2100	400	6.7	0.7	-0.0007	0.0015	0.657	0.015	0.30	0.07	-1.5	0.7
79.04420	BS-1	1-10	2200	400	4.8	0.5	0.0005	0.0014	0.851	0.019	0.90	0.09	0.1	0.7
79.04421	BS-1	10-30	0	300	4.0	0.4	0.0007	0.0011	0.089	0.005	0.29	0.09	1.4	0.8
79.04422	BS-2	0-1	1900	400	5.0	0.5	0.0130	0.0020	3.330	0.040	0.65	0.05	-0.1	0.4
79.04423	BS-2	1-10	2600	400	4.2	0.4	0.0150	0.0030	3.500	0.040	0.55	0.06	0.1	0.4
79.04424	BS-2	10-30	1900	400	4.8	0.5	0.0150	0.0020	4.010	0.040	0.49	0.06	-0.7	0.8
79.04425	BS-3	0-1	700	300	7.0	0.7	0.0420	0.0040	3.160	0.040	3.23	0.19	-0.3	0.9
79.04426	BS-3	1-10	2300	400	8.7	0.9	0.0440	0.0040	5.870	0.070	2.06	0.13	-0.4	0.6
79.04427	BS-3	10-30	1800	400	3.9	0.4	0.0040	0.0015	1.188	0.019	0.31	0.16	-1.0	1.5
79.04428	BS-4	0-1	4700	400	7.0	0.7	-0.0019	0.0009	2.160	0.030	1.63	0.12	-0.1	0.8
79.04429	BS-4	1-10	25700	600	5.4	0.5	0.0290	0.0030	3.140	0.040	0.53	0.06	0.0	0.5
79.04430	BS-5	0-1			5.0	0.5	0.0970	0.0050	15.500	0.130				
79.04431	BS-5	1-10			110.0	10.0	0.0290	0.0030	2.350	0.030				
79.04432	BS-5	10-30			7.2	0.7	0.0170	0.0030	24.700	0.200				
79.04433	BS-5	10-30			56.0	6.0	0.0190	0.0030	24.900	0.200				

[a]The ± values reported for each radionuclide are analytical laboratory uncertainty.
[b]Upper limit background levels from Purtymun (1987).
[c]The upper limit background level for Actinium 227 is the same as Uranium 235. The upper limit background level for ^{235}U was derived from Purtymun's upper limit background level for total Uranium.
[d]These samples, taken approximately 200 ft west of MDA B, were intended to document background concentrations near MDA B; however, $^{239/240}Pu$ levels in these samples were eight times the background level.

TABLE 16.2-V
1980 MDA B AND GUAJE CANYON VEGETATION SURVEY SAMPLES[a]

Sample Number BKGD.[b,c]	Sample Location	Species	Tritium Value (pCi/l) 800[b]	+/-	^{235}U Value (ppb) 156[c]	+/-	^{238}Pu Value (pCi/g) 0.00015[b]	+/-	$^{239/240}Pu$ Value (pCi/g) 0.00023[b]	+/-
	MDA B									
80.05340	1	Yucca	1400	300	160	50	-0.0040	0.0040	0.0160	0.0060
80.05341	1	Artemesia	-1800	300	1310	130	-0.0040	0.0030	0.1170	0.0150
80.05342	2	Juniper	600	300	930	100	0.0013	0.0005	0.0640	0.0030
80.05343	3	Melilotus	2900	300	390	50	0.0030	0.0030	0.2290	0.0130
80.05344	3	Andropagon	7300	400	390	50	0.0075	0.0018	0.3170	0.0130
80.05345	3	Quercus	809000	13000	1230	130	0.0043	0.0012	0.0490	0.0030
80.05346	4	Cercocarpus	2400	300	790	80	0.0023	0.0007	0.0930	0.0040
80.05347	4	Quercus	3000	300	1020	100	0.0104	0.0014	0.5100	0.0150
80.05348	4	Andropagon	2300	300	590	60	0.0019	0.0012	0.0770	0.0060
80.05349	5	Guttieriezia	543000	9000	930	100	0.0580	0.0030	0.1160	0.0040
80.05350	5	Bouteloua	29900	700	9950	1000	0.0020	0.0030	0.5200	0.0200
80.05351	5	Verbascum	374000	6000	1740	180	0.0044	0.0014	0.2500	0.0100
	Guaje Controls									
80.06867		Hochia Scoparia					-0.0005	0.0013	0.0070	0.0030
80.06868		Mylilotur					-0.0010	0.0020	0.0070	0.0030
80.06869		Quercus Gambelli					0.0021	0.0019	0.0030	0.0040
80.06870		Artemesia					0.0004	0.0013	0.0120	0.0020
80.06871		Bramus tectorium (dead)					0.0004	0.0003	0.0140	0.0010
80.06872		Bouteloua gracilis					0.0012	0.0014	0.0190	0.0030
80.06873		Pinus ponderosa					0.0020	0.0030	0.0680	0.0080
80.06874							0.0102	0.0018	0.2840	0.0100
80.06875		Pinus edulis					0.0034	0.0014	0.0500	0.0050
80.06876		Juniperus monosperma					-0.0003	0.0010	0.0370	0.0030

aThe ± values reported for each radionuclide are analytical laboratory uncertainty.
[b]Upper limit background levels from The Environmental & Surveillance Group (1987).
[c]Upper limit background level for U-235 calculated from the upper limit background level for total uranium provided by The Environmental & Surveillance Group (1987).

TABLE 16.2-VI
MDA B VEGETATION SURVEY SAMPLE: PEACHES[a]

Sample Number	Sample Location	Sample Depth (cm)	Tritium Value (pCi/l)	+/-	^{238}Pu Value (pCi/g)	+/-	$^{239/240}Pu$ Value (pCi/g)	+/-	^{90}Sr Value (pCi/g)	+/-
BKGD.[b]			800[b]		0.00015[b]		.00023[b]			
81.07118	PEELS	LOWER	1400	500	0.0220	0.0080	0.0740	0.0130	-0.0400	0.0800
81.07119	PEELS	MIDDLE	1400	900	0.1200	0.0120	0.0750	0.0100	0.0900	0.1000
81.07120	PEELS	TOP	7800	700	0.0380	0.0080	0.0350	0.0080	0.1000	0.0800
81.07121	PULP	LOWER	4200	400	0.0110	0.0030	0.0210	0.0040	-0.0700	0.0500
81.07122	PULP	MIDDLE	7200	1000	0.0110	0.0020	0.0100	0.0020	0.0400	0.0600
81.07123	PULP	TOP	1700	400	0.0080	0.0030	0.0210	0.0040	-0.0900	0.0800
81.07124	PITS	LOWER	3600	400	0.0230	0.0060	0.0350	0.0080	-0.0100	0.1000
81.07125	PITS	MIDDLE	2900	400	0.0630	0.0150	0.0750	0.0160	0.1000	0.2000
81.07126	PITS	TOP	800	400	0.0600	0.0140	0.0270	0.0100	-0.1700	0.1100

aThe ± values reported for each radionuclide are analytical laboratory uncertainty.
b Upper background levels from The Environmental & Surveillance Group (1987).

TABLE 16.2-VII
ARITHMETIC MEAN, STANDARD DEVIATION, AND COEFFICIENT OF VARIATION FOR RADIONUCLIDE RESULTS

Sample Type BKGD.[o]	N	Sc (ppb dry) $\bar{X} \pm 1\sigma$	Sc COV	U (ppb dry) $\bar{X} \pm 1\sigma$	U COV .0096[o]	^{137}CS (fCi/g dry) $\bar{X} \pm 1\sigma$	^{137}CS COV 2060[o]	$^{239/240}Pu$ (fCi/g dry) $\bar{X} \pm 1\sigma$	$^{239/240}Pu$ COV .23[o]
Ponderosa Pine 5 - growing in waste									
Soil around waste debris (>100 cm)	6	2660±434	0.16	5070±581	0.11	168±267	1.6	578000±323000	0.56
Litter - pine needles	2	111±11.3	0.10	430±20.5	0.048	385±28.3	0.074	3570±764	0.21
Litter - misc.	1	262		585		423		7210	
Unbagged needles	3	10.4±.912	0.088	63.3±8.61	0.14	23.1±13.4	0.58	21.6±5.84	0.27
Bole bark	2	9.94±8.86	0.89	70.1±49.4	0.70	28.2±36.8	1.3	10400±5830	0.56
Bole wood	5	0.631±.0524	0.083	0.385±.195	0.51	8.50±11.21	1.3	5.27±1.59	0.30
Root wood	5	3.78±7.22	1.9	10.1±14.5	1.4	-0.699±1.96	2.8	250±328	1.3
Root bark	4	141±96.0	0.68	314±199	0.63	3.80±6.56	1.7	23900±31000	1.3
Ponderosa Pine - all remaining									
Soil 2 cm	3	2510±382	0.15	5630±793	0.14	1075±389	0.36	5650±7340	1.3
Soil 10 cm	3	2540±366	0.14	5290±497	0.094	289±266	0.92	4720±6180	1.3
Soil 25 cm, 30 cm	4	3070±760	0.25	4430±1030	0.23	110±96.3	0.88	1230±1270	1.0
Soil 45-55, 80 cm	2	2840±368	0.13	4415±827	0.19	186±335	1.8	884±702	0.79
Soil 150-160 cm	1	2450		4180		-46.9		1020	
Litter - pine needles	7	164±72.2	0.44	426±229	0.54	459±161	0.35	217±102	0.47
Litter - misc.	4	454±322	0.71	867±528	0.61	628±356	0.57	816±741	0.91
Unbagged needles	14	20.0±9.48	0.47	76.7±93.2	1.2	77.9±39.6	0.51	13.0±12.1	0.93
Bole bark	11	43.3±35.6	0.82	74.4±60.7	0.82	30.4±35.7	1.2	557±875	1.6
Bole wood	16	0.391±.538	1.4	0.996±1.36	1.4	3.71±6.52	1.8	1.52±2.25	1.5
Root wood	2	14.3±18.1	1.3	36.3±28.7	0.79	-1.62±6.92	4.3	164±211	1.3
Root bark	4	2.80±5.20	1.9	412±445	1.1	15.5±25.4	1.6	997±1940	1.9

TABLE 16.2-VII (continued)

Sample Type BKGD.[o]	N	Sc (ppb dry) X ± 1σ	COV	U (ppb dry) X± 1σ	COV .0096[o]	^{137}CS (fCi/g dry) X± 1σ	COV 2060[o]	$^{239/240}$Pu (fCi/g dry) X± 1σ	COV .23[o]
Peach and Elm (Deciduous trees)									
Soil 2 cm	1	4000		3730		476		18100	
Soil 10 cm	1	4300		3240		383		29500	
Soil 25 cm, 30 cm	1	3770		3720		189		7850	
Soil 80 cm	1	3210		3800		72.7		12100	
Unbagged leaves	4	26.5±15.5	0.58	47.9±18.2	0.38	-34.2		2.63	
Bagged leaves	3	5.18±1.56	0.30	14.4±9.65	0.67	148		4.87	
Bole bark	2	22.5±24.3	1.1	40.0±46.7	1.2	96.0±63.6	0.66	15.3±3.25	0.21
Bole wood	2	0.200±0.0290	0.15	7.68±.488	0.064	1.33±5.43	4.1	4.10±0.431	0.11
Root wood	1	4.77		14.3		-4.27		62.1	
Root bark	1	0.530		602		83.8		4160	
Oak, Chamisa, Ribes, Fallugia (Shrubs)									
Soil 2 cm	3	2850±613	0.22	5900±1850	0.31	1200±560	0.47	14600±9330	0.64
Soil 10 cm	3	3390±1500	0.44	5660±1750	0.31	664±110	0.17	5320±1850	0.35
Soils 25, 30 cm	3	3510±1500	0.43	4170±748	0.18	163±64.0	0.39	1670±759	0.45
Soils 45-55, 80 cm	2	2260±651	0.29	4020±141	0.035	-13.3±35.4	2.7	4140±5310	1.30
Soil 150, 160 cm	1	2730		3770		-35.8		729	
Soil no depth, around waste debris area (>100 cm)	2	3630±2690	0.74	15800±11900	0.75	75.5±7.42	0.098	159000±219000	1.4
Litter - pine needles	1	56.5		96.8		6570		255	
Litter - misc.	2	1100±1190	1.1	1720±1800	1.0	572±366	0.64	14300±18100	1.3
Unbagged leaves	6	23.3±3.67	0.16	62.1±33.3	0.54	28.3±20.6	0.73	36.7±8.15	0.22
Bagged leaves	12	4.86±.848	0.17	21.0±12.8	0.61	26.9±31.4	1.2	5.27±3.76	0.71
Bole bark	3	85.4±73.9	0.87	650±746	1.1	252±219	0.87	98.4±12.4	0.13
Bole wood	3	2.05±2.22	1.1	13.8±7.44	0.54	12.0±9.49	0.79	21.6±3.44	0.16
Root wood	1	39.6		210		-10.4		5.21	
Root bark	1	1.90		6250		121		113	

[a]Table from Wenzel et al. (1987).
[o]Upper limit background levels from The Environmental & Surveillance Group (1987).

TABLE 16.2-VIII
MDA B SOIL SURVEY SAMPLES[a]

Sample Number	Sample Location	Sample Depth (cm)	Tritium Value	Tritium +/-	Uranium Value (µg/g)	Uranium +/-	^{238}Pu Value (pCi/g)	^{238}Pu +/-	$^{239/240}$Pu Value (pCi/g)	$^{239/240}$Pu +/-
BKGD.[b]			7200[b]		3.40[b]		0.0050[b]		0.0250[b]	
83.02900	1L-10m	0-1	(nCi/l) 134	3	5.40	0.50	0.0150	0.0030	0.6420	0.0170
83.02901	1L-10m	1-10	(nCi/l) 126	3	4.80	0.50	0.0050	0.0030	0.3020	0.0120
83.02902	1L-10m	10-30	(nCi/l) 140	3	3.90	0.40	0.0100	0.0020	1.4900	0.0300
83.02903	1L-20m	0-1	(nCi/l) 112	2	4.10	0.40	0.0060	0.0010	0.3350	0.0100
83.02904	1L-20m	1-10	86400	1400	4.30	0.40	0.0014	0.0000	0.1300	0.0060
83.02905	1L-20m	10-30	17400	400	3.80	0.40	0.0004	0.0010	0.0080	0.0020
83.02906	1L-30m	0-1	(nCi/l) 122	2	4.9	0.50	0.0055	0.0010	0.2990	0.0100
83.02907	1L-30m	1-10	94200	1800	5.1	0.50	0.0042	0.0010	0.1910	0.0090
83.02908	1L-30m	10-30								
83.02909	1L-40m	0-1	58300	1100	6.1	0.60	0.0450	0.0040	5.7700	0.0700
83.02910	1L-40m	1-10	36100	700	5.5	0.60	0.0230	0.0030	3.2900	0.0400
83.02911	1L-40m	10-30	65900	1200	4.3	0.40	0.0090	0.0040	0.7300	0.0200
83.02912	1L-50m	0-1	95000	2000	4.4	0.40	0.0043	0.0010	0.8600	0.0200
83.02913	1L-50m	1-10	89900	1700	4.4	0.40	0.0090	0.0020	1.1300	0.0200
83.02914	1L-50m	10-30	40600	700	4.0	0.40	0.0050	0.0010	0.0700	0.0060
83.02915	1U-10m	0-1			14.8	1.50	0.0350	0.0040	7.0200	0.0100
83.02916	1U-10m	1-10								
83.02917	1U-10m	10-30	20500	500	4.0	0.40	0.0022	0.0010	0.1370	0.0090
83.02918	1U-20m	0-1			6.5	0.70	0.2470	0.0120	42.100	0.5000
83.02919	1U-20m	1-10	68500	1400	5.1	0.50	0.1740	0.0100	29.400	0.3000
83.02920	1U-20m	10-30	49600	1000	3.8	0.40	0.0060	0.0020	0.9100	0.0200
83.02921	1U-30m	0-1								
83.02922	1U-30m	1-10								
83.02923	1U-30m	10-30	53600	900	3.9	0.40	0.0021	0.0010	0.1050	0.0080
83.02924	1U-40m	0-1			5.1	0.50	0.0170	0.0030	3.3300	0.0600
83.02925	1U-40m	1-10			4.5	0.40	0.0051	0.0010	0.4890	0.0170
83.02926	1U-40m	10-30	20100	500	3.9	0.40	0.0010	0.0010	0.0100	0.0020
83.02927	1U-50m	10-30	65100	1100	4.0	0.40	0.0150	0.0030	2.2900	0.0400
83.02928	2C-0m	0-1	(nCi/l) 234	4	3.8	0.40	0.0032	0.0010	7.3400	0.1000
83.02929	2C-0m	1-10	74300	1200	3.8	0.40	0.1420	0.0080	6.5800	0.0900
83.02930	2C-0m	10-30	36500	700	4.1	0.40	0.1470	0.0090	8.0000	0.1000
83.02931	2L-10m	0-1	(nCi/l) 120	2	4.4	0.40	0.0330	0.0040	2.4800	0.0400

TABLE 16.2-VIII
MDA B SOIL SURVEY SAMPLES[a]

Sample Number	Sample Location	Sample Depth (cm)	Tritium Value (pCi/l)	+/-	Uranium Value (µg/g)	+/-	^{238}Pu Value (pCi/g)	+/-	$^{239/240}Pu$ Value (pCi/g)	+/-
BKGD.[b]			7200[b]		3.40[b]		0.0050[b]		0.0250[b]	
83.02932	2L-10m	1-10	59000	1000	4.9	0.50	0.5440	0.0180	33.200	0.0400
83.02933	2L-10m	10-30	83500	1300	4.2	0.40	0.0029	0.0010	0.2320	0.0100
83.02934	2L-20m	0-1	64500	1100	4.4	0.40	0.0057	0.0010	0.5000	0.0170
83.02935	2L-20m	1-10	(nCi/l) 165	3	4.6	0.50	0.0930	0.0070	0.2800	0.0120
83.02937	2L-30m	0-1	(nCi/l) 113	1.9	4.1	0.40	0.0120	0.0070	0.2800	0.0300
83.02938	2L-30m	1-10	80500	1300	4.5	0.40	0.0029	0.0010	0.0620	0.0050
83.02940	2L-40m	0-1	(nCi/l) 137	2	6.3	0.60	0.0200	0.0030	1.3400	0.0300
83.02941	2L-40m	1-10	(nCi/l) 101	1.7	5.1	0.50	0.0017	0.0010	0.1440	0.0070
83.02943	2L-50m	0-1	(nCi/l) 170	3	5.3	0.50	0.0084	0.0010	0.4350	0.0130
83.02944	2L-50m	1-10	(nCi/l) 143	4	4.8	0.50	0.1270	0.0070	0.8200	0.0200
83.02945	2L-50m	10-30	92200	1700	4.2	0.40	0.0340	0.0030	0.0140	0.0020
83.02946	2U-10m	0-1	(nCi/l) 180	3	5.0	0.50	0.0210	0.0040	1.4600	0.0300
83.02947	2U-10m	1-10	59500	1000	4.5	0.50	0.0440	0.0050	4.4900	0.0600
83.02948	2U-10m	10-30	60200	1000	3.7	0.40	0.0090	0.0030	1.0300	0.0200
83.02949	2U-20m	0-1	(nCi/l) 145	3	7.4	0.70	0.1100	0.0200	21.200	2.0000
83.02950	2U-20m	1-10	(nCi/l) 101	1.6	8.4	0.80	0.2010	0.0200	31.800	3.0000
83.02951	2U-20m	10-30	83100	1300	5.0	0.50	0.3460	0.0400	58.500	5.0000
83.02952	2U-30m	0-2	59800	1100	5.1	0.50	0.0110	0.0080	2.9700	0.0500
83.02953	2U-30m	2-10	52800	900	5.9	0.60	0.0470	0.0050	8.5100	0.1100
83.02954	2U-30m	10-30	27800	600	4.2	0.40	0.0031	0.0010	0.4520	0.0160
83.02955	2U-40m	0-1	85200	1500	4.80	0.50	0.0140	0.0030	2.3300	0.0400
83.02956	2U-40m	1-10	42700	800	4.10	0.40	0.0006	0.0010	0.2310	0.0120
83.02957	2U-40m	10-30	20200	500	3.90	0.40	0.0005	0.0010	0.0140	0.0030
83.02958	2U-50m	0-1	70000	1300	3.40	0.30	0.0460	0.0050	6.9800	0.0900
83.02959	2U-50m	1-10	67400	1100	5.90	0.60	0.0100	0.0020	1.8600	0.0300
83.02960	2U-50m	10-30	23200	500	7.30	0.70	0.0270	0.0040	3.8600	0.0600
83.02961	3L-10m	0-1	(nCi/l) 101.7	1.9	4.70	0.50	0.1230	0.0070	25.800	0.3000
83.02962	3L-10m	1-10	91600	1600	4.50	0.50	0.1210	0.0070	20.000	0.2000
83.02963	3L-10m	10-30	87100	1500	4.40	0.40	0.0055	0.0010	0.7840	0.0170
83.02964	3L-20m	0-1	(nCi/l) 118	2	4.20	0.40	0.0113	0.0010	0.6010	0.0130
83.02965	3L-20m	1-10	(nCi/l) 114	3	4.30	0.40	0.0610	0.0040	4.5300	0.0500
83.02966	3L-20m	10-30	(nCi/l) 117	2	4.20	0.40	0.0080	0.0020	0.4910	0.0160

TABLE 16.2-VIII
MDA B SOIL SURVEY SAMPLES[a]

Sample Number	Sample Location	Sample Depth (cm)	Tritium Value (pCi/l)	+/-	Uranium Value (µg/g)	+/-	^{238}Pu Value (pCi/g)	+/-	$^{239/240}Pu$ Value (pCi/g)	+/-
BKGD.[b]			7200[b]		3.40[b]		0.0050[b]		0.0250[b]	
83.02967	3L-30m	0-1	(nCi/l) 205	4	7.10	0.70	0.0220	0.0030	1.5300	0.0300
83.02968	3L-30m	1-10	(nCi/l) 774	11	5.30	0.50	0.0470	0.0040	3.0400	0.0400
83.02969	3L-30m	10-30								
83.02970	3L-40m	0-1	(nCi/l) 1301	19	21.20	2.10	0.3060	0.0100	18.600	0.1700
83.02971	3L-40m	1-10	(nCi/l) 174	3	9.80	1.00	0.4220	0.0120	27.000	0.2000
83.02972	3L-40m	10-30								
83.02973	3L-50m	0-1	(nCi/l) 25600	400	5.90	0.60	0.1440	0.0070	8.1600	0.0900
83.02974	3L-50m	1-10	(nCi/l) 7050	100	6.20	0.60	0.1130	0.0070	7.4900	0.0900
83.02975	3L-50m	10-30	(nCi/l) 4740	70	4.50	0.50	0.0080	0.0010	0.3830	0.0130
83.02976	3U-10m	0-1	69600	1200	3.50	0.40	0.0270	0.0040	2.1800	0.0400
83.02977	3U-10m	1-10	67100	1100	3.60	0.40	0.0360	0.0040	5.7300	0.0800
83.02978	3U-10m	10-30								
83.02979	3U-20m	0-1	(nCi/l) 105.9	1.7	3.40	0.40	0.0080	0.0080	1.0500	0.0300
83.02980	3U-20m	1-10	85100	1400	3.70	0.40	0.0050	0.0020	0.9000	0.0300
83.02981	3U-20m	10-30	37800	700	3.40	0.40	0.0006	0.0010	0.4510	0.0170
83.02982	3U-30m	0-1	(nCi/l) 113	1.8	5.80	0.60	0.0770	0.0070	12.310	0.1500
83.02983	3U-30m	1-10	90700	1400	6.70	0.70	0.5770	0.0500	102.20	10.000
83.02985	3U-40m	0-1	(nCi/l) 104.8	1.6	9.20	0.90	0.0190	0.0030	2.7000	0.0500
83.02986	3U-40m	1-10	83000	2000	4.70	0.50	0.0011	0.0010	0.4120	0.0160
83.02987	3U-40m	10-30	37800	700	3.90	0.40	0.0042	0.0010	0.0250	0.0030
83.02991	4C-0m	0-1	84600	1400	4.00	0.40	0.0320	0.0040	2.7000	0.0500
83.02992	4C-0m	1-10	93800	1500	3.70	0.40	0.0200	0.0040	1.8300	0.0400
83.02993	4C-0m	10-30	73800	1300	3.70	0.40	0.0250	0.0030	2.3700	0.0400
83.02994	4L-10m	0-1	(nCi/l) 164	3	4.20	0.40	0.0570	0.0050	4.9800	0.0700
83.02995	4L-10m	1-10	(nCi/l) 183	3	4.50	0.40	0.0490	0.0040	4.3200	0.0600
83.02996	4L-10m	10-30	(nCi/l) 102.2	1.6	4.50	0.40	0.0280	0.0030	2.9200	0.0400
83.02997	4L-20m	0-1	(nCi/l) 219	4	3.30	0.30	0.1510	0.0090	27.400	0.3000
83.02998	4L-20m	1-10	(nCi/l) 497	7	3.50	0.40	0.1900	0.0090	33.700	0.3000
83.02999	4L-20m	10-30	91200	1500	3.90	0.40	0.0760	0.0080	9.5900	0.9000
83.03000	4L-30m	0-1	(nCi/l) 120	14	3.20	0.30	0.3100	0.0300	58.000	6.0000
83.03001	4L-30m	1-10	(nCi/l) 425	7	3.40	0.30	0.4120	0.0160	73.600	0.8000
83.03002	4L-30m	10-30	(nCi/l) 224	4	2.80	0.30	0.3830	0.0130	66.900	0.6000

TABLE 16.2-VIII
MDA B SOIL SURVEY SAMPLES[a]

Sample Number	Sample Location	Sample Depth (cm)	Tritium Value (pCi/l)	Tritium +/-	Uranium Value (µg/g)	Uranium +/-	^{238}Pu Value (pCi/g)	^{238}Pu +/-	$^{239/240}Pu$ Value (pCi/g)	$^{239/240}Pu$ +/-
BKGD.[b]			7200[b]		3.40[b]		0.0050[b]		0.0250[b]	
83.03009	4U-10m	0-1	(nCi/l) 124	3	4.90	0.50	0.0200	0.0030	1.7600	0.0300
83.03010	4U-10m	1-10	69400	1100	3.80	0.50	0.0280	0.0040	2.8400	0.0400
83.03012	4U-20m	0-1	(nCi/l) 102	1.7	4.40	0.40	0.0035	0.0010	5.3300	0.0700
83.03013	4U-20m	1-10	72200	1200	3.80	0.40	0.0048	0.0050	5.9400	0.0800
83.03014	4U-20m	10-30	33400	700	3.50	0.40	0.0530	0.0050	6.1300	0.0900
83.03015	4U-30m	0-1	95200	1800	5.80	0.60	0.0150	0.0080	1.3500	0.0300
83.03016	4U-30m	1-10	61800	1000	4.80	0.50	0.0110	0.0020	0.9000	0.0200
83.03017	4U-30m	10-30	26300	600	4.50	0.50	0.0004	0.0010	0.0280	0.0040
83.03018	4U-40m	0-1	75500	1500	4.90	0.50	0.0380	0.0040	5.0800	0.0700
83.03019	4U-40m	1-10	43600	800	5.50	0.60	0.0370	0.0050	5.7600	0.0800
83.03020	4U-40m	10-30	14600	400	4.60	0.50	0.0160	0.0030	2.2500	0.0300
83.03024	1C-0m	0-1	63400	1100	4.10	0.40	0.0004	0.0010	0.0060	0.0010
83.03025	1C-0m	1-10	(nC/l) 119	14	4.30	0.40	0.0006	0.0000	0.0390	0.0030
83.03026	1C-0m	10-30	(nCi/l) 139	3	4.00	0.40	0.0150	0.0030	1.8500	0.0300

[a] The ± values reported for each radionuclide are analytical laboratory uncertainty.
[b] Upper limit background levels from Purtymun (1987).

TABLE 16.2-IX
1982 MDA B SOIL SURVEY SAMPLES[a]

Sample Number	Sample Location	Sample Depth (cm)	Tritium Value (pCi/l)	+/-	Uranium Value (ppm)	+/-	^{238}Pu Value (pCi/g)	+/-	$^{239/240}Pu$ Value (pCi/g)	+/-
BKGD.[b]			7200[b]		3.40[b]		0.0050[b]		0.0250[b]	
82.09371	B-1	0-1	18900	500	4.80	0.50	0.0005	0.0000	0.1160	0.0080
82.09372	B-1	1-6	25800	500	4.60	0.50	0.0022	0.0010	0.1170	0.0080
82.09373	B-2	0-1	31200	600	5.10	0.50	0.0100	0.0020	1.1800	0.0300
82.09374	B-2	1-10	33400	600	4.80	0.50	0.0140	0.0020	2.5900	0.0400
82.09375	B-2	10-30	13000	400	3.80	0.40	0.0012	0.0010	0.2840	0.0110
82.09376	B-3	0-1	53100	1000	3.60	0.40	0.0080	0.0020	0.2290	0.0100
82.09377	B-3	1-10	13200	400	3.10	0.30	0.0070	0.0020	0.2400	0.0400
82.09378	B-3	10-30	10100	300	5.20	0.50	0.0110	0.0020	0.6300	0.0160
82.09379	B-4	0-1	45700	900	3.00	0.30	0.0007	0.0000	0.4830	0.0140
82.09380	B-4	1-10	12900	400	4.80	0.50	0.0100	0.0020	0.5750	0.0160

[a]The ± values reported for each radionuclide are analytical laboratory uncertainty.
[b]Upper limit background levels from Purtymun (1987).

TABLE 16.2-X
MDA B SURFACE SOIL SAMPLES[a,b]

Sample Number	Sample Location (cm)	Sample Depth	Tritium Value (pCi/l)	+/-	Uranium Value (µg/g)	+/-	^{238}Pu Value (pCi/g)	+/-	$^{239/240}Pu$ Value (pCi/g)	+/-
BKGD.[c]			7200[c]		3.40[c]		0.0050[c]		0.0250[c]	
83.04582	N1E0	0-1	14900	1600	3.19	0.16	0.0005	0.0014	0.0200	0.0030
83.04583	N1E0	1-10	18400	1900	3.25	0.23	0.0090	0.0030	0.7800	0.0300
83.04584	N1E0	10-30	9300	1000	4.16	0.21	0.0120	0.0030	1.2900	0.0500
83.04585	N1E2	0-1	16500	1700	3.87	0.19				
83.04586	N1E2	1-10	7900	900	3.86	0.19	0.0004	0.0015	0.0035	0.0018
83.04587	N1E2	10-30	10400	1100	4.45	0.22	-0.0011	0.0014	0.0049	0.0017
83.04588	N1E4	0-1	17600	1800	3.63	0.18	0.0029	0.0017	0.0080	0.0020
83.04589	N1E4	1-10	10300	1300	3.90	0.20	0.0005	0.0015	0.0040	0.0020
83.04590	N1E4	10-30	10000	1100	3.90	0.20	-0.0007	0.0014	0.0029	0.0014
83.04591	N1E6	0-1	13000	1400	4.52	0.23	0.0015	0.0009	0.0007	0.0009
83.04592	N1E6	1-10	9400	1000	3.52	0.25	0.0005	0.0015	0.0032	0.0018
83.04593	N1E6	10-30	20000	2000	3.76	0.19	0.0006	0.0016	0.0010	0.0020
83.04594	N1E8	0-1	24000	2000	3.61	0.18	0.0027	0.0018	0.0021	0.0016
83.04595	N1E8	1-10	8000	900	3.64	0.18	0.0010	0.0016	0.0021	0.0014
83.04596	N1E8	10-30	7800	900	3.98	0.20	0.0006	0.0017	0.0011	0.0018
83.04597	N1E10	0-1	24000	2000	3.71	0.19	0.0029	0.0019	0.1410	0.0100
83.04598	N1E10	1-10	15900	1700	3.54	0.18	0.0021	0.0017	0.0011	0.0017
83.04599	N1E10	10-30	9300	1000	4.16	0.21	-0.0005	0.0017	0.0005	0.0014
83.04600	N1E12	0-1	27000	3000	3.70	0.19	0.0016	0.0014	0.0110	0.0030
83.04601	N1E12	1-10	35000	4000	3.63	0.25	0.0010	0.0030	0.0090	0.0030
83.04602	N1E12	10-30	10900	1200	3.87	0.19	0.0023	0.0013	0.0053	0.0017
83.05615	N1E14	0-1	16600	1700			0.0010	0.0020	0.0050	0.0020
83.05616	N1E14	1-10	10900	1200			0.0004	0.0013	0.0042	0.0018
83.05617	N1E14	10-30	12600	1300	3.89	0.20	0.0013	0.0011	0.0020	0.0011
83.05618	N1E16	0-1	14600	1500	3.77	0.19	0.0009	0.0013	0.0027	0.0015
83.05619	N1E16	1-10	12900	1400	3.74	0.19	0.0018	0.0019	0.0040	0.0020
83.05620	N1E16	10-30	13100	1400	3.72	0.19	-0.0006	0.0016	0.0070	0.0020
83.05621	N1E18	0-1	21000	2000	3.82	0.19	0.0011	0.0017	0.0027	0.0019
83.05622	N1E18	1-10	10700	1100	3.58	0.18	-0.0017	0.0016	0.0022	0.0019
83.05623	N1E18	10-30	6100	700	3.64	0.18	-0.0004	0.0006	0.0027	0.0017

TABLE 16.2-X
MDA B SURFACE SOIL SAMPLES[a,b]

Sample Number	Sample Location (cm)	Sample Depth	Tritium Value (pCi/l)	+/-	Uranium Value (µg/g)	+/-	^{238}Pu Value (pCi/g)	+/-	$^{239/240}Pu$ Value (pCi/g)	+/-
BKGD.[c]			7200[c]		3.40[c]		0.0050[c]		0.0250[c]	
83.05624	N1E20	0-1	11100	1200	3.49	0.18	0.0027	0.0013	0.1090	0.0080
83.05625	N1E20	1-10	50000	5000	3.49	0.18	0.0060	0.0020	0.8000	0.0300
83.05626	N1E20	10-30	10100	1100	3.52	0.18	0.0130	0.0030	3.8000	0.1300
83.05627	N3E0	0-1	3500	4000	4.81	0.24	0.0190	0.0040	3.0500	0.1100
83.05628	N3E0	1-10	27000	3000	4.41	0.22	0.0080	0.0030	1.6900	0.0700
83.05629	N3E0	10-30	9800	1100	4.51	0.23	0.0210	0.0040	2.7500	0.1100
83.05630	N3E2	0-1	21000	2000	3.75	0.19	0.0018	0.0019	0.0040	0.0020
83.05631	N3E2	1-10	19000	2000	3.65	0.18	-0.0010	0.0020	0.0030	0.0030
83.05632	N3E2	10-30	8500	900	4.16	0.21	-0.0015	0.0017	-0.0010	0.0020
83.05633	N3E4	0-1	22000	2000	3.76	0.19	0.0020	0.0020	0.0010	0.0020
83.05634	N3E4	1-10	9300	1000	4.24	0.21	-0.0012	0.0015	0.0006	0.0012
83.05635	N3E4	10-30	9200	1000	4.20	0.21	0.0010	0.0030	0.0070	0.0030
83.05636	N3E6	0-1	31000	3000	3.63	0.18	0.0008	0.0016	0.0040	0.0030
83.05637	N3E6	1-10	12200	1300	3.68	0.18	0.0017	0.0019	0.0030	0.0030
83.05638	N3E6	10-30	14500	1500	4.03	0.20	-0.0005	0.0015	0.0010	0.0015
83.05639	N3E8	0-1	25000	3000	3.73	0.19	0.0008	0.0017	0.0030	0.0030
83.05640	N3E8	1-10	7100	800	3.48	0.17	0.0037	0.0019	0.0053	0.0018
83.05641	N3E8	10-30	10500	1100	4.01	0.20	0.0015	0.0011	0.0090	0.0030
83.05642	N3E10	0-1	18100	1900	3.56	0.25	-0.0020	0.0020	0.3000	0.0300
83.05643	N3E10	1-10	21000	2000	3.61	0.18	0.0009	0.0017	0.0410	0.0070
83.05644	N3E10	10-30	7000	800	4.29	0.22	0.0010	0.0020	0.0010	0.0020
83.05645	N3E12	0-1	31000	3000	3.72	0.26	0.0080	0.0040	0.8300	0.0400
83.05646	N3E12	1-10	9100	1000	3.98	0.20	-0.0010	0.0020	0.0010	0.0020
83.05647	N3E12	10-30	6400	700	4.37	0.22	0.0020	0.0020	-0.0010	0.0030
83.05648	N3E14	0-1	31000	3000	3.98	0.20	-0.0020	0.0020	0.0090	0.0030
83.05649	N3E14	1-10	11400	1200	4.19	0.21	-0.0018	0.0018	0.0020	0.0020
83.05650	N3E14	10-30	6500	800	4.31	0.22	0.0007	0.0016	-0.0010	0.0030
83.05651	N3E16	0-1	16300	1700	3.70	0.26	0.0040	0.0020	0.0060	0.0030
83.05652	N3E16	1-10	9000	1000	4.04	0.20	0.0010	0.0020	0.0080	0.0020
83.05653	N3E16	10-30	7000	800	3.55	0.25			0.1600	0.0200

TABLE 16.2-X
MDA B SURFACE SOIL SAMPLES[a,b]

Sample Number	Sample Location (cm)	Sample Depth	Tritium Value (pCi/l)	Tritium +/-	Uranium Value (µg/g)	Uranium +/-	^{238}Pu Value (pCi/g)	^{238}Pu +/-	$^{239/240}Pu$ Value (pCi/g)	$^{239/240}Pu$ +/-
BKGD.[c]			7200[c]		3.40[c]		0.0050[c]		0.0250[c]	
83.05654	N3E18	0-1	19200	2000	3.64	0.26	0.0021	0.0017	0.0026	0.0016
83.05655	N3E18	1-10	9600	1000	3.59	0.18	0.0005	0.0015	0.0050	0.0020
83.05656	N3E18	10-30	4700	600	3.20	0.22	0.0012	0.0017	0.0080	0.0030
83.05657	N3E20	0-1	13100	1400	3.67	0.18	0.0030	0.0020	0.3340	0.0170
83.05658	N3E20	1-10	17100	1800	3.69	0.26	0.0045	0.0019	0.2950	0.0150
83.05659	N3E20	10-30	4500	600	3.29	0.23	0.0005	0.0015	0.0250	0.0040
83.05660	N4E10	0-1	15300	1600	3.61	0.18	0.0017	0.0014	0.1930	0.0130
83.05661	N4E10	1-10	12800	1400	3.58	0.25	0.0015	0.0018	0.3460	0.0170
83.05662	N4E10	10-30	3100	500	3.94	0.28	0.0005	0.0012	0.0270	0.0040
83.05663	N4E12	0-1	12500	1300	2.32	0.16	0.0260	0.0040	0.1770	0.0100
83.05664	N4E12	1-10	45000	5000	2.80	0.20	0.0039	0.0017	0.2550	0.0150
83.05665	N4E12	10-30	12700	1300	3.57	0.25	0.0057	0.0019	0.4200	0.0200
83.05666	N4E14	0-1	13100	1400	4.24	0.21	0.0010	0.0020	0.1670	0.0130
83.05667	N4E14	1-10	19000	2000	3.79	0.19	0.0010	0.0016	0.2370	0.0130
83.05668	N4E14	10-30	13900	1500	3.98	0.20	0.0010	0.0030	0.0009	0.0030
83.05669	N4E16	0-1	43000	4000	3.91	0.20	0.0070	0.0030	0.3330	0.0190
83.05670	N4E16	1-10	12900	1400	3.86	0.27	0.0020	0.0020	0.4700	0.0200
83.05671	N4E16	10-30	3500	500	3.91	0.20	0.0030	0.0020	0.0670	0.0070
83.05672	N4E20	0-1	67000	7000	3.27	0.16	0.0060	0.0020	0.0390	0.0050
83.05673	N4E20	1-10	27000	3000	3.08	0.22	0.0028	0.0017	0.0910	0.0080
83.05674	N4E20	10-30	14700	1500	3.80	0.19	0.0012	0.0017	0.0090	0.0020
83.05675	S1E0	0-1	81000	8000	4.54	0.23	0.0280	0.0050	3.2900	0.1300
83.05676	S1E0	1-10	92000	9000	4.11	0.21	0.0014	0.0016	0.0570	0.0060
83.05677	S1E0	10-30	66000	7000	3.74	0.19	0.0017	0.0014	0.4390	0.0190
83.05678	S1E2	0-1	7200	800	3.83	0.19	0.0018	0.0015	0.3320	0.0160
83.05679	S1E2	1-10	8800	1000	4.09	0.21	0.0004	0.0012	0.2390	0.0120
83.05680	S1E2	10-30	15100	1600	4.19	0.21	0.0031	0.0017	0.4600	0.0200
83.05681	S1E4	0-1	42000	4000	3.51	0.18	0.0030	0.0020	0.0500	0.0060
83.05682	S1E10	0-1	18500	1900	3.73	0.19	0.0210	0.0030	1.2900	0.0500
83.05683	S1E10	1-10	11600	1200	3.59	0.18	0.0026	0.0013	0.1280	0.0080

TABLE 16.2-X
MDA B SURFACE SOIL SAMPLES[a,b]

Sample Number	Sample Location (cm)	Sample Depth	Tritium Value (pCi/l)	Tritium +/-	Uranium Value (µg/g)	Uranium +/-	^{238}Pu Value (pCi/g)	^{238}Pu +/-	$^{239/240}Pu$ Value (pCi/g)	$^{239/240}Pu$ +/-
BKGD.[c]			7200[c]		3.40[c]		0.0050[c]		0.0250[c]	
83.05684	S1E10	10-20	22000	2000	4.05	0.20	0.0024	0.0014	0.2110	0.0110
83.05685	S1E12	0-1	5400	700	4.13	0.21	0.0026	0.0014	0.1280	0.0080
83.05686	S1E12	1-10	36000	4000	3.77	0.19	-0.0013	0.0016	0.0460	0.0050
83.05687	S1E12	10-30	12500	1300	4.56	0.23	0.0080	0.0020	0.3240	0.0180
83.05688	S1E14	0-1	19000	2000	4.07	0.20	0.0030	0.0017	0.1830	0.0110
83.05689	S1E14	1-10	19000	2000	3.81	0.19	0.0032	0.0012	0.0760	0.0060
83.05690	S1E14	10-30	14000	1500	3.83	0.19	0.0009	0.0015	0.0870	0.0070
83.05691	S1E16	0-1	5100	600	2.96	0.21	0.0010	0.0020	0.0100	0.0030
83.05692	S1E16	1-10	18400	1900	3.60	0.18	0.0024	0.0018	0.2710	0.0140
83.05693	S1E16	10-30	13300	1400	4.96	0.25	0.0038	0.0019	0.3350	0.0180
83.05694	S1E18	0-1	12800	1400	3.53	0.25	-0.0010	0.0020	0.0340	0.0050
83.05695	S1E18	1-10	15400	1600	4.24	0.21	-0.0011	0.0017	0.1510	0.0110
83.05696	S1E18	10-30	8100	900	4.33	0.22	0.0005	0.0013	0.0920	0.0080
83.05697	S1E20	0-1	13000	1400	4.27	0.21	0.0030	0.0020	0.3600	0.0200
83.05698	S1E20	1-10	46000	5000	4.45	0.22	0.0029	0.0015	0.2030	0.0100

[a]Mayfield (1983).
[b]The ± values reported for each radionuclide are analytical laboratory uncertainty.
[c]Upper limit background levels from Purtymun (1987).

TABLE 16.2-XI
MDA B SURFACE SOIL SAMPLES[a,b]

Sample Number	Sample Location	Sample Depth (cm)	Tritium Value (pCi/l)	+/-	Uranium Value (ppm)	+/-	^{238}Pu Value (pCi/g)	+/-	$^{239/240}$Pu Value (pCi/g)	+/-
BKGD.[c]			7200[c]		3.40[c]		0.0050[c]		0.0250[c]	
84.04056	B-1	0-1	4800	600			0.0009	0.0018	0.5200	0.0200
84.04057	B-1	1-10	2700	400			0.0054	0.0017	0.6000	0.0200
84.04058	B-1	10-14	2400	300			0.0008	0.0017	0.3900	0.0200
84.04059	B-2	0-1	2400	300			0.0043	0.0016	1.4800	0.0500
84.04060	B-2	1-10	1800	300			0.0080	0.0020	1.0700	0.0400
84.04061	B-2	10-18	1800	300			0.0070	0.0020	1.1800	0.0400
84.04062	B-3	0-1	2500	300			0.0220	0.0040	3.0700	0.1100
84.04063	B-3	1-10	2300	300			0.0228	0.0098	7.3900	0.3100
84.04064	B-3	10-25	2400	300			0.0017	0.0014	0.3900	0.0180

[a]Mayfield (1984).
[b]The ± values reported for each radionuclide are analytical laboratory uncertainty.
[c]Upper limit background levels from Purtymun (1987).

TABLE 16.2-XII
RADIOCHEMICAL ANALYSES OF SOIL AND TUFF FROM TEST HOLES DPS-1, 3, & 5
(DRILLED IN 1966)

Depth (feet)	Material	Gross alpha (d/m/g)[a]			Gross beta-gamma (d/m/g)[a]			Plutonium (d/m/g)[a]	Uranium (µg/g)[b]
		DPS-1 DPS-1, 3, 5		DPS-3 DPS-1, 3, 5	DPS-5		DPS-1	DPS-3	DPS-5
0-1	Soil	0.4	1.2	0.5	3.1	12.6	4.5	<0.4	<0.5
1-2	Soil	0.5	0.3	0.9	3.0	4.3	4.8	<0.4	<0.5
2-3	Soil	0.7	0.1	0.3	3.6	1.6	2.7	<0.4	<0.5
3-5	Tuff	0.3	0.1	0.1	2.4	1.5	3.4	<0.4	<0.5
5-10	Tuff	0.3	0.6	0.1	6.0	1.3	1.5	<0.4	<0.5
10-15	Tuff	0.6	0.3	0.4	2.7	0.0	3.6	<0.4	<0.5
15-20	Tuff	0.7	0.1	0.3	3.6	0.0	1.3	<0.4	<0.5
20-25	Tuff	0.4	0.1	0.3	2.2	0.1	1.6	<0.4	<0.5
25-30	Tuff	0.3	0.1	1.0	1.0	0.1	7.6	<0.4	<0.5
30-35	Tuff	0.2	0.5	0.5	1.2	1.6	3.1	<0.4	<0.5
35-40	Tuff	0.3	0.4	0.2	0.6	0.7	0.9	<0.4	<0.5
40-45	Tuff	0.4	0.0	0.2	1.2	0.1	2.5	<0.4	<0.5
45-50	Tuff	0.4	0.1	0.3	0.0	0.7	4.6	<0.4	<0.5

[a] Disintegrations per minute per gram.
[b] Micrograms per gram.

TABLE 16.2-XIII
RADIOCHEMICAL ANALYSES OF SOIL AND TUFF FROM TEST HOLES DPS-2 & 4
(DRILLED IN 1966)

Depth (feet)	Material	Gross alpha (d/m/g)[a]		Gross beta-gamma (d/m/g)[a]		Plutonium (d/m/g)[a]	Uranium (µg/g)[b]
		DPS-2	DPS-4	DPS-2	DPS-4	DPS-2 & 4	DPS-2 & 4
0-1	Soil	0.9	0.3	9.1	4.3	<0.4	<0.5
1-2	Soil	0.5	1.1	2.8	4.9	<0.4	<0.5
2-3	Soil	0.8	0.0	0.6	0.0	<0.4	<0.5
3-5	Tuff	0.6	0.2	0.3	0.0	<0.4	<0.5
5-10	Tuff	0.3	0.3	1.8	1.9	<0.4	<0.5
10-15	Tuff	0.6	0.1	2.5	1.3	<0.4	<0.5
15-20	Tuff	0.6	0.5	3.3	0.6	<0.4	<0.5
20-25	Tuff	0.5	0.9	2.1	4.6	<0.4	<0.5

[a] Disintegrations per minute per gram.
[b] Micrograms per gram.

TABLE 16.2-XIV
RADIOCHEMICAL ANALYSES OF SOIL AND TUFF FROM TEST HOLES DPS-6, 8, & 11
(DRILLED IN 1966)

Depth (feet)	Material	Gross alpha (d/m/g)[a]			Gross beta-gamma (d/m/g)[a]			Plutonium (d/m/g)[a]	Uranium (µg/g)[b]
		DPS-6 DPS-6, 8, 11		DPS-8 DPS-6, 8, 11	DPS-11		DPS-6	DPS-8	DPS-11
0-2	Soil	0.8	0.6	0.3	6.1	3.3	2.1	<0.4	<0.5
2-5	Soil	0.7	0.5	0.6	4.6	4.9	4.0	<0.4	<0.5
5-10	Soil & tuff	0.8	0.4	0.4	4.0	5.8	1.3	<0.4	<0.5
10-15	Tuff	0.6	0.3	0.5	3.3	3.6	1.9	<0.4	<0.5
15-20	Tuff	0.8	0.4	0.5	5.2	2.2	2.8	<0.4	<0.5
20-25	Tuff	1.2	0.4	0.5	5.7	1.3	1.2	<0.4	<0.5
25-30	Tuff	0.8	0.1	0.7	3.4	1.0	3.0	<0.4	<0.5
30-35	Tuff	0.5	0.6		2.7	3.4		<0.4	<0.5
35-40	Tuff	0.3	0.2	0.6	3.6	4.9	1.9	<0.4	<0.5
40-45	Tuff	0.2	0.4	0.9	2.8	4.6	2.7	<0.4	<0.5
45-50	Tuff	0.2	0.4	0.5	3.0	3.0	1.8	<0.4	<0.5

[a]Disintegrations per minute per gram.
[b] Micrograms per gram.

TABLE 16.2-XV
RADIOCHEMICAL ANALYSES OF SOIL AND TUFF FROM TEST HOLES DPS-7&9
(DRILLED IN 1966)

Depth (feet)	Material	Gross alpha (d/m/g)[a]		Gross beta-gamma (d/m/g)[a]		Plutonium (d/m/g)[a]	Uranium (µg/g)[b]
		DPS-7	DPS-9	DPS-7	DPS-9	DPS-7 & 9	DPS-7 & 9
0-2	Soil	1.2	0.7	3.9	2.4	<0.4	<0.5
2-5	Soil & Tuff	0.6	0.5	3.9	2.1	<0.4	<0.5
5-10	Tuff	0.2	0.4	1.3	3.7	<0.4	<0.5
10-15	Tuff	0.3	0.5	1.5	1.8	<0.4	<0.5
15-20	Tuff	0.5	0.5	2.4	3.7	<0.4	<0.5
20-25	Tuff	0.4	0.3	2.7	1.0	<0.4	<0.5

[a] Disintegrations per minute per gram.
[b] Micrograms per gram.

TABLE 16.2-XVI
RADIOCHEMICAL ANALYSES OF SOIL AND TUFF FROM TEST HOLES DPS10, 12, & 13
(DRILLED IN 1966)

Depth (feet)	Material	Gross alpha (d/m/g)[a]			Gross beta-gamma (d/m/g)[a]			Plutonium (d/m/g)[a]	Uranium (µg/g)[b]
		DPS-10	DPS-12	DPS-13	DPS-10	DPS-12	DPS-13	DPS-10, 12, 13	DPS-10, 12, 13
0-2	Soil	0.4	0.8	1.0	3.1	1.2	4.3	<0.4	<0.5
2-5	Soil & tuff	0.3	0.4	0.7	3.0	1.6	0.0	<0.4	<0.5
5-10	Tuff	0.8	0.4	0.4	2.5	0.4	2.1	<0.4	<0.5
10-15	Tuff	0.6	0.3	0.7	2.7	1.0	2.8	<0.4	<0.5
15-20	Tuff	0.6	0.4	0.6	4.3	0.0	0.0	<0.4	<0.5
20-25	Tuff	0.5	0.5	0.8	2.7	3.0	0.9	<0.4	<0.5
25-30	Tuff	0.2	0.8	0.9	2.1	0.9	1.9	<0.4	<0.5
30-35	Tuff	1.0	0.4	0.4	0.7	0.6	0.4	<0.4	<0.5

[a] Disintegrations per minute per gram.
[b] Micrograms per gram.

TABLE 16.2-XVII
1983 PERIMETER SUBSURFACE SOIL SAMPLES

Sample Number	Sample Location	Sample Depth (ft)	Tritium Value (pCi/l)	+/-	Uranium Value (ppm)	+/-	^{238}Pu Value (pCi/g)	+/-	$^{239/240}Pu$ Value (pCi/g)	+/-	^{137}Cs Value (pCi/g)	+/-
BKGD.[a]			7200[a]		3.40[a]		0.0050[a]		0.0250[a]		1.0900[a]	
83.04341	B-1	0-3	7500	800	3.62	0.18	0.0018	0.0012	0.2060	0.0100	0.0628	0.0368
83.04342	B-1	3-8	20000	2000	3.56	0.18	-0.0006	0.0009	0.0029	0.0013	0.0162	0.0207
83.04343	B-1	8-13	23000	2000	3.59	0.18	0.0003	0.0006	0.0024	0.0011	0.0525	0.0271
83.04344	B-1	13-18	32000	3000	3.34	0.18	0.0004	0.0000	0.0011	0.0010	-0.0547	0.0357
83.04345	B-1	18-23	22000	2000	3.35	0.18	0.0006	0.0010	0.0050	0.0010	0.0382	0.0667
83.04353	B-2	0-3	8500	900	3.56	0.18	0.0018	0.0009			-0.0580	0.0362
83.04354	B-2	3-8	17700	1800	3.52	0.18	0.0007	0.0010	0.2540	0.0110	-0.7230	0.0770
83.04355	B-2	8-13	28000	3000	3.24	0.18					0.0530	0.0687
83.04356	B-2	13-18	20000	2000	3.50	0.18	0.0005	0.0010	0.0070	0.0020	0.0463	0.0556
83.04357	B-2	18-23	34000	4000	3.68	0.18	0.0026	0.0010	0.0020	0.0010	0.0330	0.0664
83.04358	B-2 (cm)	23-28	36000	4000	3.71	0.18	-0.0014	0.0000	0.0003	0.0000	0.0975	0.0474
83.04346	B-1	23-28			3.34	0.18	0.0010	0.0000	0.0017	0.0010	0.0647	0.0415
83.04347	B-1	28-33			3.68	0.18	0.0003	0.0010	0.0023	0.0010	0.0665	0.0529
83.04348	B-1	33-38			3.61	0.18	0.0004	0.0000	0.0014	0.0000	0.0457	0.0721
83.04349	B-1	38-43			3.80	0.18	0.0007	0.0000	0.0007	0.0000	-0.4170	0.0372
83.04350	B-1	43-48			3.34	0.18	0.0004	0.0010	0.0009	0.0010	-0.2400	0.0345
83.04351	B-1	48-53			3.71	0.18	0.0009	0.0000	0.0003	0.0000	0.0357	0.0261
83.04352	B-1	53-58			3.51	0.18	0.0019	0.0010	0.0110	0.0020	-0.0012	0.0323
83.04359	B-2	28-33			3.63	0.18	0.0007	0.0010	0.0036	0.0010	-0.2060	0.0213
83.04360	B-2	33-38			3.70	0.18	0.0010	0.0010			0.0305	0.0305
83.04361	B-2	38-43			3.49	0.18	-0.0008	0.0010			-0.1590	0.0385
83.04362	B-2	43-48			3.53	0.18	-0.0003	0.0010			-0.0017	0.0332
83.04363	B-2	48-53			3.39	0.18	-0.0004	0.0000			-0.0027	0.0571
83.04364	B-2	53-58			3.53	0.18	-0.0007	0.0000			-0.7170	0.0355

[a]Upper limit background levels from Purtymun (1987).

16.3 SWMU 21-016 Material Disposal Area (MDA) T

16.3.1 Site Description

Material Disposal Area T (MDA T) is located at DP West as shown in Fig. 16.3-1 (LASL 1976c). The area of MDA T is approximately 0.89 ha (2.21 ac). MDA T consists of four absorption beds used to dispose of liquid wastes, a retrievable waste storage area, and a series of disposal shafts used to dispose of wastes mixed with cement.

Several SWMU subunits and areas of concern resulted from the activities conducted at this MDA. They are described in Table 16.3-I. This field sampling plan addresses potential contamination from all of these subunits.

The first disposal units at MDA T were four absorption beds. These absorption beds were approximately 36.6-m long (120-ft) x 6.1-m wide (20-ft) x 1.8-m (6-ft) deep. A cross section of the beds (Nyhan et al. 1984) is shown in Fig. 16.3-2. The two sources of liquid waste for the absorption beds in 1946 were

- sumps collecting effluent from Buildings 2, 3, 4, and 5 at DP West that discharged effluent to the distribution box located between beds 1 and 2; and
- the floor drain leading directly from Building 12 at DP West to bed 1 (Fig. 16.3-3).

In 1952, Building 35, which was located to the south of the absorption beds, began liquid waste treatment operations, and afterwards the beds were used for waste disposal on an intermittent basis until 1967.

The next disposal units at MDA T were a series of shafts located mainly between beds 2 and 4 (Fig. 16.3-1). The shafts were augered starting on May 1, 1968, and were used to dispose of cement paste wastes from liquid waste treatment processes at Building 257. Forty-nine of the shafts were 2.4 m (8 ft) in diameter with a 1.2-m (4-ft) pilot hole to determine suitability of the geologic material. Thirteen of the shafts were 1.8 m (6 ft) in diameter. These solid waste disposal shafts were initially expected to go to a depth of 18.3 m (60 ft), but, as shown in Table 16.3-II, their depth varied because of the presence of a boulder zone encountered between 15- to 32-ft depths in some shafts. The shafts were lined with asphalt prior to disposal of wastes.

The final disposal activity was a retrievable waste storage facility excavated in 1974 between absorption beds 1 and 3 (Fig. 16.3-1). A pit, 9-m (30-ft) wide by 18-m (60-ft) long and 6-m (20-ft)

deep, was used to store corrugated metal pipes that were 0.75 m (2.5 ft) in diameter and 6-m (20-ft) long. During 1984 and 1986, these pipes were removed from MDA T and relocated to MDA G.

16.3.1.1 Site History

MDA T is one of the oldest disposal areas at the Laboratory. Table 16.3-III is based on archival information dating back to 1945 and provides a chronological sequence of events and data that pertain to MDA T. A brief history is given below for each disposal unit.

16.3.1.1.1 Absorption beds.

There are two references (Abrahams 1962 and Purtymun 1967) that state MDA T was receiving wastes as early as 1943, but the earliest record of any disposal activity is 1945. Fowler (1964) indicated that the absorption beds were constructed "about 1945." The absorption beds were used until 1952 when Building 35, the industrial liquid waste treatment facility (SWMU 21-010, see Sec. 16.4), was constructed to treat the wastes "because the tuff in the beds had become clogged with suspended solids" (Christenson and Thomas 1962).

Christenson and Thomas (1962), reported that 39.56 m3 (10450 gal.) of ammonium citrate waste were discharged to the absorption beds in 1951 and 1952. The nature of the waste effluent is discussed further in Sec. 16.3.1-3.

Although after 1952 effluent from the liquid waste treatment at Building 35 was discharged to DP Canyon north of the absorption beds, records indicate that some wastes from DP West continued to be discharged to the beds from 1952 to 1965 (Table 16.3.IV).

From 1965 to 1967, wastes from DP-East were discharged to the absorption beds (Table 16.3-IV). The composition of these wastes is unknown.

16.3.1.1.2 Disposal Shafts

The filling of the disposal shafts was started in May 1968 (Christenson 1969). The term shaft is used here, rather than pits cited in the original memorandums. Figure 16.3-1 shows the shafts are mainly located between absorption beds 2 and 4. Depths of the shafts are given in Table 16.3-II. The operation of filling these shafts involved mixing wastes such as "neutralized americium," "strip," alkaline fluoride, and plant sludge with cement in a pug mill operation at Building 257 and discharging the slurry to the asphalt-lined shafts. In addition, some shafts during certain intervals received unspecified volumes of wash water. In a memorandum dated January 6, 1971,

Christenson (1971a) indicated that the wash water contained unaccounted activity. Also, five shafts (numbers 3, 17, 18, 19, and 26) had bathyspheres containing $^{239/240}Pu$ buried at various depths within the cement-filled shafts. The shaft-filling sequence is partially recorded in memorandums from Christenson (1969, 1970a, 1970b, 1971a, 1971b, 1972a, 1972b, 1973a, 1973b) and Emelity (1974). This operation was discontinued in April 1983.

16.3.1.1.3 Retrievable Waste Storage Area

In 1974, a retrievable waste storage area was excavated between Pits No. 1 and 3 (Fig. 16.3-1). The retrievable wastes contained either 10 nCi/g transuranic radionuclides or 100 nCi/g ^{238}Pu and were to be stored in a retrievable manner for a minimum of 20 years (H Division 1975). The retrievable waste was pumped from the pug mill into corrugated metal pipes (CMP) 0.75 m (2.5 ft) in diameter and 6 m (20 ft) in length. The bottom of each CMP was capped with a 0.3 m (1 ft) plug of "cold cement," and the top was capped with another 0.3 m (1 ft) plug after the pipe was filled. Operations ended in 1983, and beginning in August 1984, CMPs were relocated to MDA G (Becker et al. 1985). Nyhan and Drennon (1990) reported that 69 CMPs were removed in 1984, and 158 CMPs were removed in 1986. Following the removal of the CMPs, the site was reclaimed, and no further waste storage activities occurred at MDA T.

16.3.1.1.4 Surface Spills

Two surface spills of ^{241}Am paste at MDA T are identified as areas of concern C-21-009 and C-21-012 (Table 16.3-I). Additionally, potential surface releases may have occurred from SWMU 21-028(a).

Area of concern C-21-009. A 1978 spill of ^{241}Am in a cement paste occurred at MDA T while filling asphalt lined shafts. The paste was removed and the area was decontaminated (LANL 1990). Since no records exist of the location of this 1978 cement paste spill, any contamination found around the asphalt-lined shafts at MDA T could not be directly attributed to this 1978 spill. However, since the surface and subsurface characterization activities detailed in this chapter address the area occupied by the asphalt-lined shafts, if any residual contamination exists from this 1978 spill it will be detected as part of MDA T characterization.

Area of concern C-21-012. This area of concern resulted from a 1976 spill of cement paste contaminated with ^{241}Am and plutonium that spilled during the filling of a corrugated metal pipe (LANL 1990). The location of this particular spill is unknown; therefore any contamination between absorption beds 1 and 3 could not be directly attributed to this spill. However, the surface

and subsurface field sampling described in this section will characterize this part of MDA T, and any residual contamination remaining from this spill will be addressed.

SWMU 21-028(a). This was a satellite container storage area for alcohol, acetone, and freon located within the MDA T fence that has been inactive since January 1990. Under RCRA generator guidance, when a storage area is removed by the Environmental Surveillance Group (HSE-8), all materials stored and any visually present stained soil from spills is removed. If any surface contamination remains from surface spills that may have occurred from this area, they will be detected as part of the general surface sampling for MDA T (see Sec. 16.3.4.1.2).

16.3.1.1.5 Surface Stabilization

In 1987, the surface of MDA T inside the fenced area was stabilized. Runoff from developed areas of TA-21 south of MDA T was routed around the northwest end of MDA T in an asphalt-lined ditch (Hansen and Tillery 1987). The run-off had previously been channeled across MDA T, resulting in gully formation on the northeast corner of absorption bed number 2. MDA T was regraded to a slope of approximately 5% towards DP Canyon. A large mound of tuff on the south end of MDA T near adsorption beds 2 and 4 and also an earthen berm running east-west along the north boundary of the site were used as fill in regrading the area (Hansen and Tillery 1987). The thickness of this fill after regrading is unknown. It was covered with approximately 6 to 12 in. of topsoil prior to reseeding and mulching.

16.3.1.2 Existing Information

16.3.1.2.1 Waste Discharge Information

16.3.1.2.1.1 Radioactive contaminants

Early records for the amount and composition of effluents to the absorption beds are not available. Christenson (1973) estimated that an average of 1.4035 Ci per year of plutonium was discharged to the MDA T absorption beds between 1945 and 1951 for a total source of 9.8 Ci. This estimate was based on experience after the liquid waste treatment plant (Building 35) was established. In the same memorandum, Christenson estimated 2 Ci per year of tritium were discharged to the beds for a total of 14 Ci. Citrate wastes were disposed from June 1951 to July 1952 with a plutonium count of 7,000 c/min/ml. Nyhan and Drennon (in preparation) reported a concentration of 6,300 pCi Pu/ml for the citrate wastes. Assuming that these wastes were $^{239/240}Pu$, the activity of plutonium added in these wastes was 0.245 Ci. The total known discharge

to the beds is given in Table 16.3-IV, but no information is available on the composition of the low-level wastes from DP East.

The shafts between pits 2 and 4 were used for disposal of cement paste from the new waste treatment facility, Building 257. Warren (1979) listed the americium and $^{239/240}Pu$ content of these shafts (See Table 16.3-V). Included in the fourth column of Table 16.3-V is the amount of $^{239/240}Pu$ buried in the 0.91-m (3-ft) diameter bathyspheres. In addition to the americium and plutonium isotopes listed above, there was some ^{238}Pu (approximately 2.5 g) and mixed-fission products including strontium and cesium (approximately 14.8 Ci) that were disposed in the shafts (Warren 1979). All corrugated metal pipes have been removed from the retrievable storage area; therefore, it is assumed that only residual contamination remains, if any.

Table 16.3-VI summarizes available radioactivity data for known radionuclides at MDA T. As can be seen in this table, the disposal shafts represent a large source of radionuclides, especially when compared to the absorption beds.

16.3.1.2.1.2 Nonradioactive contaminants

Little data are available on other chemicals in the waste stream at MDA T. Table 16.3-VII was taken from Christenson and Thomas (1962) and gives approximate ranges as well as averages. Table 16.3-VIII describes the citrate wastes disposed between June 1951 to July 1952 (Christenson and Thomas 1962). An indication of the composition of the waste stream going into Building 257 for the period January through May 1973 can be seen in Table 16.3-IX. These wastes were not necessarily disposed in MDA T because different operations at Building 257 split the waste stream into different modes of disposal.

16.3.1.2.2 Historical Surface Sampling Data

Although data have been collected from 1946 through 1986, two detailed surface soil surveys taken in 1984 and 1986 as part of the environmental surveillance of low-level radioactive waste management areas are the most thorough and appropriate for assessing radionuclide contamination and determining data needs (Nyhan and Drennon in preparation). The 1986 data were also reported and analyzed in the "Environmental Surveillance of Low-Level Radioactive Waste Management Areas at Los Alamos During 1986" (Environmental Science Group et al. 1987).

1984 Soil Sampling. The 1984 survey sampled at grid points on a 20- by 20-m grid at depths of 0 to 1 cm, 1 to 10 cm, and 10 to 30 cm. The samples were analyzed for tritium, $^{239/240}Pu$, and

^{238}Pu. This survey showed very few elevated tritium levels, that is, levels above the 7200 pCi/L used as an upper limit for background (Purtymun et al. 1987). These elevated levels occurred in samples from the deeper depth intervals in the area between the northern fence and Absorption Bed 4. Figure 16.3-4 shows the 1984 sample locations and the tritium concentration contours developed by Nyhan and Drennon (in preparation) for samples taken at a depth of 10-30 cm. Other depths showed similar patterns, however, the maximum levels were lower. In contrast to the tritium levels, ^{238}Pu and $^{239/240}Pu$ were above the background level at all sampling locations. These upper limits are 0.005 pCi/g for ^{238}Pu and 0.025 pCi/g for $^{239/240}Pu$ (Purtymun et al. 1987). The sample locations included areas outside the fence, on the north rim of DP Mesa (Fig. 16.3-4).

1986 Soil Sampling. The 1986 survey used a 10- by 10-m grid consisting of 75 sampling locations inside the fenced area, 16 locations along the fence, and 16 locations outside the fence across the road on the north rim of DP Mesa (Fig. 16.3.5). Samples were taken at the surface (0-5 cm). Phoswich and RASCAL survey measurements were done at all grid points. Samples from 71 of these grid points were analyzed in the laboratory for ^{238}Pu, $^{239/240}Pu$, and ^{241}Am, and ^{137}Cs. The 1986 data (Figs. 16.3-5 to 16.3-10) showed the same trends as the 1984 data and, because there were more sampling locations in 1986, we focused on this more current data.

Kriged prediction surfaces (Cressie 1988) were used to study the spatial distributions of the contaminants from the 1986 data. Figures 16.3-5 - 16.3-10 show the data, the kriged surfaces, and the corresponding uncertainty regions for Phoswich, RASCAL, ^{238}Pu, $^{239/240}Pu$, ^{241}Am, and ^{137}Cs.

Most of the Phoswich counts exceeded Laboratory background counts (Fig. 16.3-5). Also included in Fig. 16.3-5 is the contour map of kriged phoswich levels and the corresponding uncertainty regions. These data indicate that there were elevated levels throughout the sampling region. The RASCAL data (Fig. 16.3-6) also show elevated levels. However, areas with elevated readings for phoswich and RASCAL data do not correspond, indicative of the different radiation responses of the two instruments.

Plutonium-238, $^{239/240}Pu$, and ^{241}Am levels generally exceeded their background levels (Figs. 16.3-7 and 16.3-8). These elevated levels reflect a widespread source of these nuclides on the surface of MDA T. [Note that the Laboratory's upper limit "background" level for $^{239/240}Pu$, reported by the Environmental Science Group et al. (1987) is 0.054 pCi/g, over twice that of the worldwide fallout levels reported by Purtymun (1987)]. Concentrations in soil ranged from background levels to 35 pCi/g ^{238}Pu, 70 pCi/g $^{239/240}Pu$, and 260 pCi/g ^{241}Am. These

maxima all occurred within the fenced area. However, as with previous data, contamination existed outside the fenced area adjacent to DP Canyon. Most of the ^{137}Cs concentrations (Fig. 16.3-10) that exceeded the upper background limit were outside the fence of MDA T to the north. A maximum of 42 pCi/g of cesium was observed down slope just inside the north east section of the fence.

The kriged surfaces for all three transuranics (^{238}Pu, $^{239/240}Pu$, and ^{241}Am) suggest elevated levels may persist along the southern boundary of the sampled area into the center and southern part of MDA T inside the fence (Figs. 16.3-7, 16.3-8, and 16.3-9). A region of high Phoswich predictions (Fig. 16.3-5) in the southern section of the fenced region, which was not covered by the soil samples, also suggests elevated levels may be present. However, this cannot be confirmed without additional soil sampling.

All kriged surfaces (Figs. 16.3-7, 16.3-8, 16.3-9, and 16.3-10) show that the northern perimeter of the 1986 sampling area to DP canyon deserves much more investigation. These contaminant contours also indicate a central area of elevated radioactivity that may be very local but which was not bounded by the data.

The 1986 survey also included analysis of vegetation for ^{137}Cs, ^{238}Pu (Fig. 16.3-11), $^{239/240}Pu$, and americium (Fig. 16.3-12). These data are discussed in the report, Environmental Surveillance of Low-level Radioactive Waste Management Areas at Los Alamos During 1986 (Environmental Science Group et al. 1987). This report states that ^{137}Cs concentrations in vegetation often exceeded those measured in soil from corresponding locations. Exactly what the corresponding locations were or what levels would be observed at such locations, is not clear. The maximum ^{137}Cs concentration was about 65 pCi/g, well above worldwide fallout levels. Elevated ^{137}Cs levels in vegetation were observed outside the fenced area as they were in the soil samples. Plutonium-238, $^{239/240}Pu$, and ^{241}Am also showed elevated levels and followed patterns similar to the soil samples. The report states that "all of the radionuclides were transported into the vegetation component of the system at levels predictable based on concentration ratio data in the published literature."

16.3.1.2.3 Historical Subsurface Sampling Data

Many studies have been done to evaluate subsurface radionuclide movement beneath MDA T. Most of these studies have emphasized the four absorption beds and radionuclide movement beneath them. In particular, absorption bed 1 has been studied several times, beginning in 1953.

1953 Borehole Sampling. In 1953, Herman (1954), of the United States Geological Survey (USGS), initiated a study to investigate the distribution of plutonium discharged into the beds. Five holes were drilled into and around the absorption beds (Fig. 16.3-13). Two of the holes, DPW-1 and DPW-2, were drilled between absorption beds 1 and 3 and absorption beds 2 and 4, respectively. Plutonium concentrations from all five holes are given in Table 16.3-X. Data were also collected on the mineralogy and ion exchange capacity of the tuff, and these are given in Table 16.3-XI.

These 1953 data showed that, at that time, little movement of radionuclides had occurred between the absorption beds. Higher radionuclide concentrations were present for the holes located in the beds and an obvious increase in plutonium concentration occurred in the slant hole, DPW-3, where it intersected bed 1 (Table 16.3-X).

In 1959, a caisson was constructed at the northwest corner of absorption bed 1 to study subsurface plutonium distribution. The caisson was 9.14-m (30-ft) deep, 1.83-m (6-ft) wide, and 3.66-m (12-ft) long. Two horizontal holes at 2-ft depth intervals to a 28-ft depth were drilled into the center of the absorption bed (midpoint in terms of width not geometric center of the bed). Each pair of horizontal holes was instrumented, one for soil moisture and one for gross alpha measurement. Generally, these studies showed that alpha activity had percolated into the tuff and that its concentration decreased with increasing depth (Table 16.3-XII). An increase in activity at the 12-ft depth coincides with high moisture readings at that depth (Christenson and Thomas 1962). Of primary interest are infiltration studies conducted in 1960 and 1961 in which water was added to absorption bed 1. The effect of this additional water on subsurface moisture and plutonium distribution was studied as described below.

The 1960 Infiltration experiment. In 1960, as part of the infiltration experiment, wastes from DP west were diverted into bed 1 during the period July 6 to July 31, 1960 (Abrahams 1963). Christenson and Thomas (1962) indicated that the average daily rate of this diversion was 32.93 m^3/d (8,700 gpd), and Abrahams (1963) listed a value of 30.27 m^3/d (8,000 gpd). From August 1 to September 7, 1960, Los Alamos tap water was added to bed 1 (Abrahams 1963). The tap water was added at a rate of 24.98 m^3/d (6,600 gpd) according to Christenson and Thomas (1962) and 24.61 m^3/d (6,500 gpd) according to Abrahams (1963).

To study the effect of this additional water, six holes were drilled around the periphery of bed 1 in late 1960 at locations shown in Fig. 16.3-14. These holes were air drilled and ranged in depth from 23.16 to 30.18 m (76 to 99 ft); all holes were 6.35 cm (2.5 in) in diameter. Cuttings were collected from each hole at 1.5-m (5-ft) intervals and analyzed for gross alpha (Table 16.3-XIII).

The highest gross alpha content was obtained from the hole designated DPW-2. This hole was drilled at 19° from vertical and angled under absorption bed 1. Christenson and Thomas (1962) indicated that these readings were found at depths of 9.1 m (30 ft) to 16.7 m (45 ft) below the surface. They attributed these high values to a vertical fissure.

Plastic pipe was inserted into each hole for moisture monitoring with a neutron probe (Christenson and Thomas 1962). Moisture data collected during and after the 1960 water additions are unavailable. However, Christenson and Thomas (1962) stated these data showed similar results as those obtained from the 1961 infiltration study discussed below.

The 1961 Infiltration experiment. In the 1961 infiltration experiment, 24.23 m^3/d (6400 gpd) of DP raw waste was diverted to absorption bed 1 during the period June 30 to August 1, 1961 (Christenson and Thomas 1962; Abrahams 1963). This was followed by adding tap water to bed 1 from August 2 to August 26, 1961, at the rate of 26.88 m^3/d (7,100 gpd) (Christenson and Thomas 1962; Abrahams 1963). Moisture distribution in the tuff for the 1961 experiment from the five holes drilled in 1960 can be seen in Figs. 16.3-15 and 16.3-16. (Christenson and Thomas 1962). The moisture distribution plots show that there was relatively little change in the moisture content for holes 3, 4, and 5 despite the large volume of water added during this time. This indicates that the bed had a high infiltration capacity and there was little lateral movement of water in the tuff. The limited lateral movement is further supported by the lack of contamination in the holes drilled adjacent to the absorption beds as shown in Table 16.3-XIII (Herman 1954). However, the irregular moisture curves for holes 1, A-1, and 2 suggest that percolating water may either perch (note peaks in curves) or travel rapidly along fissures. Abrupt decreases in moisture indicate rapid drainage that may be caused by fissures. Christenson and Thomas (1962) acknowledged that these factors will influence radionuclide accumulation and sorption, but exactly how they influence these events is unknown.

In 1974, a hole was cored to a depth of 4.3 m (14 ft) into absorption bed 3 (Fried et al. 1977). The ^{241}Am and $^{239/240}Pu$ distributions are shown in Fig. 16.3-17. All samples were above worldwide fallout background levels. The highest levels of americium were at the surface and between 8.5 and 10 ft; and the highest levels of plutonium were at the surface and between 12.5 and 14 ft.

In 1978, holes were cored into both beds 1 and 2, and these results were reported in Nyhan et al. (1984; 1985). (See Fig. 16.3-2) Results for plutonium and americium are reproduced in Figs. 16.3-18 and 16.3-19, respectively. These data indicated that both plutonium and americium have

moved to depths of 30.5 m (100 ft) beneath bed 1. Bed 2 received only overflow effluent, and both plutonium and americium migrated a shorter distance beneath this bed than in bed 1.

16.3.1.2.4 Summary of historical data

The historical surface soil data in 1984 and 1986 indicate that MDA T and the down slope area to the north rim of DP Mesa contain elevated levels of plutonium, americium, and cesium on or near the ground surface. Levels are high at the borders of the sampling locations along DP canyon and within MDA T. The vegetation data indicate that transport of radionuclides into vegetation both within and outside MDA T has occurred. The surface of MDA T inside the fence was stabilized in 1987, and fill was added. Whether elevated surface contamination currently exists within or outside the fence is not known.

The subsurface data indicate that transport of plutonium and americium into the tuff has occurred to at least 28 to 30 m. Data beyond that depth are unavailable; therefore, the total vertical depth of the plume is unknown. The lateral extent of contamination is also unknown.

Data on contaminants other than radionuclides, such as organics, (volatile and semivolatile) and inorganics are unavailable for either surface or subsurface. However, available information on the composition of the waste stream applied to the absorption beds (Tables 16.3-VII through 16.3-IX), in addition to plutonium processing knowledge (Sec. 3.2), will provide useful information to guide future sampling (see Sec. 16.3.2).

16.3.1.2.5 Subsurface modeling of radionuclides

Attempts at simulating the subsurface pathway were conducted by Travis and Nuttall (1984) and HydroGeoLogic (1989). The study by Travis and Nuttall (1984) compared a porous media continuum approach using a linear K_d or retardation factor, a separate K_d for the tuff and clay layer, and a colloid transport model. Travis and Nuttall compared their results for plutonium with the data from Nyhan et al. (1984) for hole 1 in absorption bed 1. Their results indicated that the constant K_d values did not reproduce the observed data very well but that the variable K_d did allow plutonium transport down to the depths where plutonium was observed. The colloid transport simulation matched a peak in plutonium concentration found near 10 m in depth, but the curve quickly tailed off and was essentially below detection limits by 17 m in depth. The HydroGeoLogic simulation (HydroGeoLogic 1989) used a porous media continuum approach for water flow and contaminant transport. One aspect of this study was to use a spatially variable K_d in a layered system that reproduced the serrated concentration profile that was observed. Both of

these modeling studies were limited by available hydrologic and geochemical data.

The two modeling studies demonstrated how different conceptual views of the subsurface pathway can be applied to available data to recreate site history. In fact, both the colloid transport and distributed K_D are potential mechanisms that can occur simultaneously or over different phases during the history of the waste site. A feature of the Bandelier tuff noted by HydroGeoLogic (1989) was the rapid damping of input pulses. Abrahams(1963) reported on two infiltration studies showing that in locations where water was ponded for several months, the soil water content returned to pretest levels within a year after water application was discontinued. This is important in deciphering the behavior observed in the absorption beds at MDA T. As noted by HydroGeoLogic (1989), the soil water contents measured by Nyhan et al. (1984) may be the residual after the main pulse has passed, rather than a series of advancing pulses. Differing rates of movement of the water and radionuclides mean that the radionuclide pulse for the most part will be retarded. These results point to the need to understand the mechanisms controlling water and solute movement, rather than predicting the mechanisms from the residual evidence from past events.

The role of fractures in flow and transport is not well understood. Adequate models cannot be constructed to represent their function in variably saturated porous media. During the infiltration experiments conducted in 1960 and 1961 on absorption bed 1, there was evidence from Abrahams (1963) that the tuff was saturated and flow occurred through joints. The HydroGeoLogic (1989) report stated that the disappearance and reappearance at a lower depth of measurable plutonium is characteristic of flow in joints. One of the key issues to consider for unsaturated porous media is when, or under what conditions, flow occurs in fractures.

Lateral diversion of subsurface flow or perching of water can be caused by a discontinuity in the hydraulic properties of the tuff. The lateral movement of water has the potential of creating seeps on the canyon walls. This effect has not been documented at TA-21. Occurrence of perched water has been documented primarily in the alluvial material in canyons at Los Alamos (Abrahams 1963) and not within the main body of tuff. The alluvial water is perennial and fluctuates with snow melt and rainfall recharge. The alluvial aquifers are believed to be confined to the channels, and the presence of perched zones beneath the mesas has not been documented.

16.3.1.3 Source Term

The source of all waste disposed in MDA T was plutonium-processing waste from DP West, with the exception of waste from DP East added to the absorption beds from 1965 to 1967.

Table 16.3-VI summarizes the estimated radionuclide source terms from MDA T. The source input to the absorption beds was plutonium-processing waste, which contained organic extractants used in plutonium processing at the time it was input to the absorption beds. Some limited data are available on the composition of the waste input to the absorption beds (see Tables 16.3-VII thru 16.3-IX). No previous sampling has analyzed for metals or organics.

The material placed in the disposal shafts contains much greater activity than that added to the absorption beds; however, it was input as a cement paste into asphalt-lined disposal shafts. Again, whether organics or metals were part of this waste stream is unknown. No sampling has been done either adjacent to or beneath these shafts.

16.3.2 Objectives and Data Needs

The significant estimated radionuclide source term at MDA T and documented plutonium and americium contamination to 30 m lead to a need for extensive subsurface sampling data. Two modeling studies with different conceptual views of the subsurface pathway give similar results and indicate the mechanism controlling water and solute movement needs to be better defined. Additional surface sampling is also necessary because historical surface soil data from detailed surveys in 1984 and 1986 indicate MDA T and the down slope area to the north rim of DP Mesa contain elevated radionuclide concentrations.

The following data are needed:

1. Identification of contaminants present. Because this site received plutonium-processing waste, organic extractants and metals were likely present in the waste stream. At a minimum, a subset of surface and subsurface samples collected will require analysis for metals and organics. Because stabilization-in-place is the preferred remedial alternative, Level III/IV data will be used to define the contaminants present.

2. Determination of the vertical and lateral distribution of contaminants both within and beyond the MDA T fence.

   Surface. Previous surface sampling has shown contamination beyond the MDA T fence towards DP Canyon. Additional grid sampling and analyses for metals and organics, in addition to radioactive constituents, are needed, both within and outside the MDA T fence to define the nature and extent of surface contamination. Since these are surface samples, Level II VOA screening will be used to determine presence or absence. Level III data are required for other analyses.

   Subsurface. Subsurface sampling beneath the absorption beds beyond 30 m is required to define the vertical extent of the plume. The lateral extent of the subsurface plume, because of liquid wastes input to the

absorption beds, also needs to be defined. Emphasis will be placed on absorption bed 1 because it received the most effluent and because previous studies have shown contaminants to have migrated to the greatest depth in this bed. Additionally, data are needed on the presence of subsurface contamination and the lateral and vertical extent of contamination beneath the disposal shafts and the retrievable waste storage area. Level III/IV data will be used.

3. Characterization of all contaminant migration pathways. The vertical subsurface pathway and the surface lateral pathway (surface transport and erosion) toward DP Canyon are believed to be the most important.

4. Determination of geologic stability of the site, particularly with respect to erosion. Although this MDA is not immediately adjacent to the canyon side, the geologic stability of the site must be determined to evaluate whether capping and *in situ* stabilization of waste is a viable remedial alternative at this site.

5. Definition of the TA-21 OU conceptual model (see Chapters 7 and 12) is particularly important for this SWMU because previous modeling and field studies have not fully defined system behavior. This SWMU requires results of general TA-21 site characterization to define the importance of fractures, layering, presence of pumice inclusions, etc. This information is necessary to accurately assess the risks to human health and the environment from chemical and radionuclide contamination and to support the screening and selection of remedial alternatives.

16.3.3 Sampling Investigation and rationale

No current information is available on surface contamination at MDA T because the site underwent surface stabilization in 1987. Surface sampling data will be collected on a 20- by 20-m grid within the MDA T fence and extending beyond the fence to the canyon edge north of MDA T, because previous surface sampling has indicated contamination to the north beyond the MDA T fence. This data will be analyzed in the context of the TA-21 OU surface sampling done on a 40- by 40-m grid (see Chapters 12 and 13) and the detailed drainage data (Sec. 16.1.4).

Because MDA T was a liquid disposal area, both vertical and angle boreholes will be drilled to define the source term and the lateral and vertical extent of contamination. Migration that has occurred since 1978 beneath absorption bed 1 will be evaluated by locating a drill hole close to a previous borehole.

Because only radionuclide data exist for MDA T, the initial investigation will require analyses for a full analytical suite of radionuclides, organics, inorganics, and metals.

Dependent upon results of initial sampling, the sampling program may need to be expanded. Results of mesa top characterization studies detailed in Chapters 12 and 13 will be important in

making this determination. In these additional investigations, the analytical suite will be focused to specific contaminants identified in the initial sampling.

16.3.4 Sampling Plan

Detailed tables have been prepared to identify the sample screening and analysis requirements for each planned investigation planned at MDA T. However, due to the large number of pages these tables have been placed in Section F.3 of Appendix F, Analytical Tables.

16.3.4.1 The MDA T Surface Sampling Plan

Samples collected inside MDA T as part of this sampling plan will be used to study erosion patterns and help assess the adequacy of the 1987 surface stabilization process. Because stabilization was only within the fence, the samples collected outside the fence will be used to characterize the extent of migration and to understand the migration patterns.

16.3.4.1.1 Initial Investigation

The kriging analysis of the 1986 data showed (Sec. 16.3.1.2.2) that additional sampling is needed to characterize the southern end of the site and the extent of migration from the northern perimeter to DP canyon. To accomplish these goals, the MDA T sampling plan will be sequential. The 40 initial investigation samples will be taken on a 20- by 20-m grid within the fence, extending to the canyon edge and coordinated with the TA-21 OU surface-sampling plan described in Chapters 12 and 13 (Fig. 16.3-20). Radiation survey instruments will be used within the 20- by 20-m gridded area to confirm that no areas of elevated radioactivity are present between grid points. Up to 10 additional samples will be taken of any such areas to further characterize the extent of migration. In addition, samples from drainages will be collected as described in Sec. 16.1.4. These sample data will be combined and used to develop spatial prediction surfaces such as those developed for the 1986 data (Sec. 16.3.1.2.2).

Five additional samples within the MDA and five in the area to the north will be taken 5 m from grid locations. These will allow estimation of the importance of spatial variability.

All samples will be analyzed in an analytical laboratory for radionuclides, metals, and semivolatiles. Table F.3-I (see Appendix F) gives the sample screening and analysis requirements.

16.3.4.1.2 Subsequent Investigation

The need for additional sampling and the required number and locations of additional samples will be determined on the basis of the initial sample analysis results and the accuracy requirements for the prediction surfaces.

For planning purposes, it is assumed that 30 surface samples on a 10- by 10-m grid surrounding MDA T will be required in the subsequent investigation. If appropriate, a reduced analytical suite determined by analytical results from the initial investigation will be used. However, for planning purposes, it is assumed the analytical suite used in initial investigations will be used. Table F.3-II (see Appendix F) presents the assumed screening and analysis requirements for the subsequent investigations.

16.3.4.2 Subsurface Sampling Plan

The subsurface sampling plan for MDA T emphasizes the characterization of potential contamination associated with

- the four liquid waste absorption beds;
- the 63-ft deep (up to 18.3 m) asphalt-lined vertical shafts containing waste immobilized in cement; and
- the deactivated retrievable waste storage area located between absorption beds 1 and 3 (Fig. 16.3.1).

16.3.4.2.1 Initial Investigation

The initial investigation of the subsurface sampling plan will concentrate on characterizing the source terms and the vertical extent of contamination in the four liquid-waste absorption beds. The subsequent investigation of subsurface characterization at MDA T will include the continuing delineation of the contaminant plumes associated with the absorption beds; and the examination of areas beneath and adjacent to the cement-filled shafts and the retrievable waste storage area for evidence of contaminant migration.

Initial drilling in absorption bed 1 will consist of two vertical holes which are designed to characterize the source term and to define the vertical extent of the contaminant plume beneath this bed. These two drill holes will be cored to a nominal depth of 150 ft below the bed; these holes will be deepened if necessary to penetrate the contaminant plume. One of these holes will be extended 50 ft below the contaminant plume. One of the drill holes (Fig. 16.3-21) is sited in the eastern

part of absorption bed 1 next to the hole drilled in 1978 to examine contaminant migration. The second drill hole is sited at the western end of the absorption bed to assess the amount of lateral variability in contaminant distributions. Information from these two drill holes will be used to compare contaminant concentrations to 100 ft with those reported in the 1978 study by Nyhan et al. (1984).

Absorption bed 2 will be characterized by two vertical drill holes (Fig. 16.3-21). One of the holes is located at the western end of bed 2 near the inlet from the distribution box which diverted effluent into the bed. The other hole is sited at the eastern end of bed 2 next to two holes drilled in 1978 that were used to examine contaminant concentrations with depth. Both holes in bed 2 will be drilled to a nominal depth of 75 ft. Information from the eastern hole will be used to assess the amount of contaminant migration that has occurred since 1978 (Nyhan et al. 1984).

Initial drilling in absorption beds 3 and 4 will consist of a single vertical drill hole located near the center of each bed. Fried et al. (1977) drilled to 14 ft in bed 3 and found elevated levels of plutonium and americium to that depth. Absorption bed 4 has not been previously drilled, and it is not known if radionuclides or other contaminants have migrated beneath it. It should be noted that beds 3 and 4 served as an overflow catchment to beds 1 and 2, respectively, and probably received relatively small amounts of contaminated effluent. The vertical holes in these beds are located near the inlet of the overflow pipes from beds 1 and 2 and thus probably represent the areas of maximum contamination. The nominal depth of each of these holes is 75 ft.

Samples for contaminant characterization in vertical holes will be collected at varying intervals along the length of the drill holes. More closely spaced samples will be taken at the interface separating the absorption beds from the underlying tuffs. Samples will be collected at 2.5-ft intervals in the absorption beds and across the interface separating the absorption beds and the underlying tuffs. Below the absorption beds, samples will be collected at 5-ft intervals. These sample intervals may be modified because of variable amounts of core recovery and to meet requirements for greater sample volumes for laboratory analyses. Samples for soil moisture determination will be collected at 5-ft intervals.

The nominal depth of the drill holes is given in Fig. 16.3-21. The borehole stopping criteria in Sec. 11.5.3 will be applied to all boreholes, and the field laboratory will be used to make these determinations. In the initial investigation, the full suite of analyses in an analytical laboratory will be conducted on all core samples. The screening and analysis requirements are presented in Table F.3-III (see Appendix F).

One vertical hole in absorption bed 1 will be extended 50 ft below the contamination plume to determine whether the liquid waste infiltrating beneath MDA T has altered rock properties. In this region of this hole, samples will be analyzed at 10-ft intervals for geochemical parameters and mineralogy as detailed in Sec. 12.5.1.5 and given in Table F.3-IV (see Appendix F).

An important objective of this investigation is to evaluate the importance of fractures as potential preferential transport pathways, if fractures are encountered they will be preferentially sampled. If a fracture is encountered over a 5-ft-sampling interval, two samples will be taken from that sampling interval to provide data allowing a comparison between fracture and nonfracture intervals. This sampling is included as a contingency for 5 additional samples in Table F.3-III (see Appendix F).

Geochemical parameters and mineralogy (as detailed in Sec. 12.5.1.5) will be characterized in all initial boreholes on 20-ft intervals of core and on additional contaminant zones to define the geochemical parameters associated with particular contaminants. For planning purposes it is assumed that 20% additional sampling within contaminant zones will be needed to define mineralogical and geochemical control on contaminants. Geochemical analysis is summarized by borehole in Table F.3-IV (see Appendix F).

One 300-ft borehole will be drilled at MDA T (see Fig. 16.3-21) for geohydrological parameter characterization and geophysical logging as detailed in Sec. 12.5.1.

16.3.4.2.2 Subsequent Investigation

The location of subsequent investigation holes may be modified after results of the initial investigation drilling are evaluated.

Eighteen holes have been tentatively identified for subsequent drilling at MDA T (Fig. 16.3-21). Ten of the drill holes will be inclined at 20 to 80° to sample areas adjacent to and beneath absorption beds and the cement-filled shafts (Fig. 16.3-22). The inclination and orientation of these drill holes may be modified, based on data gathered during initial drilling of the four absorption beds. Eight of the drill holes will be vertical and will penetrate to depths of 75 to 150 ft.

Seven drill holes have been tentatively located to characterize the vertical asphalt-lined shafts containing waste immobilized in cement. The area in which the shafts are placed has not been drilled previously, and it is not known if radionuclides or other contaminants have migrated from the shafts. Initially, drill holes will penetrate tuff adjacent to and below the shafts without actually penetrating the shafts themselves. Several of these drill holes also will be used to characterize

the contaminant plumes associated with the adjacent absorption beds. Five of the subsequent investigation holes have inclinations of 60° and will penetrate to depths up to 150 ft adjacent and beneath the shafts (Figs. 16.3-21 and 16.3-22). Vertical drill holes are sited near the southwest and northeast corners of the shaft site to define lateral migration of contaminants. Source term characterization of the shafts is not planned in the present drilling program but may be added later if significant contaminant migration is found.

The deactivated retrievable waste storage area located between absorption beds 1 and 3 will be characterized by four drill holes as part of the subsequent investigation. Three of the planned holes are inclined 20° and serve the dual purpose of also characterizing tuff beneath absorption bed 3. A vertical drill hole is sited in the western part of the storage area (Fig. 16.3-21).

Because subsurface lateral migration has been observed (Sec. 16.3.1.3), four subsequent investigation vertical drill holes are sited along the northeast fence line next to DP Canyon (see Fig. 16.3-20). These holes will penetrate to a depth of 150 ft and will be used to assess the possible lateral migration of contaminants towards DP Canyon.

A reduced analytical suite, based on results from the initial investigation will be used in the subsequent investigations. However, for planning purposes, it is assumed that a full analytical suite will be used. Table F.3-V (see Appendix F) details the assumed screening and analysis requirements for the subsequent investigations.

Shallow angle boreholes beneath MDA T will help determine the presence of vertical fractures and enable evaluation of their importance as potential preferential transport pathways. Therefore, if fractures are encountered they will be preferentially sampled. If a fracture is encountered over a 5-ft-sampling interval, two samples will be taken from that sampling interval to compare analytical results for fracture and nonfracture intervals. A five-sample per borehole contingency is planned for fracture sampling, as indicated in Table F.3-V.

Depending on results of hydrogeological parameter determinations in both the planned OU-wide 300-ft vertical boreholes and the MDA T initial investigation 300-ft vertical borehole, an additional 300-ft borehole for hydrogeological parameter determination may be drilled. If so, analyses detailed in Sec. 12.5.2 would be conducted.

The necessity for additional subsequent investigations for characterization will be determined after results from the initial and subsequent investigations are evaluated. No additional phases are detailed herein.

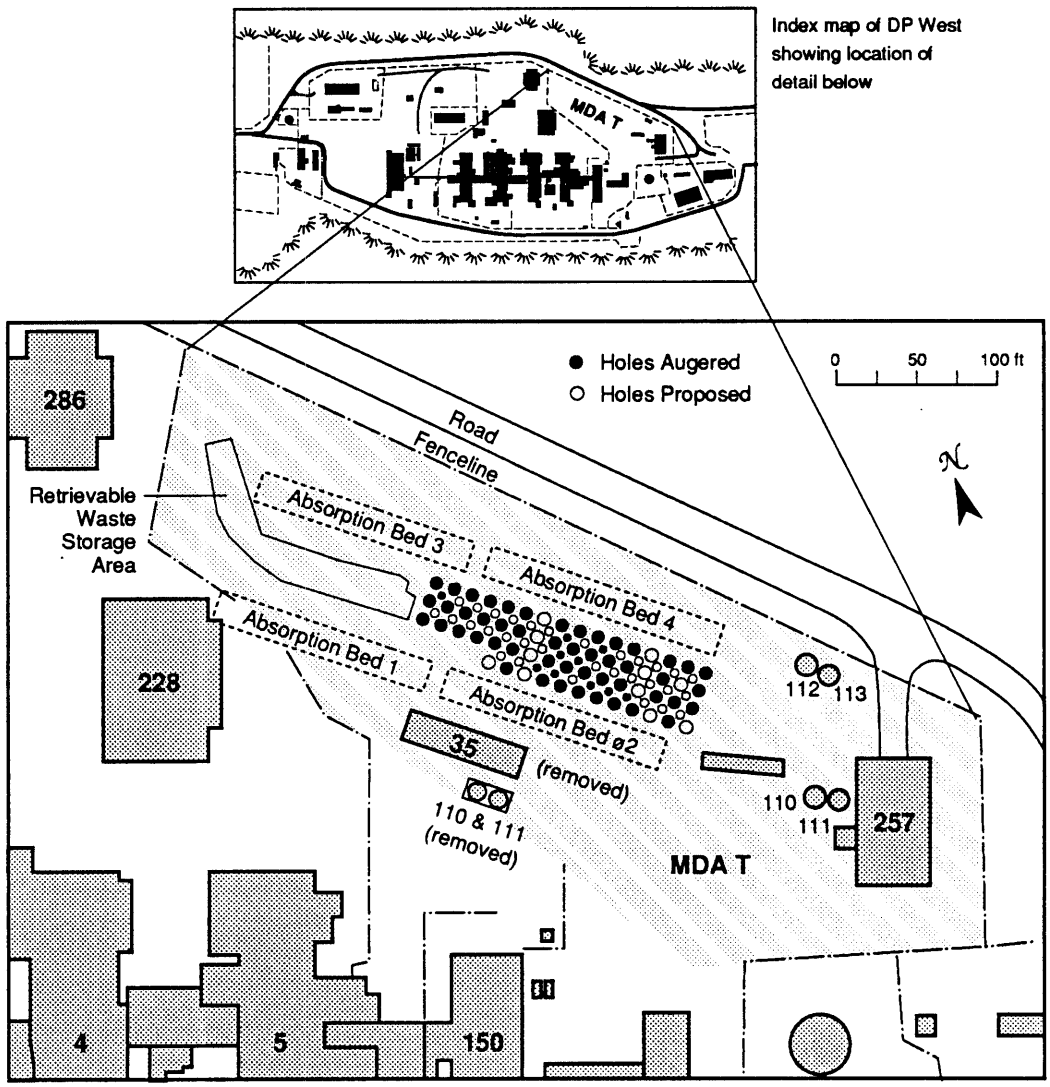


Fig. 16.3-1 General base map of MDA T showing locations of absorption beds, cement-filled shafts, the Retrievable Waste Storage Area, and Buildings 35 and 257. (LASL 1976c)

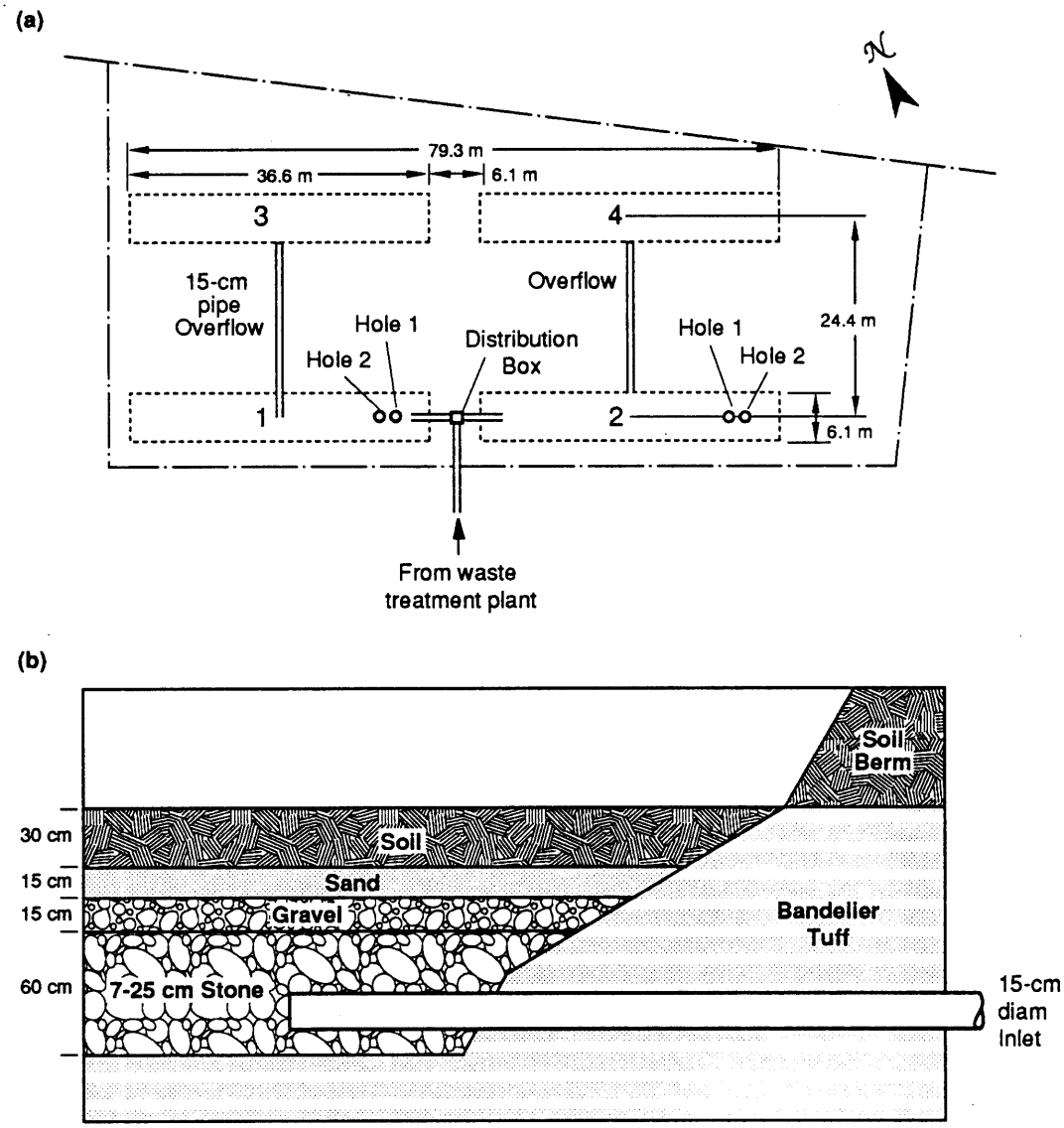


Fig. 16.3-2 Design of absorption beds at MDA T from Nyhan et al. (1984) showing a plan view (a) and cross section (b).

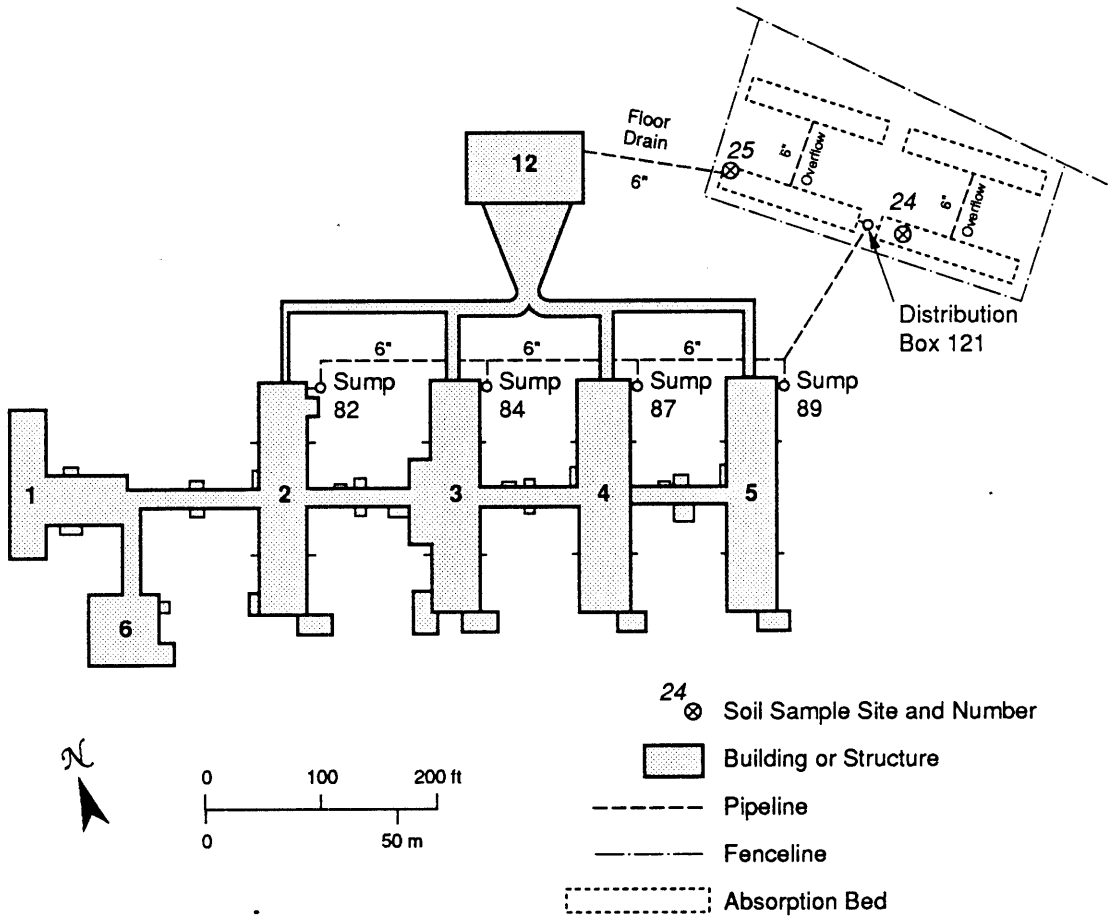


Fig. 16.3-3 Location of lines discharging to absorption beds at MDA T prior to 1952. (LASL 1945)

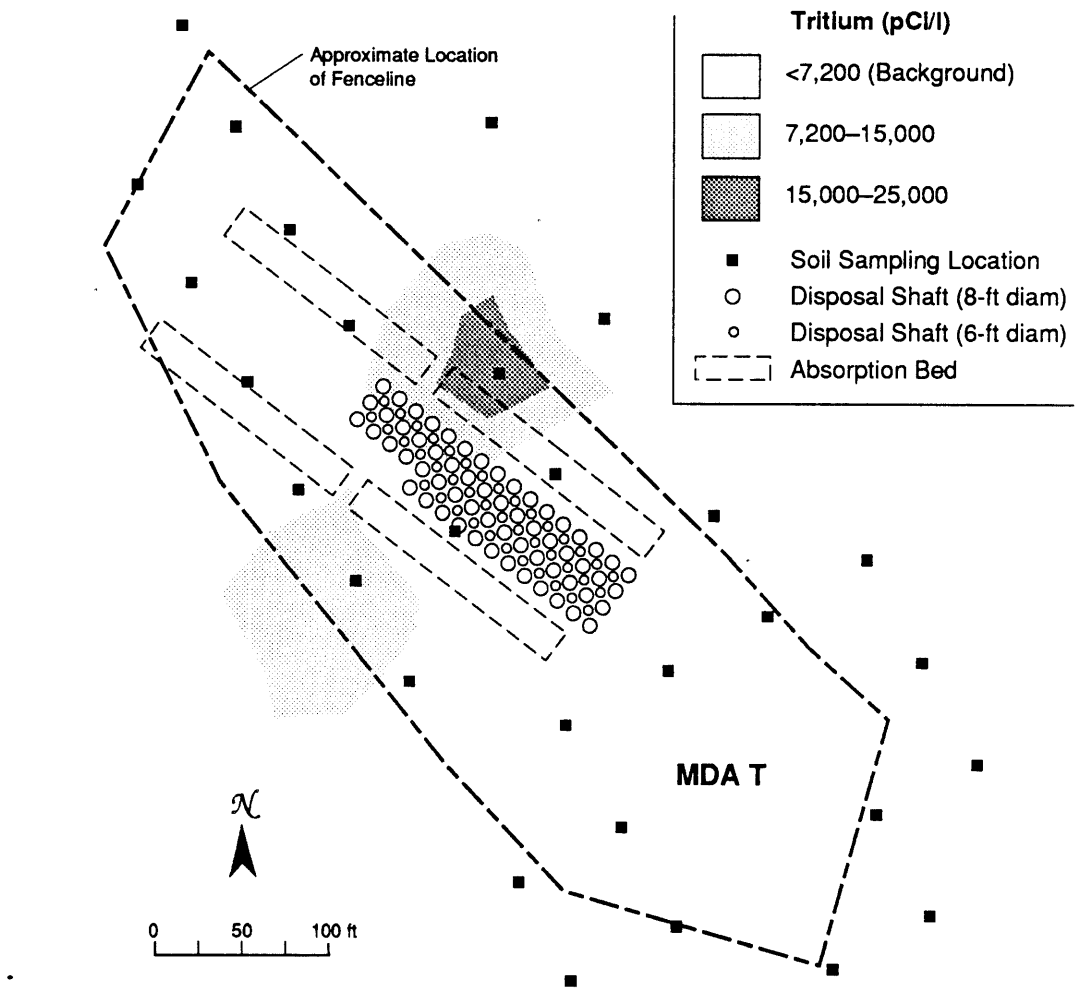
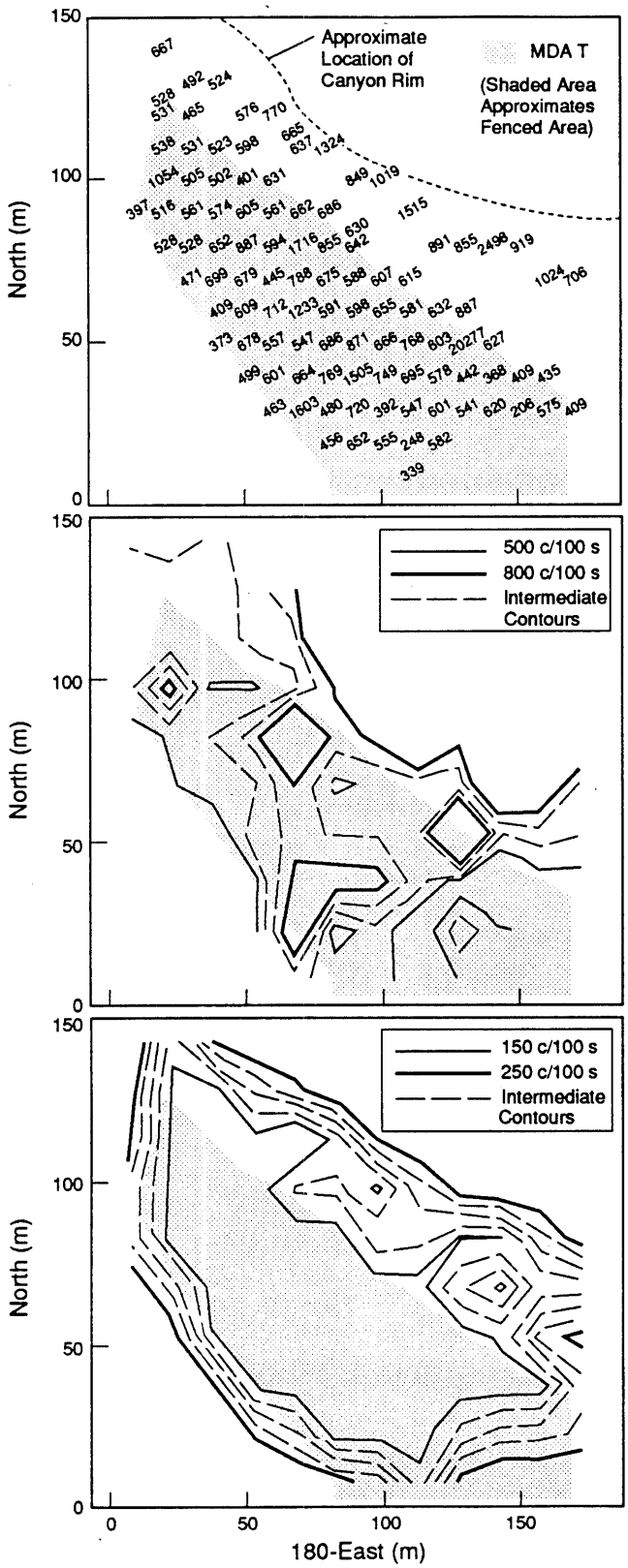


Fig. 16.3-4 Sample locations and soil tritium concentration contours for the 1984 sampling grid at MDA T (10- to 30-cm depth). (Nyhan and Drennon 1990)



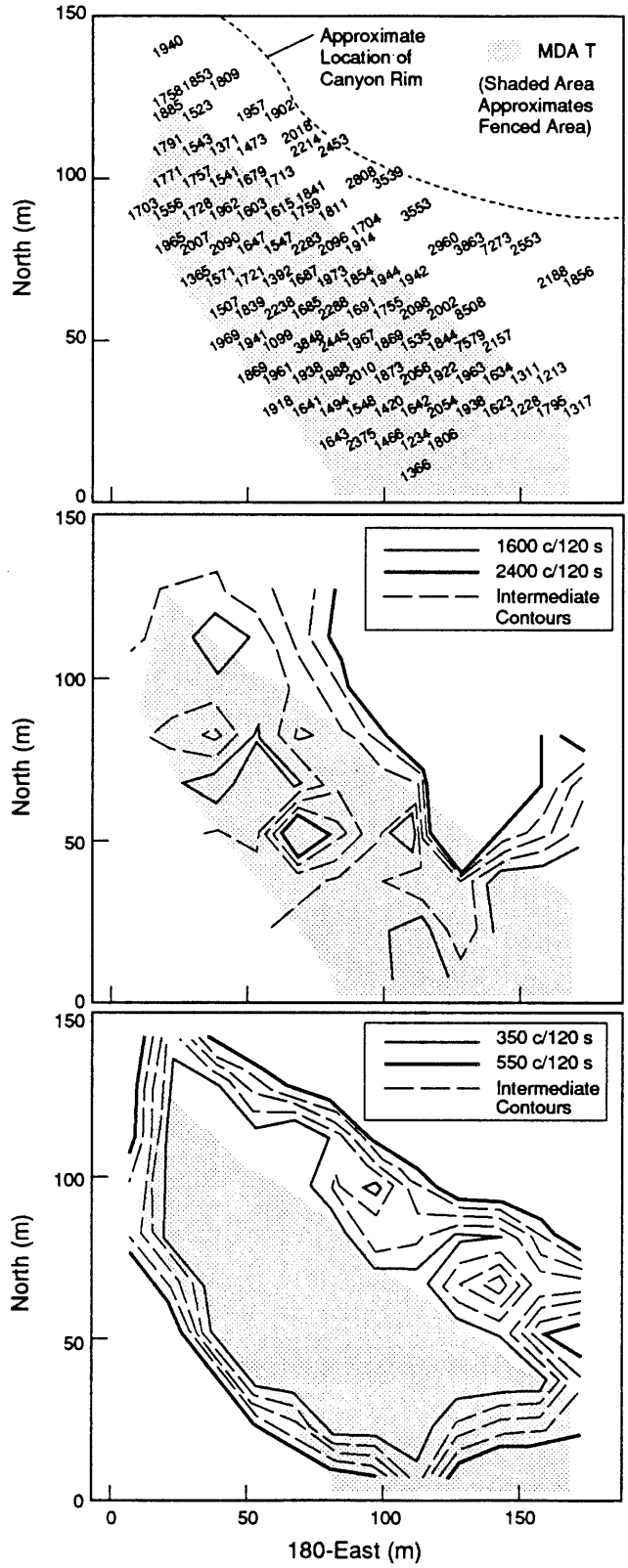
Phoswich Counts per 100 Seconds

Background <385 c/100 s
(Environmental Science Group 1987)

Kriged Phoswich

Phoswich Prediction Errors (+/-)

Fig. 16.3-5 Phoswich data from 1986 Survey for Environmental Surveillances for MDA T.

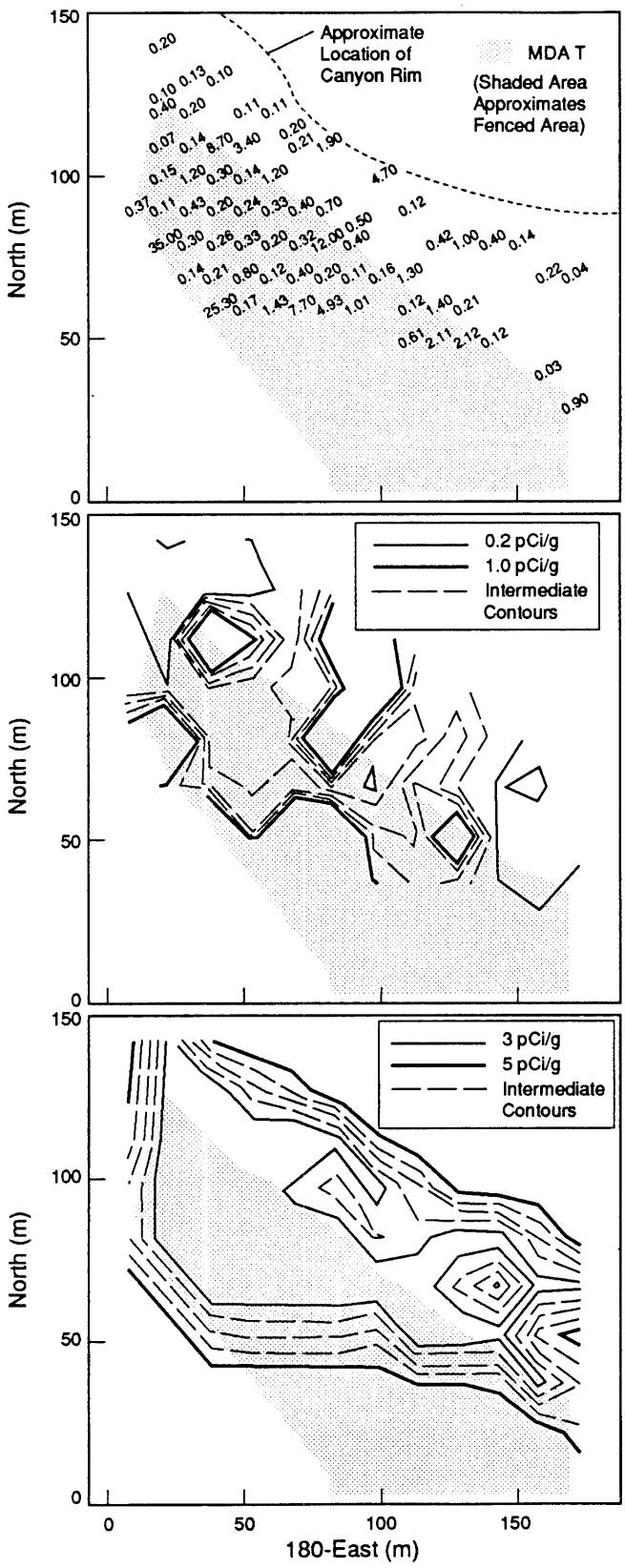


RASCAL Counts per 120 Seconds
Background <1,418 c/120 s
(Environmental Science Group 1987)

Kriged RASCAL

RASCAL Prediction Errors (+/-)

Fig. 16.3-6 RASCAL data from 1986 Survey for Environmental Surveillances for MDA T.



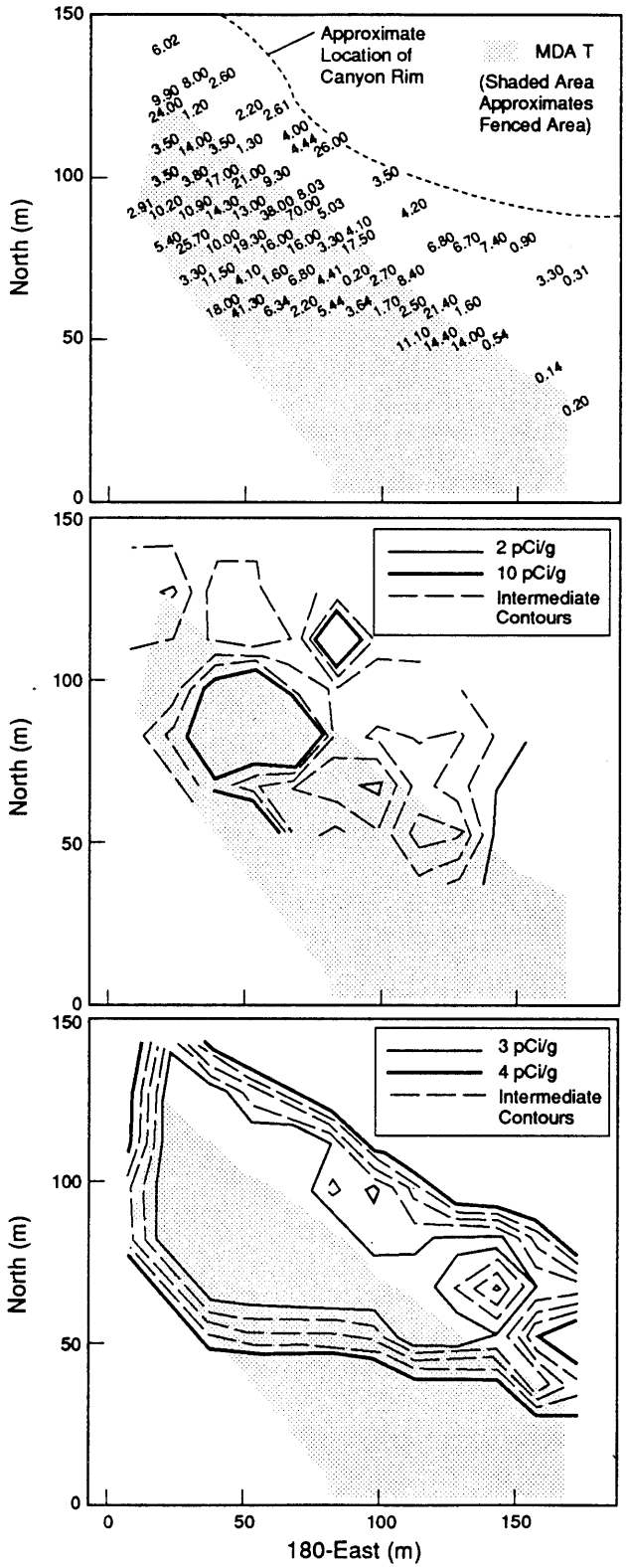
Plutonium-238 (pCi/g)

Worldwide Fallout Background <0.005 pCi/g (Purtymun et al. 1987)

Kriged Plutonium-238

Plutonium-238 Prediction Errors

Fig. 16.3-7 Plutonium-238 data from 1986 Survey for Environmental Surveillances for MDA T.



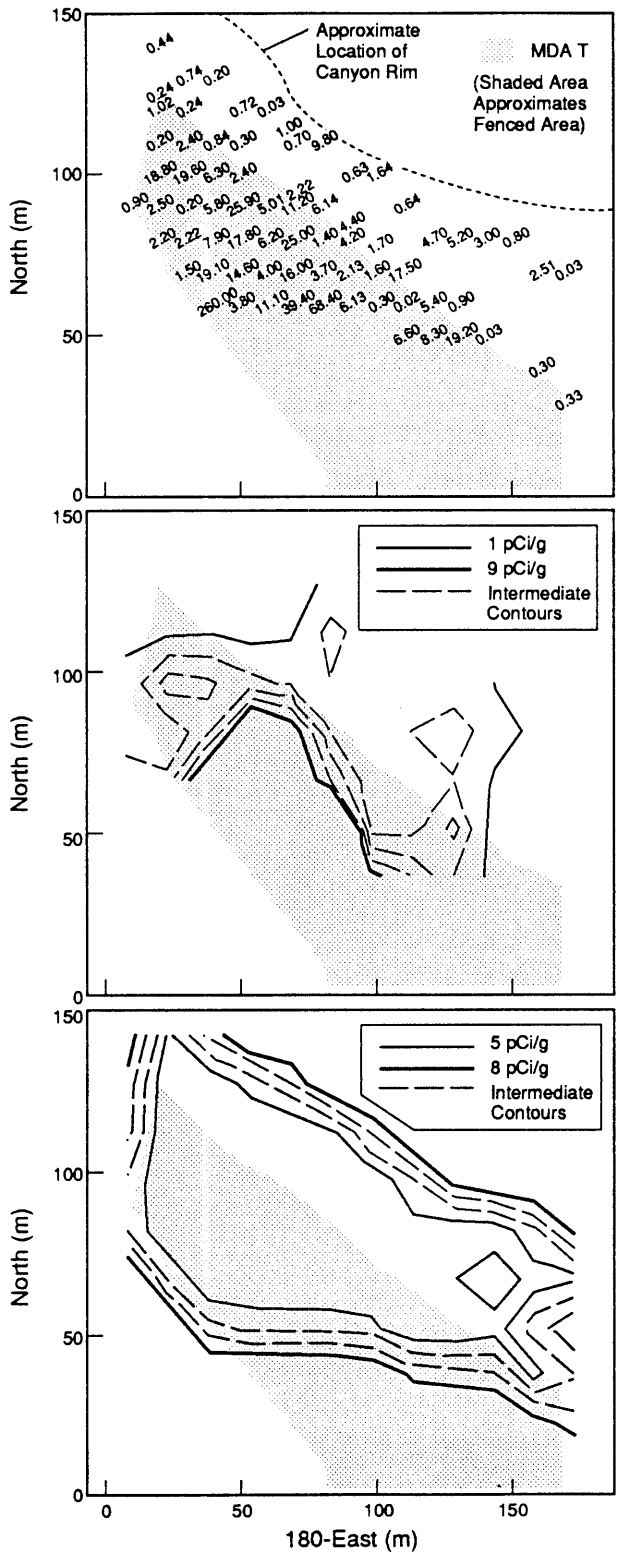
Plutonium-239/240 (pCi/g)

Laboratory Background <0.054 pCi/g (Environmental Science Group 1987)
Worldwide Fallout <0.025 pCi/g (Purtymun et al. 1987)

Kriged Plutonium-239/240

Plutonium-239/240 Prediction Errors

Fig. 16.3-8 Plutonium-239/240 data from 1986 Survey for Environmental Surveillances for MDA T.



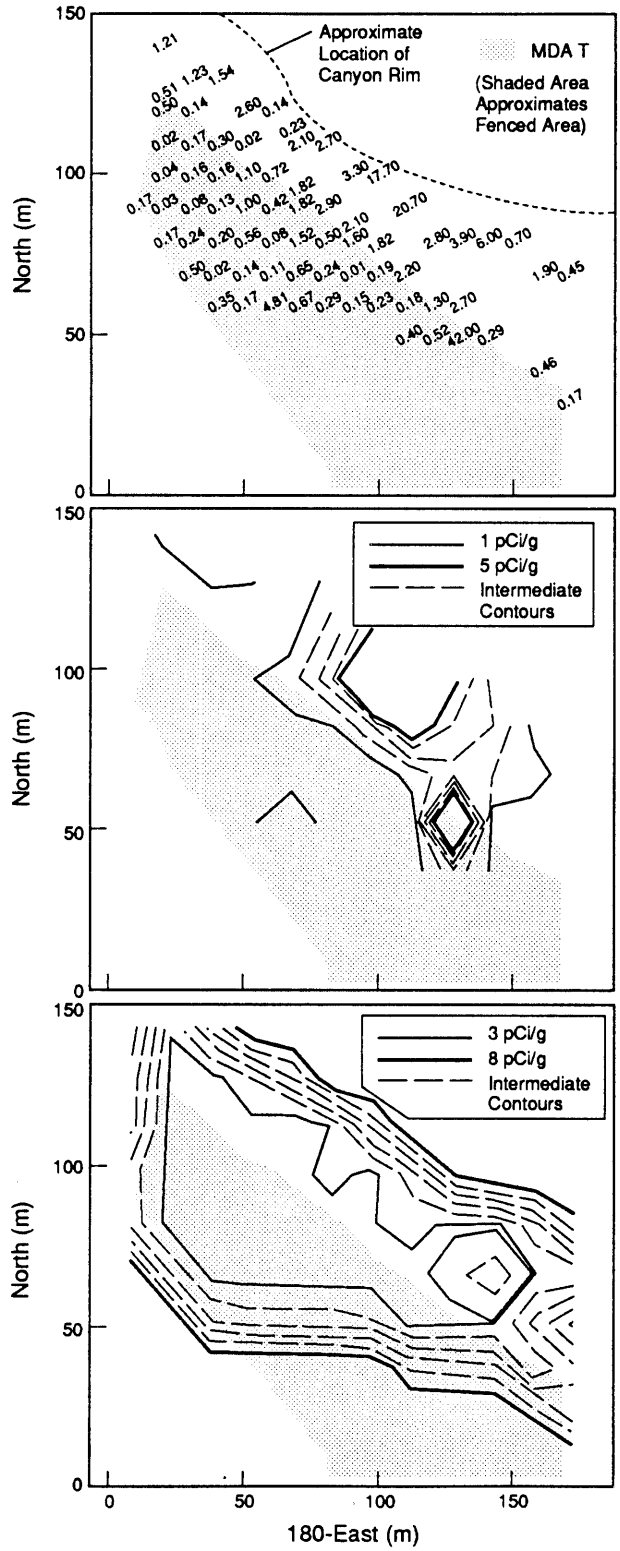
Americium-241 (pCi/g)

Background <0.23 pCi/g (Environmental Science Group 1980)

Kriged Americium-241

Americium-241 Prediction Errors

Fig. 16.3-9 Americium-241 data from 1986 Survey for Environmental Surveillances for MDA T.



Cesium-137 (pCi/g)

Worldwide Fallout Background 1.09 pCi/g (Purtymun et al. 1987)

Kriged Cesium-137

Cesium-137 Prediction Errors (+/-)

Fig. 16.3-10 Cesium-137 data from 1986 Survey for Environmental Surveillances for MDA T.

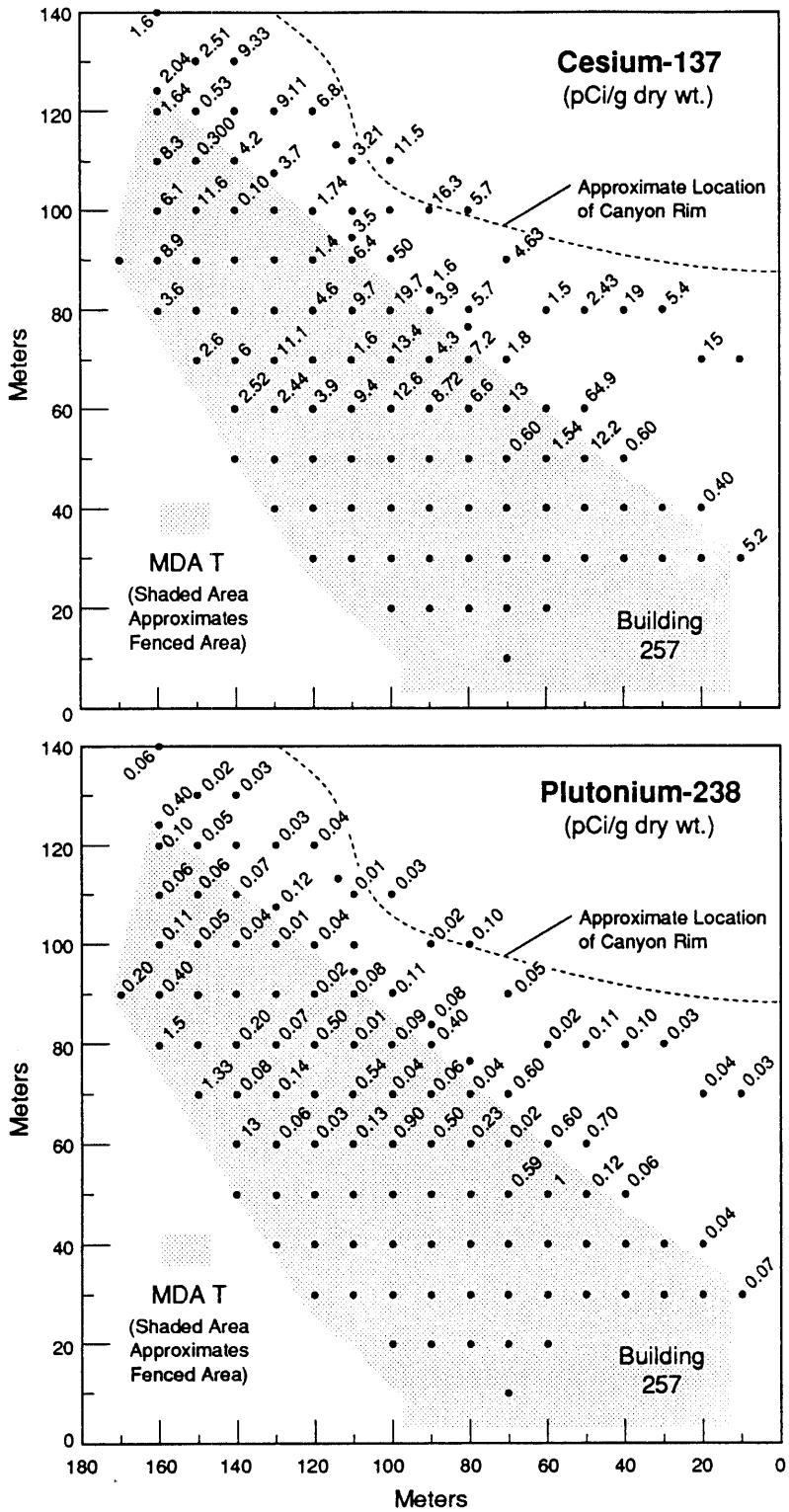


Fig. 16.3-11 Concentrations of cesium-137 and plutonium-238 in vegetation from MDA T in 1986.

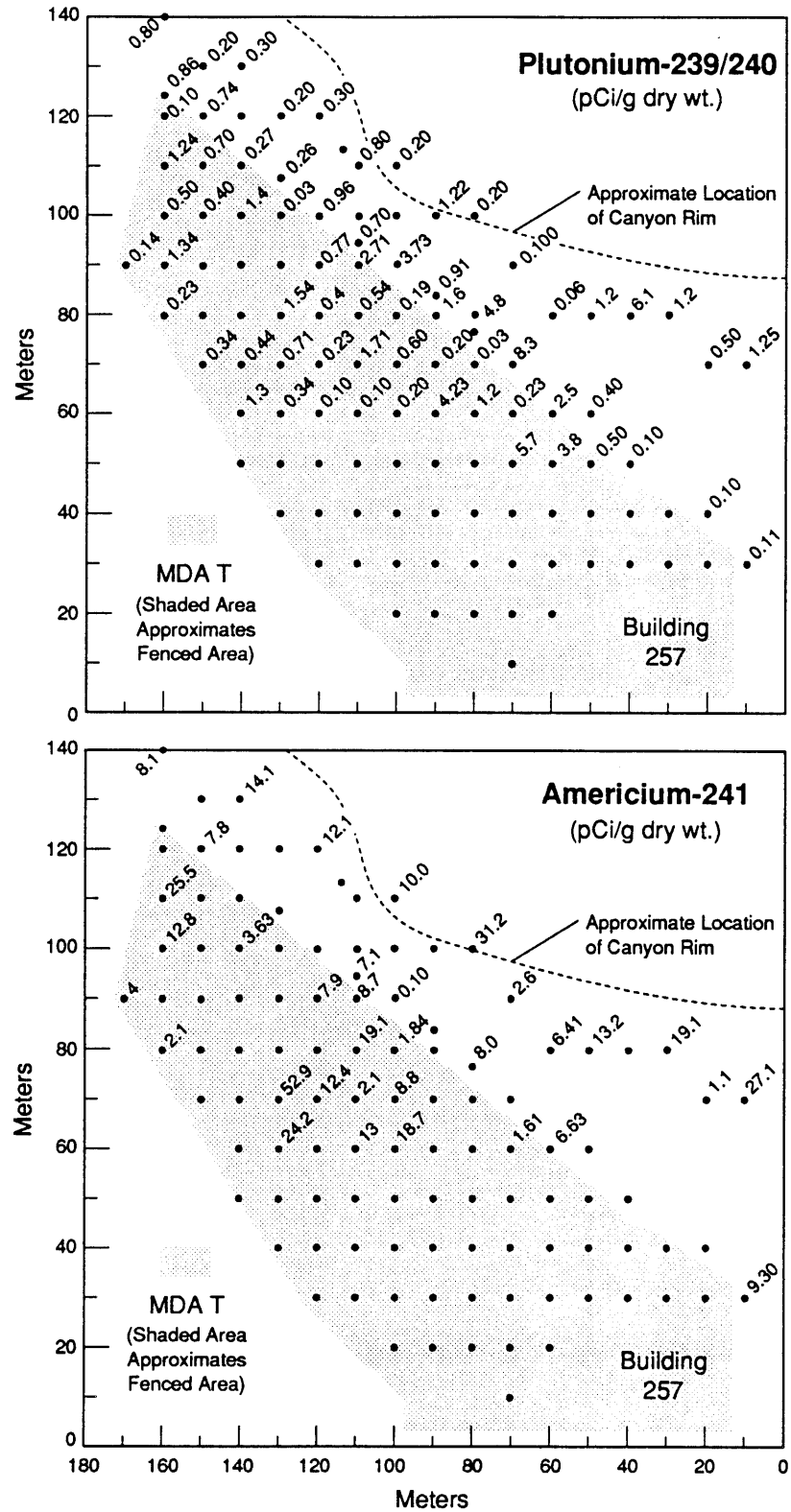


Fig. 16.3-12 Concentrations of plutonium-239/240 and americium-241 in vegetation from MDA T in 1986.

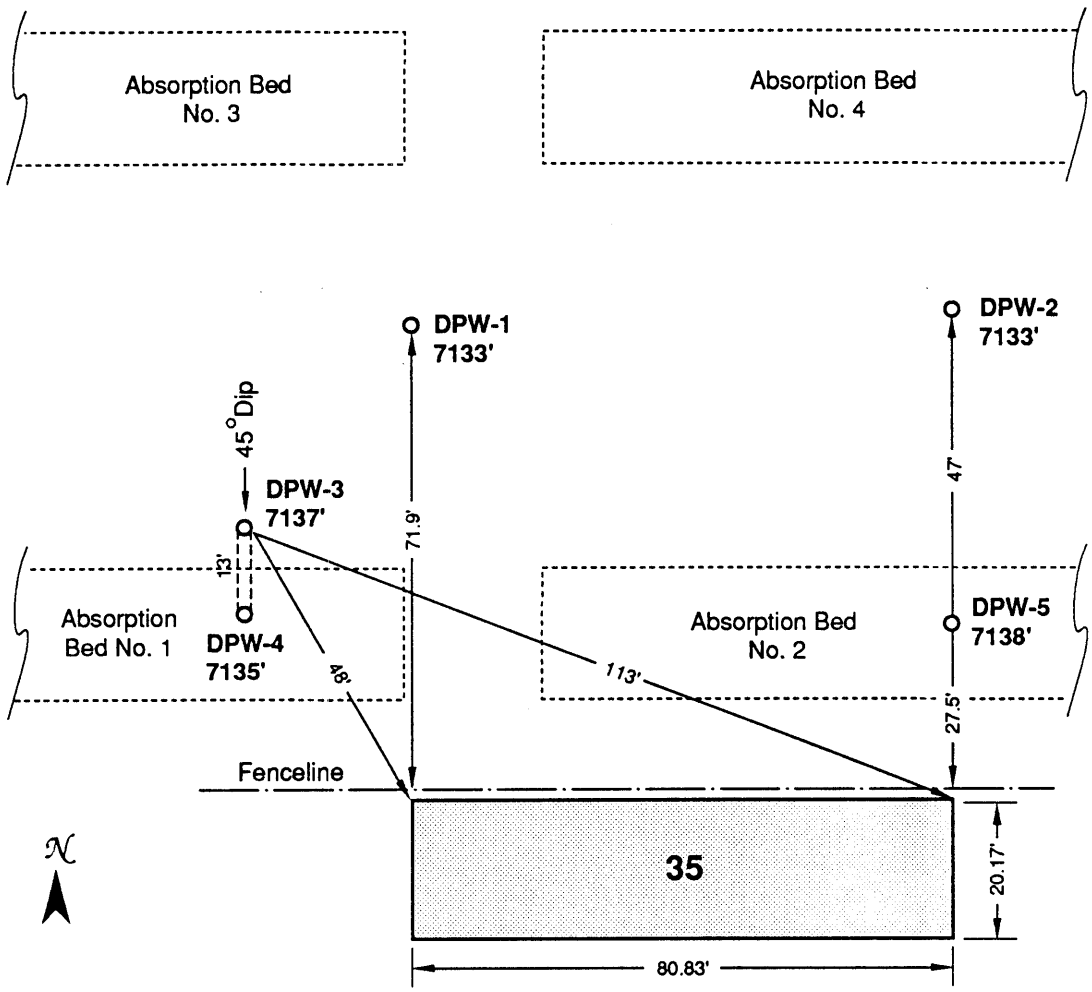


Fig. 16.3-13 Location of boreholes drilled in and around the absorption beds by Herman (1954) at MDA T.

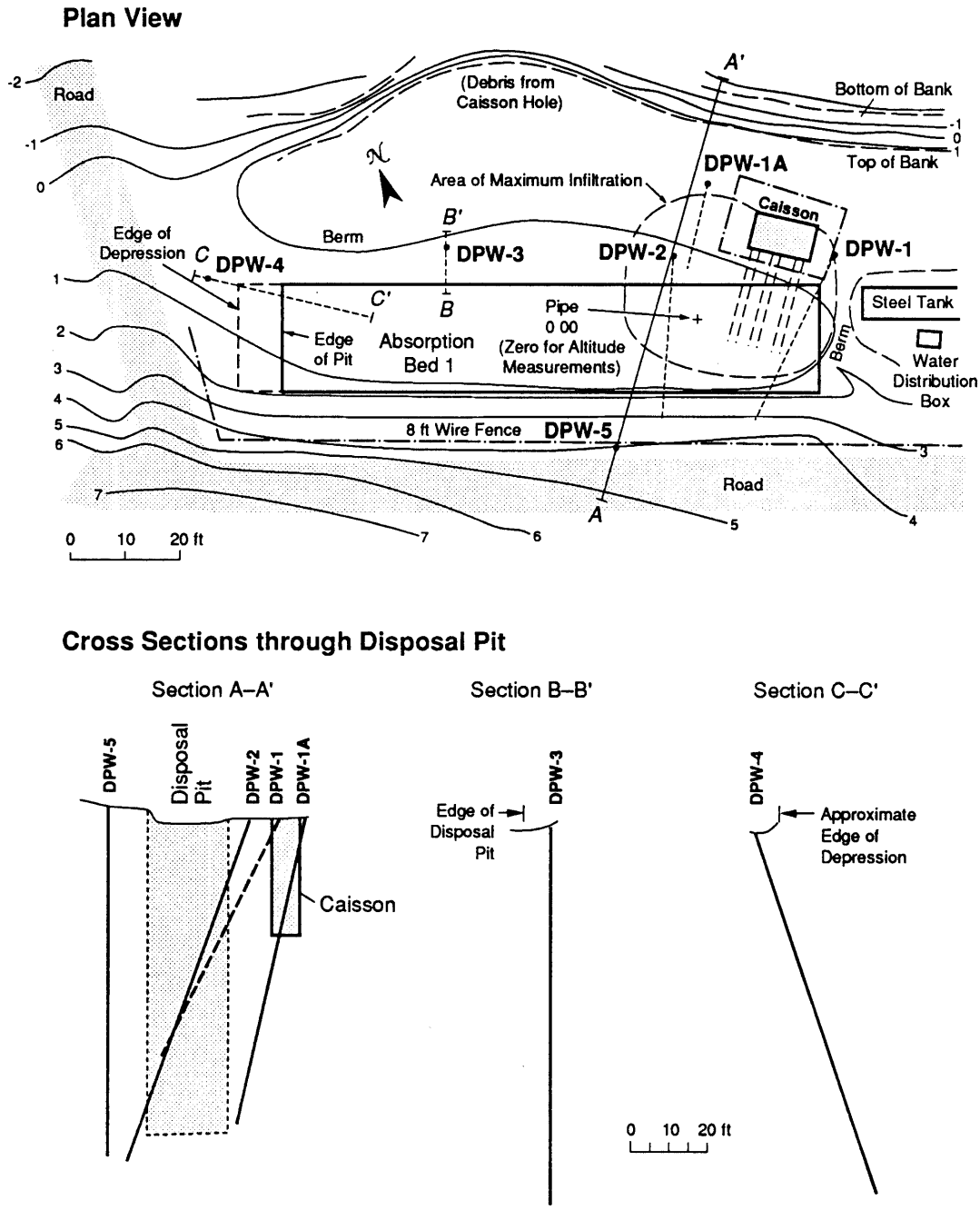


Fig. 16.3-14 Schematic of absorption bed 1 showing location of the caisson [SWMU 21-016(b)] and five boreholes drilled in 1960.

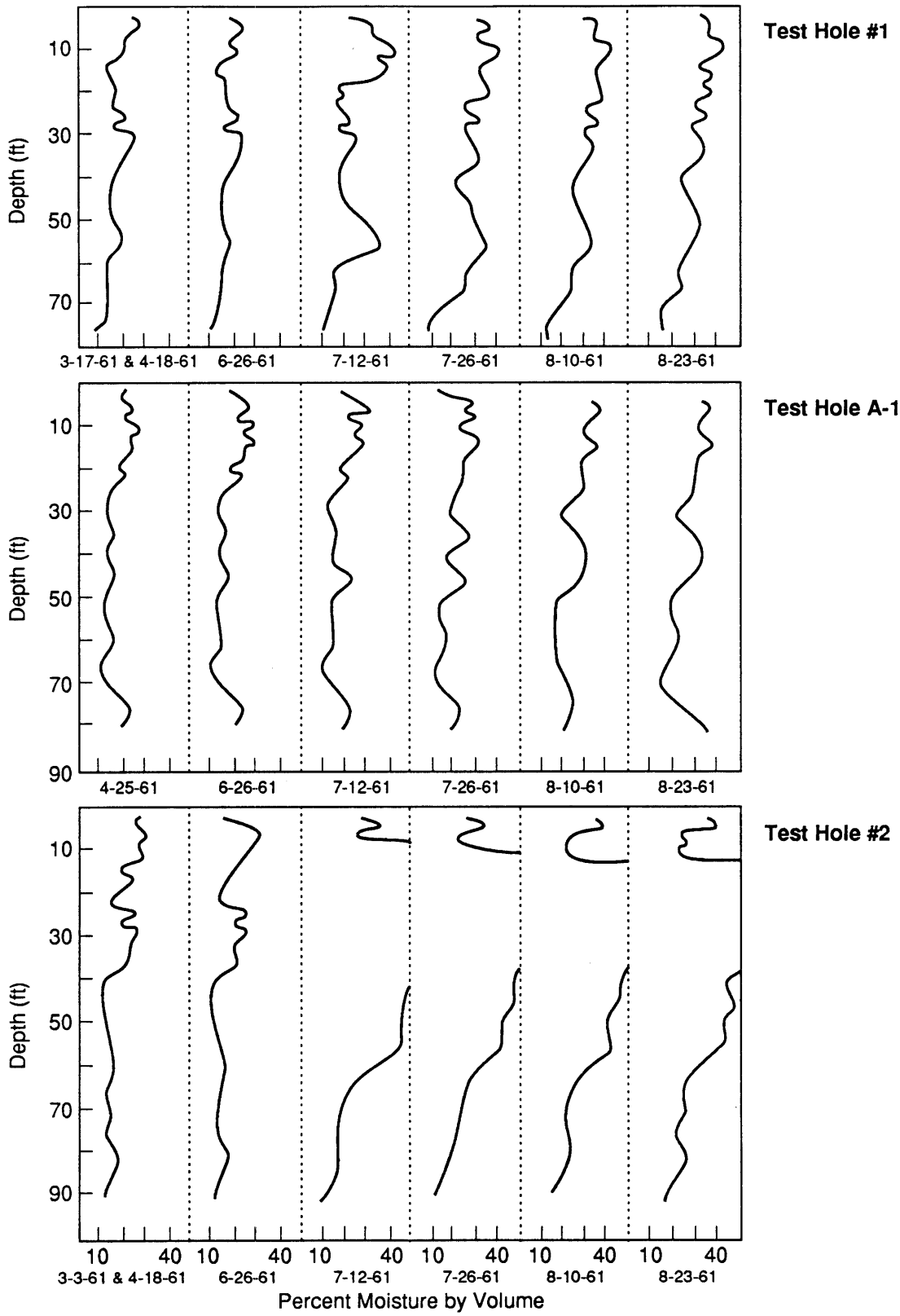


Fig. 16.3-15 Absorption bed 1 moisture distribution plots for Test Holes #1, A-1, and #2 (1961 infiltration experiment).

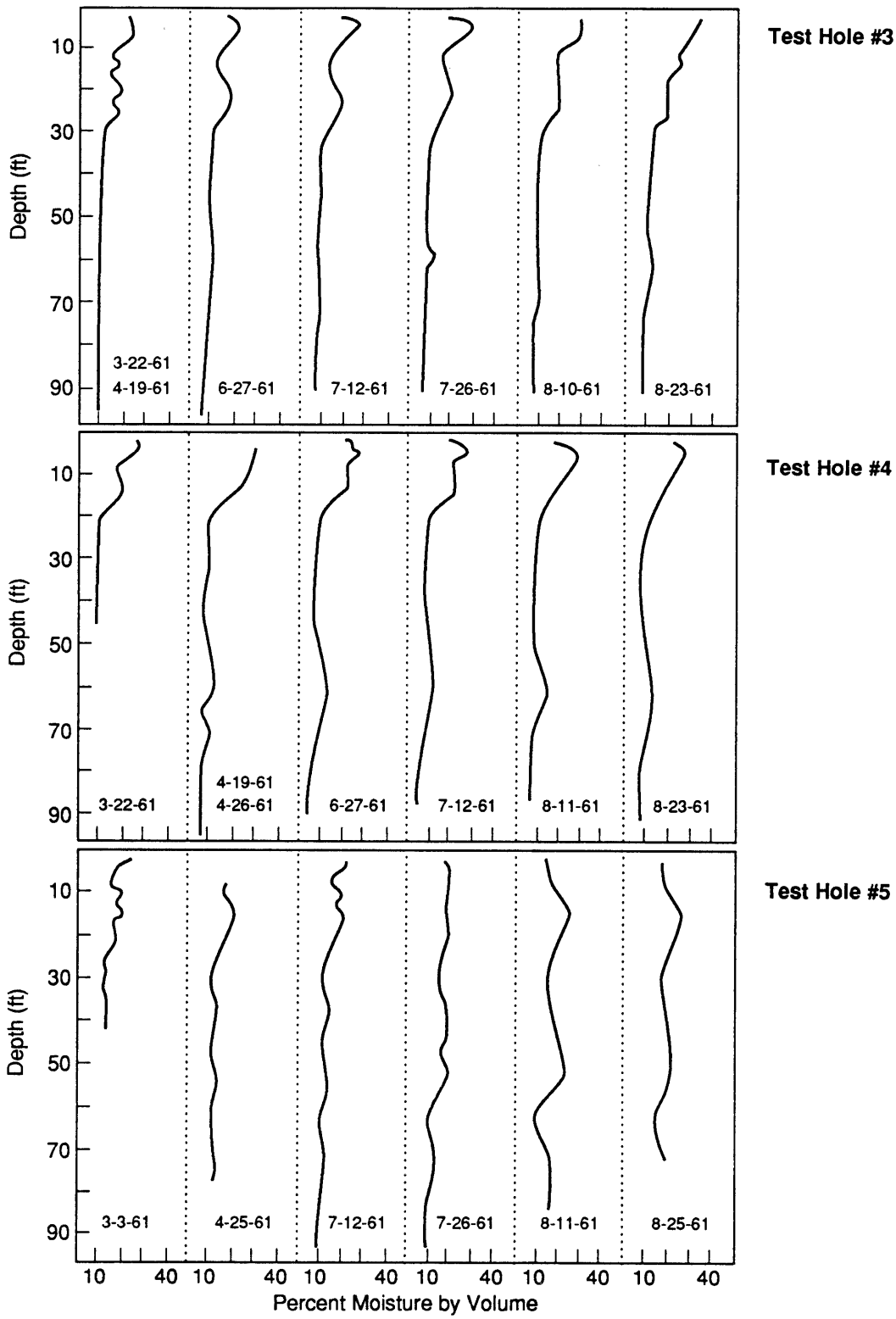


Fig. 16.3-16 Absorption bed 1 moisture distribution plots for Test Holes #3, #4, and #5 (1961 infiltration experiment).

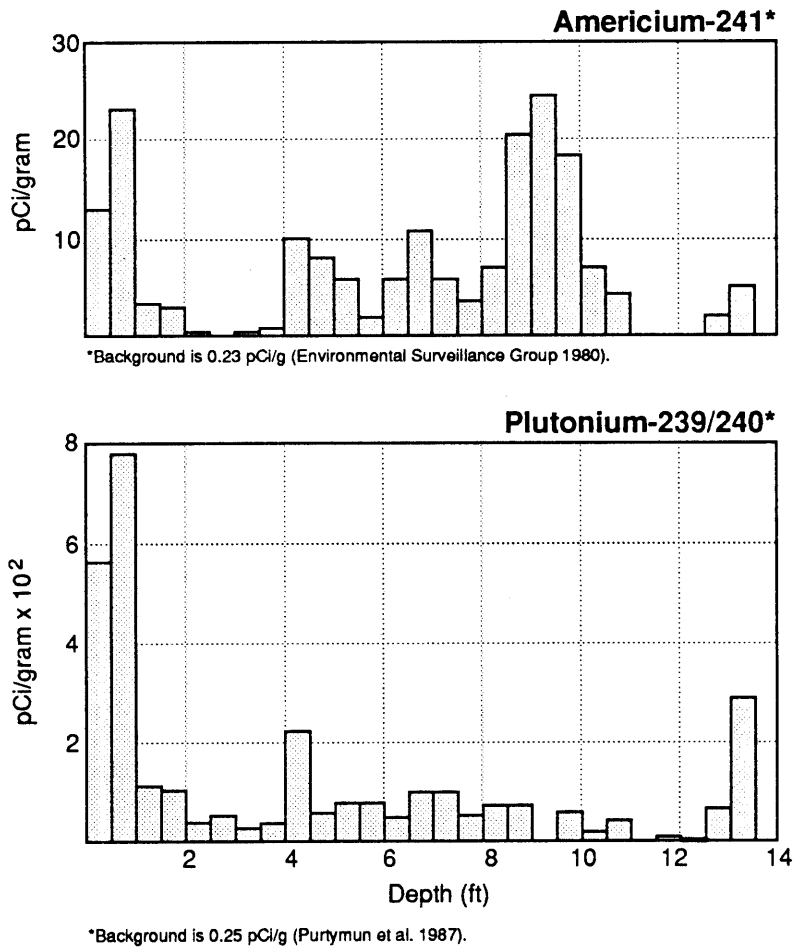


Fig. 16.3-17 Distribution of americium and plutonium in absorption bed 3 from 1974 sampling by Fried et al. (1977).

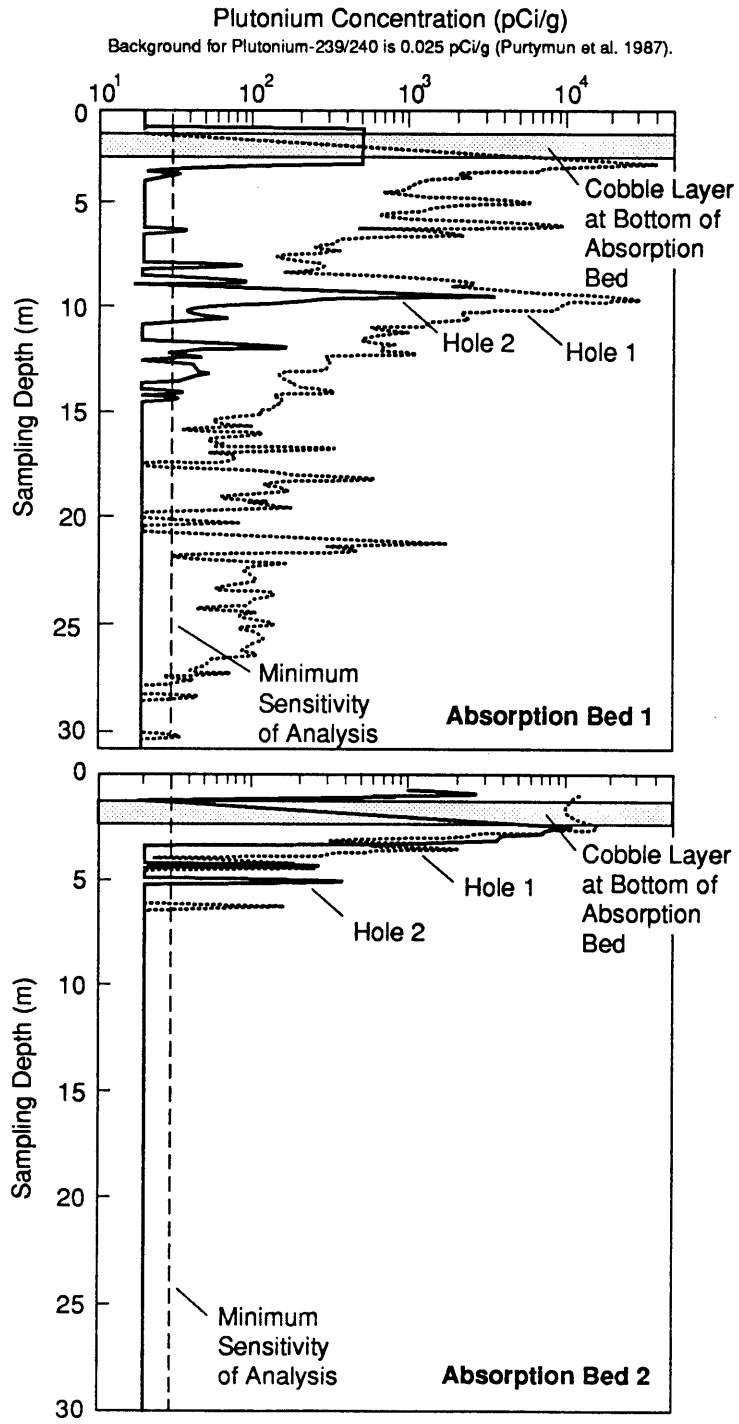


Fig. 16.3-18 Concentration of plutonium as a function of sampling depth for absorption beds 1 and 2 in 1978 from Nyhan et al. (1984).

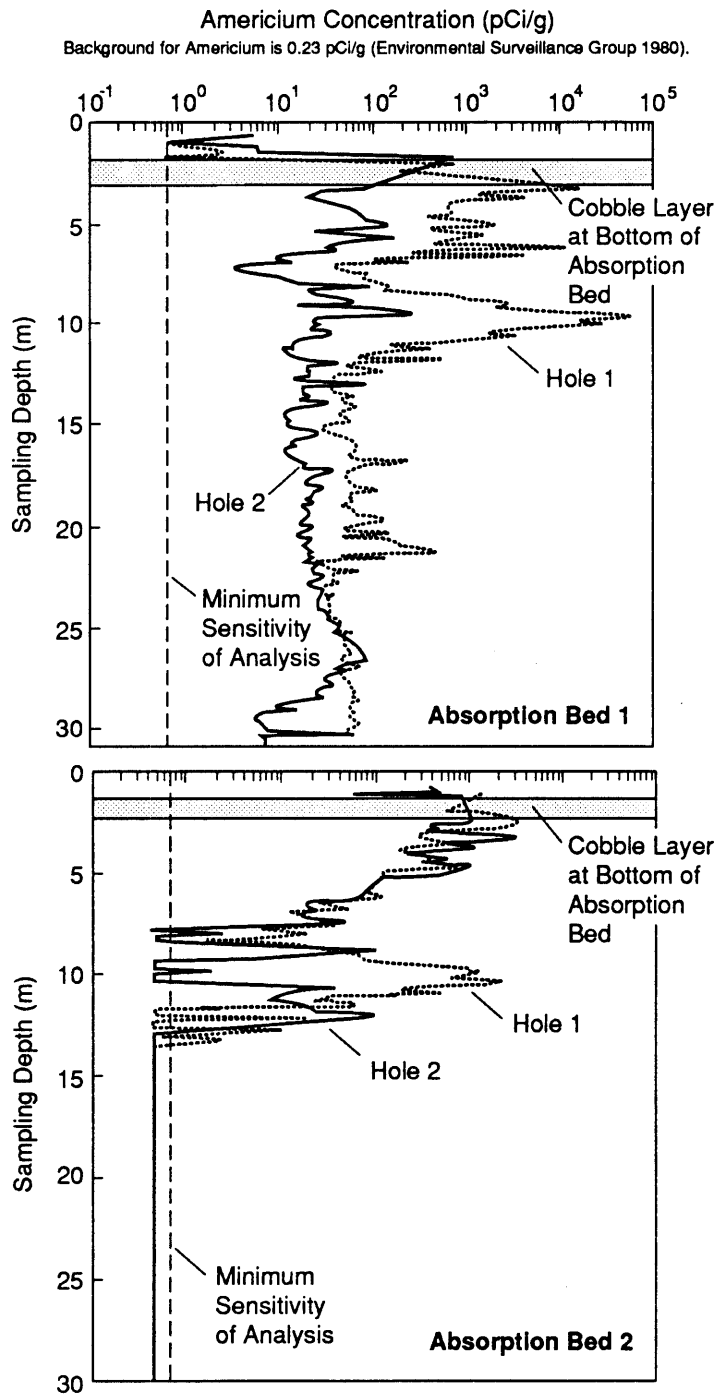


Fig. 16.3-19 Concentration of americium-241 as a function of sampling depth for absorption beds 1 and 2 in 1978 from Nyhan et al. (1984).

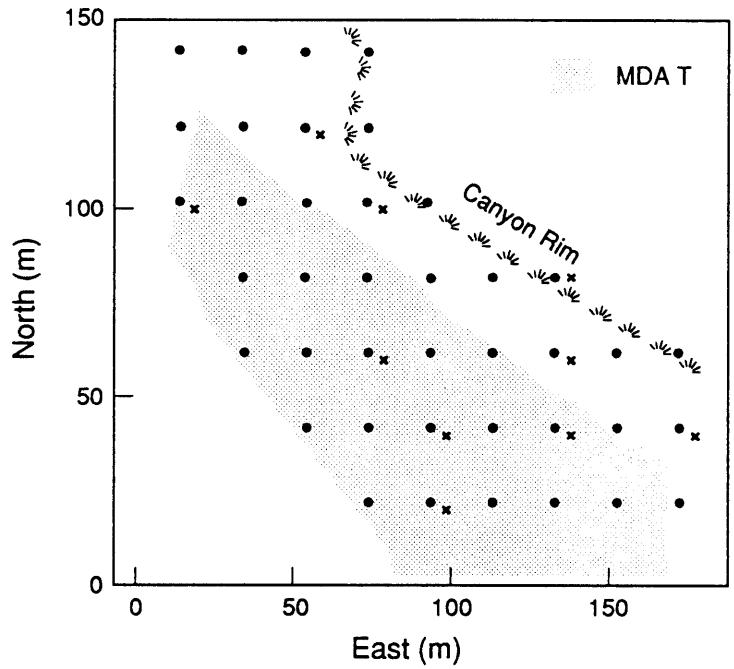


Fig. 16.3-20 Twenty-meter by twenty-meter grid for surface samples on MDA T. The x's indicate possible replicate sample locations.

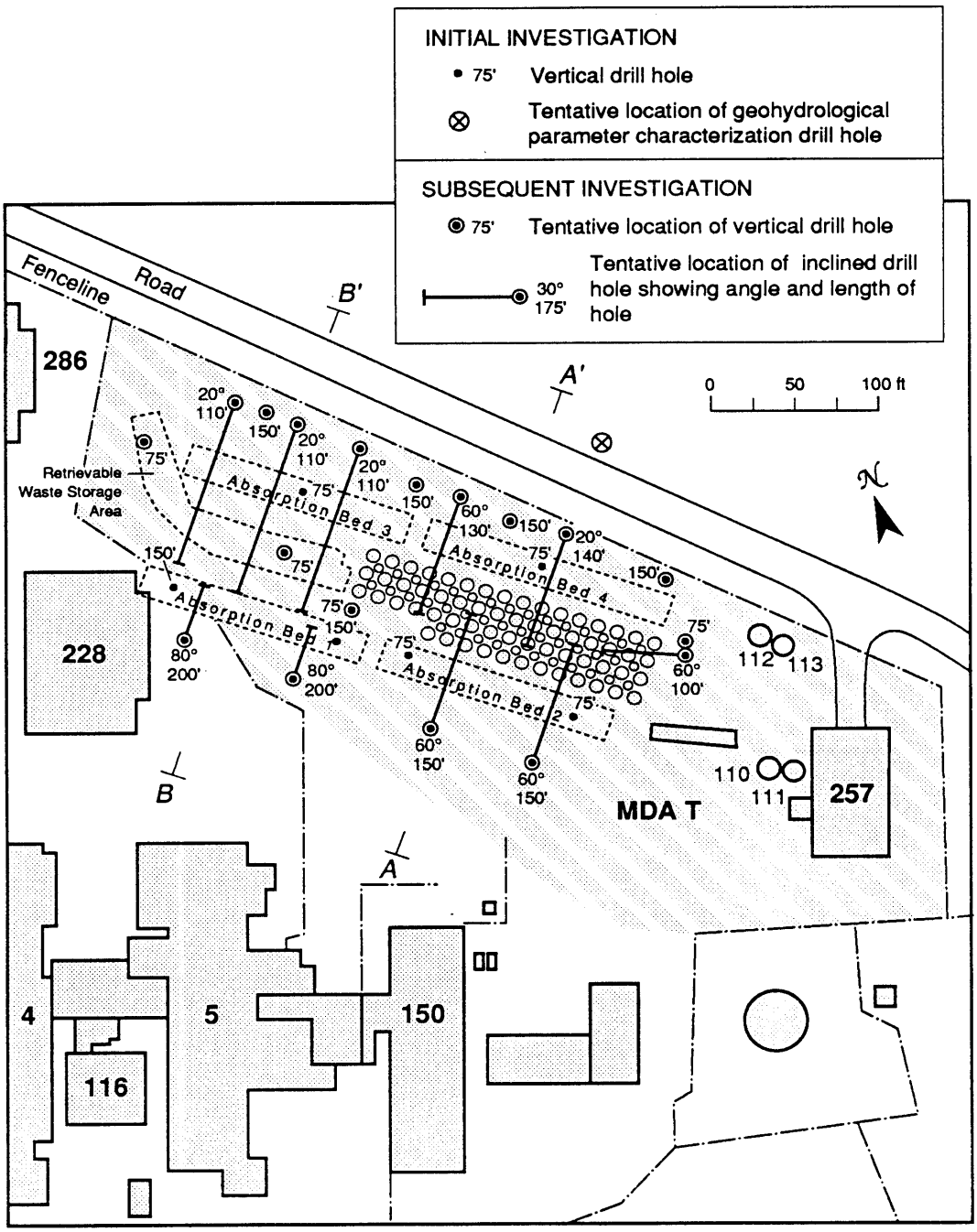


Fig. 16.3-21 Map of MDA T showing locations of absorption beds, cement-filled shafts, the retrievable waste storage area, and initial and subsequent investigation drill holes.

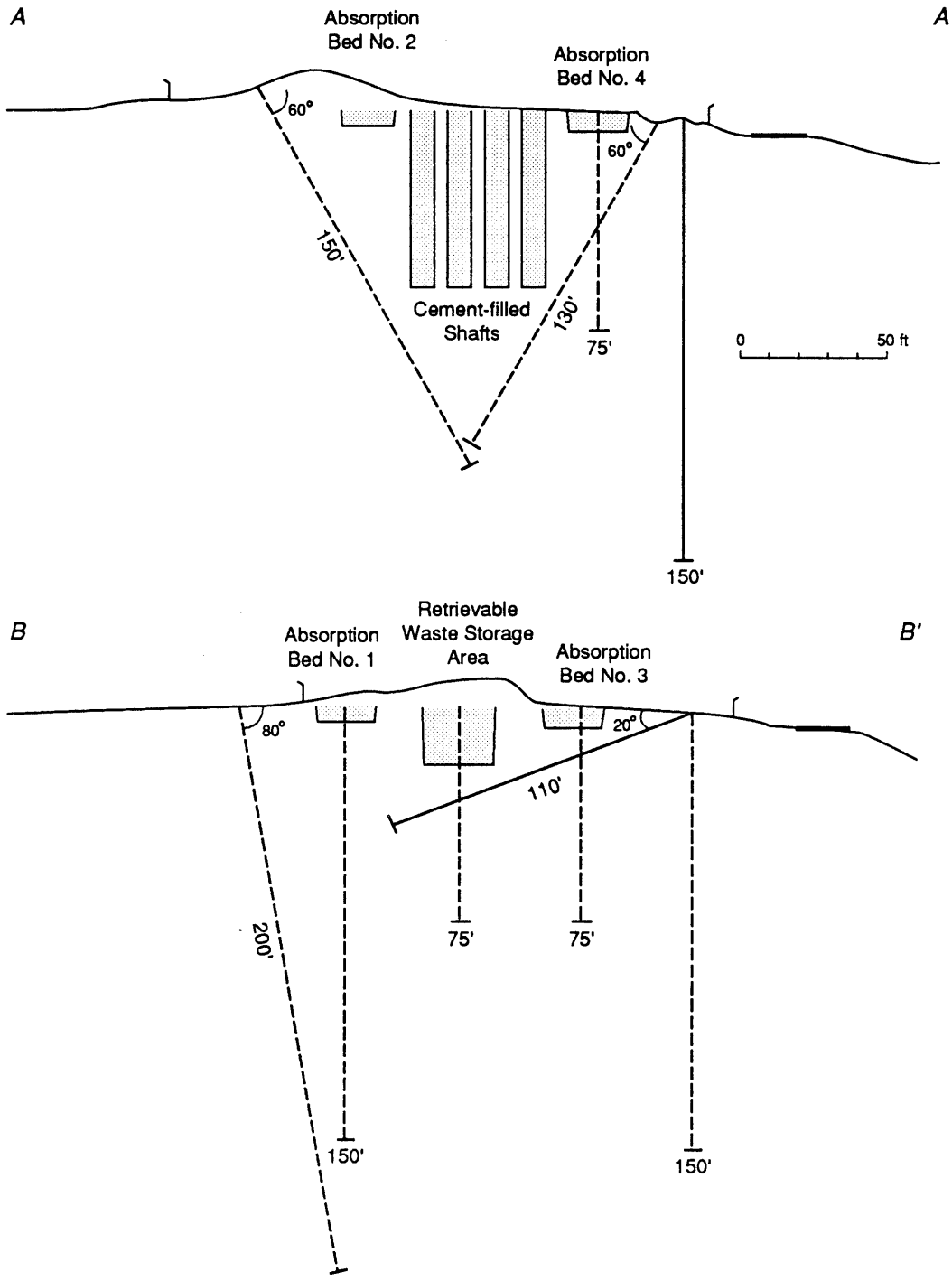


Fig. 16.3-22 Cross sections for MDA T showing layout of absorption beds, cement-filled shafts, the retrievable waste storage area, and initial and subsequent investigation drill holes. Drill holes outside the plane of the section are dashed.

TABLE 16.3-I MDA T REGULATED UNITS

SWMU Subunit	Area of Concern	Description
21-011(c)	-	An acid holding tank (TA-21-120) and an acid sump (TA-21-121) located within MDA T. Both structures are located as shown in Figs. 16.3-3 and 16.5-1.
21-016(a)	-	Four absorption beds.
21-016(b)	-	TA-21-186, a caisson built at the northwest corner of absorption bed 1 in 1959 to study subsurface Pu distribution. It did not contain waste (LANL 1990).
21-016(c)	-	62 asphalt-lined shafts between absorption beds 2 and 4
21-028(a)	-	Satellite container storage area for alcohol, acetone, and freon inactive as of January 1990.
-	C-21-009	1978 spill of ^{241}Am in cement paste at MDA T shafts. Paste was removed and MDA was decontaminated.
-	C-21-012	1976 spill of ^{241}Am and plutonium in a cement paste.

TABLE 16.3-II
DEPTHS OF NONRETRIEVABLE WASTE DISPOSAL SHAFTS LOCATED AT MDA T.

Shaft Number	Diameter (m)	Depth (m)	Shaft Number	Diameter (m)	Depth (m)
1	2.4	18.7	46	2.4	20.1
2	2.4	6.4	47	2.4	7.6
3	2.4	8.2	48	2.4	19.2
5	2.4	8.8	49	2.4	20.4
6	2.4	8.2	50	2.4	19.9
8	2.4	20.4	51	2.4	9.1
9	2.4	19.2	52	2.4	7.1
10	2.4	7.1	53	2.4	15.8
11	2.4	8.5	54	2.4	19.1
13	2.4	19.8	55	2.4	21.0
17	2.4	15.2	56	2.4	18.9
18	2.4	18.0	57	2.4	7.6
19	2.4	19.8	58	2.4	6.8
20	2.4	19.2	59	2.4	16.5
21	2.4	19.0	60	2.4	19.1
22	2.4	19.5	70 6-10[a]	1.8	20.7
23	2.4	19.1	75 6-15[a]	1.8	20.3
24	2.4	18.6	76 6-16[a]	1.8	20.5
25	2.4	4.9	78 6-18[a]	1.8	19.7
26	2.4	4.6	80 6-20[a]	1.8	20.1
27	2.4	17.7	82 6-22[a]	1.8	19.5
28	2.4	20.4	83 6-23[a]	1.8	7.3
29	2.4	18.5	84	1.8	15.1
30	2.4	18.9	87 6-27[a]	1.8	20.0
31	2.4	5.6	91	1.8	7.9
32	2.4	4.6	92	1.8	8.2
33	2.4	19.5	94	1.8	6.6
34	2.4	18.4	95	1.8	4.9
35	2.4	19.0	100	1.8	20.2
36	2.4	18.7			
41	2.4	18.9			
42	2.4	6.4			
43	2.4	18.9			
44	2.4	19.2			

[a]Designation prior to 3-12-76.

16.3-III Chronological Events at MDA T

Date	Location	Reference	Event
1945-1952	MDA T	N/A	Untreated wastes released to absorption beds from Buildings 2,3,4,5, and 12.
1945	MDA T	N/A	Construction of four absorption beds completed (115-ft long x 20-ft wide x 4-ft deep).
Jul-Nov. 1946	Absorption beds 1 & 2 of MDA T	1947 Los Alamos Report LAMS-516	Two soil and water samples from beds 1 & 2 for Pu and Po
1952-1967	MDA T	N/A	Treated liquid waste additions to absorption beds and to DP Canyon outfall from TA-21-35
1952	MDA T	N/A	Building TA-21-35 (first liquid waste treatment plant) installed to treat liquid wastes from DP West and DP East before they were released to DP Canyon Small amounts of liquid wastes were added to absorption beds from TA-21-35.
Aug-Sept 1953	5 holes drilled in and around the MDA T Absorption beds	Unpublished 1954 USGS Report cited in LA-6848-MS	Pu assays performed on samples collected to a depth of 20 ft geologic descriptions of core.
1959-60	Absorption bed 1 of MDA T	Unpublished 1963 USGS Report cited in LA-6848-MS, 1962 US Dept. of Commerce Report TID-7628	Hundreds of samples collected in a series of horizontal holes originating in a 9.1 m-deep caisson next to Absorption bed 1. Tuff samples and soil solution samples assayed for Pu and soil chemistry parameters. Neutron moisture gauge data collected in several locations near and under Absorption bed 1 to depths of 100 ft, before and after addition of about 11 m of water to the bed.

16.3-III Chronological Events at MDA T

Date	Location	Reference	Event
1967-1986	MDA T	N/A	Treated liquid waste additions to DP Canyon from TA-21-257 (same outfall pipe as when effluents originated from TA-21-35)
1967	MDA T	N/A	Building TA-21-257 built and replaces building TA-21-35
Jan 1967	Area between Absorption bed 1 and 3 at MDA T	Los Alamos Report LA-6848-MS	Soil solution samples and a tuff sample neutron moisture gauge data collected to 100 ft
1968-1976	MDA T	N/A	Treated wastes from TA-21-257 mixed with cement and pumped down 62 15–68 ft-deep, asphalt coated disposal shafts, located principally between absorption beds 2 and 4.
March 1974	10 sampling locations over Absorption beds 1 and 3 and between these two beds at MDA T	Los Alamos Report LA-6848-MS	Pu and Am surface contamination/external radiation survey (FIDLER and ionization chamber data).
April 17 & 18 1974	7 holes augered between Absorption beds 1 and 3 at MDA T	Los Alamos Report LA-6848-MS	Samples collected at 2.5 foot intervals to 40 feet and assayed for water content, gross alpha, gross beta, ^{137}Cs, and tritium.
October 1974	Retrievable waste storage area pit between beds 1 and 3 at MDA T	Los Alamos Report LA-6848-MS	23 samples collected from walls of pit and assayed for tritium, Pu, and Ludlum alpha counts.
1975-1983	MDA T	N/A	Retrievable Waste Storage Area, located between absorption beds 1 and 3, used to store treated waste-cement mixtures in CMPs (corrugated metal

16.3-III Chronological Events at MDA T

Date	Location	Reference	Event
			pipes with a diameter of 30 inches and a length of 20 feet).
March 1976 and	4 holes in Absorption beds 3 and 4 at MDA T	Los Alamos Report LA-6848-MS and Nevada Operations Office Report NVO-178	Samples collected to a maximum depth of 240 inches. Assayed for plutonium and a ZnS detector.
3/17/78-10/5/78	Absorption beds 1 and 2 at MDA T	Los Alamos Report La-10159-LLWM, July 1984, Journal of Environ. Quality 14:501-509	Over 800 tuff samples collected in 4 100-ft holes and assayed for Pu, Am, and soil water content. Geologic characteristics published in a log of each hole. Hydrologic research done in the past used to evaluate migration of water and radionuclides.
4/13/78 and 4/17/78	Survey of MDA T: 10 locations inside fence and 5 locations outside MDA T	Los Alamos Notebook 20652	Phoswich and ZnS surveys with soil samples at 15 locations assayed for Pu and Am.
6/14/78 and 6/18/78	Survey of asphalt ditch area southwest of Building SM-257 at MDA T	Los Alamos Notebook 20652	10 soil samples assayed for Pu and Am.
2/28/80	23 locations around perimeter of MDA T and 11 locations inside MDA T	Los Alamos Notebook in A411 Project File	Phoswich and μR meter survey.
Sometimebefore 5/20/80 (assay date)	2 locations inside MDA T and 2 locations north and east of MDA T	Los Alamos Notebook A411 Project File	Soil samples from 3 depths assayed for tritium, total uranium, Pu, and gamma emittors (^{137}Cs).

16.3-III Chronological Events at MDA T

Date	Location	Reference	Event
Sometime before 6/10/80 (assay date)	1 location inside MDA T and 2 locations north and east of MDA T	Los Alamos Notebook A411 Project File	7 vegetation samples assayed for tritium, total total uranium, ^{235}U, ^{238}U, Pu.
Sometime in 1982	Several locations around MDA T	A411 Project File	Qualitative observations on fencing and erosion from MDA T. R meter measurements at 6-7 broad locations within MDA T. Phoswich monitoring along MDA T fence. 9 soil samples collected from 3 locations (3 depths/location) outside of MDA T and assayed for tritium, total U, Pu, and gamma spectrometer assays.
4th quarter 1982	7 locations on perimeter of MDA T	Los Alamos Notebook 23820 notes, 1983 Los Alamos report LA-9762-ENV	TLD data.
Sometime in 1983	North of paved road immediately north of MDA T (generally north of Absorption bed 4)	A411 Project File	18 samples collected from 0 to 88 ft and assayed for tritium, total uranium, Pu, and ^{137}Cs, as well as gamma spectrometry assays.
4 quarters 1983	7 locations on perimeter of MDA T	Los Alamos Notebook 23820 notes, 1984 Los Alamos report LA-10100-ENV	TLD data.
1984-1986	MDA T	N/A	CMPs relocated from MDA T to Area G.

16.3-III Chronological Events at MDA T

Date	Location	Reference	Event
6/14/84-7/19/84	19 sampling locations inside and 19 sampling locations outside MDA T on a grid pattern	A411 Project File	HPIC survey locations.
6/20/84-	19 sampling locations inside and 19 sampling locations outside MDA T on a grid pattern	A411 Project File	Soil samples collected from 0-1 cm, 1-10 cm and 10–30-cm depths at all locations and assayed for tritium, total uranium, ^{238}Pu, $^{239/240}Pu$, and gamma spectrometry assays.
6/20/84-	19 sampling locations inside and 19 sampling locations outside MDA T on a grid pattern	A411 Project File	15 vegetation samples identified and assayed for tritium, uranium, ^{238}Pu, and gamma spectrometry assay.
7/12/84-8/15/84	19 sampling locations inside and 19 sampling locations outside MDA T on a grid pattern	A411 Project File	Phoswich survey of locations.
4 quarters 1984	7 locations on perimeter of MDA T	Los Alamos Notebook 23820 notes, 1985 Los Alamos report LA-10421-ENV	TLD data.
6/13/85	MDA T Annual Site Inspection	A411 Project File	Field observations on breach of confinement, condition of cap, intrusion.
4 quarters 1985	7 locations around MDA T perimeter	Los Alamos Notebook 23820 notes	TLD data.
1986	MDA T	N/A	Effluent from TA-21-257 transferred via pipeline to TA-50 for discharge into Mortandad Canyon (MDA T now an inactive waste disposal site).

16.3-III Chronological Events at MDA T

Date	Location	Reference	Event
April 1986	7 locations outside of and north of MDA T	LANL Memo HSE8-86-1094	Soil (tritium, Pu, ^{137}Cs; ^{90}Sr, total U and Am) and Phoswich radiation survey.
6/86-8/86	108 locations surveyed (75 inside MDA T and 33 outside MDA T)	A411 Project File	108 Phoswich and Rascal measurements, 73 soil samples, and 67 vegetation samples assayed for Pu, Am, ^{137}Cs.
10/30/86	12 locations in CMP Pit at MDA T	Los Alamos Notebook R-4251 notes	12 samples collected to an average depth of 15 inches and assayed for tritium and with ZnS detector for gross alpha.
4 quarters 1986	7 locations around MDA T perimeter	Los Alamos report La-10992-ENV	TLD data.
1987	MDA T	N/A	Surface stabilization of MDA T initiated, as well as measures to control runoff intrusion from paved portions around MDA T.

TABLE 16.3-IV
VOLUME OF WASTES DISCHARGED TO ABSORPTION BEDS AT MDA T IN CUBIC METERS[a]

Year	From DPE	From DPW	Year	From DPE	From DPW
1945	0	3,000 (est)	1966	4,355	0
1946	0	4,000 (est)	1967	666	0
1947	0	5,000 (est)	1968	0	0
1948	0	6,000 (est)	1969	0	0
1949	0	5,971	1970	0	0
1950	0	10,030	1971	0	0
1951	0	13,600	1972	0	0
1952	0	5,400	1973	0	0
1953	0	822			
1954	0	206			
1955	0	1,389			
1956	0	1,970			
1957	0	1,587			
1958	0	657			
1959	0	731			
1960	0	750			
1961	0	117			
1962	0	51			
1963	0	230			
1964	0	98			
1965	2,492	137			

[a]Emelity (1974).

TABLE 16.3-V
AMERICIUM AND PLUTONIUM CONTENT OF DISPOSAL SHAFTS AT MDA T[a]

Shaft Number	^{241}Am (gm)	$^{239/240}Pu$ (gm)	$^{239/240}Pu$[b] (gm)
1	21.836	20.767	
2	2.635	3.688	
3	5.524	10.208	290
5	25.007	12.001	
6	10.6	10.96	
8	30.61	44.97	
9	24.243	24.977	
10	4.378	3.97	
11	2.675	3.217	
13	35.924	39.608	
17	17.278	31.897	342
18	17.757	18.758	134
19	6.414	16.333	245
20	27.455	11.562	
21	23.532	13.255	
22	20.761	18.802	
23	32.609	20.412	
24	26.039	17.427	
25	10.382	7.235	
26	5.829	4.538	210
27	18.768	32.539	
28	34.837	40.429	
29	10.215	4.224	
30	19.52	14.048	
31	3.059	2.965	
32	9.74	5.355	
33	21.275	24.764	
34	22.157	11.425	
35	26.253	16.037	
36	26.915	12.408	
41	18.789	20.479	
42	2.573	4.203	
43	30.628	28.12	
44	22.004	14.542	
46	37.002	33.031	
47	16.157	16.552	
48	24.317	21.71	
49	51.391	62.244	
50	22.027	18.46	
51	12.193	11.398	
52	12.463	26.485	
53	35.248	28.68	
54	35.5	25.792	

TABLE 16.3-V
AMERICIUM AND PLUTONIUM CONTENT OF DISPOSAL SHAFTS AT MDA T[a]

Shaft Number	^{241}Am (gm)	$^{239/240}Pu$ (gm)	$^{239/240}Pu$[b] (gm)
55	27.735	45.886	
56	33.905	23.931	
57	12.398	19.147	
58	8.414	7.746	
59	32.37	44.17	
60	34.258	38.214	
70	30.99	79.85	
75	36.772	32.938	
76	55.18	56.74	
78	0.85	7.57	
80	4.18	19.97	
82	2.47	8.88	
83	5.0	19.61	
84	0.31	9.49	
87	0.43	7.71	
90	0.09	0.43	
91	0.49	1.88	
92	4.44	6.4	
94	0.54	1.6	
Totals	1155.28	1242.64	1221.0

[a]Warren (1979).
[b]Plutonium in bathyspheres

TABLE 16.3-VI. ESTIMATED RADIONUCLIDE SOURCE TERMS AT MDA T.

Disposal Area	Date	Radionuclide	Estimated Activity (Ci)
Absorption beds	1945-1951	Pu	9.8
		Tritium	14.0
Disposal shafts	1968-1983	^{241}Am	3743.1
		^{238}Pu	31.3[a]
		$^{239/240}Pu$	151.0
		^{233}U (731 g)	6.9[b]
		Mixed fission	7.7
Retrievable wastes		Removed to Area G	

[a]Buchholz undated personal communication to M.A. Devaurs.
[b]Warren 1980.

TABLE 16.3-VII. COMPOSITION OF WASTE APPLIED TO ABSORPTION BEDS[a]

	Avg.	Max.	Min.
pH	5.7[b]	10.2	3.0
Cond. G.P.G. NaCl	40	75	28
Na	140	175	75
P. Alk. as Ca CO3	77	375	0
M. O. Alk. as CaCO3	23	80	0
Chloride	26	40	18
Ca as Ca	7	17	0
Mg as Mg	3	8	0
Tot. Hard. as CaCO3	30	76	0
NH_4+ - N	10	20	7
NO_3 - N	75	125	55
Fluoride as F	160	225	100
Pu (c/m/ml)	60	600	20

[a]Christenson and Thomas (1962). Units are not provided in reference. Concentrations are most likely ppm.
[b]Median.

TABLE 16.3-VIII
COMPOSITION OF CITRATE WASTES APPLIED TO MDA T
ABSORPTION BEDS DURING 1951-1952[a]

Di-ammonium citrate	50,000 ppm
Magnesium	800 ppm
Calcium	160 ppm
Aluminum	160 ppm
Iron	10 ppm
Fluoride	200 ppm
Nitrate Nitrogen	1,680 ppm
pH	1 ppm
Pu (c/m/ml)	7,000

[a]Christenson and Thomas (1962).

TABLE 16.3-IX. WASTE STREAM COMPOSITION TO DP-257 JANUARY THROUGH MAY 1973.

Type of Wastes	Av Vol/Mo Gallons	Chemical Composition	Radioactivity Av/Mo
Main flow stream, DPW	129,300	pH 11.4; TS-1, 580 mg/l; Na-400 mg/l; NO_3-73 mg/l; Cl-57 mg/l	1.38×10^{-1} µCi/l gross a 1.32×10^{-3} mCi/l Sr
Main flow stream, DPE	13,700	Incl. above	Incl. above Low ^{235}U
Am-Pu acid wastes	2,500	HNO_3 + metals	22.15g ^{239}Pu, 20.4g ^{241}Am, ~0.01g ^{238}Pu
Bldg 2, NaOH wastes	400	(from recovery oper.) NaOH, Fe, Cl, NO_3, plus various others	188 mg total a include ^{239}Pu, ^{241}Am
Bldg 4, KOH	130	KOH, used to scrub HF lines	246mg ^{235}U + 2mg ^{239}Pu + trace ^{238}Pu
Bldg 5, KOH wastes	480	(scrubbing sol.), KOH, F^-	1.36g ^{239}Pu
Distillate	1,130	-NO_3	11.4g ^{235}U (incl. in main stream)
Scrub tank, Distillate	40	NO_3^-, Cl^-, Neut. KOH + misc. organics	800 mg ^{235}U
Alcohol	8	Ethyl Alcohol	1.78g ^{239}Pu
Strip wastes	255	Na, Mg, Al, Fe, Cr, Ni, NH_3 SO_4, NO_3	15.2g ^{235}U, trace amounts of ^{90}Sr and ^{137}Cs (MFP)
Organics, solvents	9	Acetone, Chlorethylene, etc.	^{235}U, ^{238}Pu, ^{239}Pu
Oils	8	Vacuum pump oil	^{238}Pu, ^{239}Pu

TABLE 16.3-X. PLUTONIUM CONCENTRATIONS WITH DEPTH FOR THE FIVE BOREHOLES LOCATED IN FIG. 16.3-13[a]

DPW-1		DPW-2		DPW-3		DPW-4		DPW-5	
Depth (ft)	Pu (pCi/gm)	Depth (ft)	Pu (pCi/gm)	(Slant) Depth (ft)	Pu (pCi/gm)	Depth (ft)	Pu (pCi/gm)	Depth (ft)	Pu (pCi/gm)
Surface	32	Surface	4	Surface	15	Surface	4	Surface	190
1	4	1	2	1	2	1	180	1	270
2	2	2	1	2	4	2	16410	2	5
3	4	3	<1	3	3	3	20730	3	36
4	2	4	1	4	4	12	640	4	1550
5	2	5	1	5	3	15	2270	5	240
6	2	6	1	6	2	16	2320	6	36
6-10	1	7	2	7	3	17	330	7	820
10-14	1	8	<1	8	1	18	11	8	18
15	2	9	1	9	1	19	5	9	170
		10	2	10	1	20	5	15	1090
		11	2	11	1				
		12	1	12	205[b]				
		13	1	12.5	686				
		14	1	13	605				
		15	1						
		16	2						
		17	1						
		18	1						
		19	1						
		20	1						

[a]Data taken from Rogers (1977) for five boreholes from Herman (1954). Data are given in this table in units originally reported in. Convert from dpm/dry gram to pCi/gm by multiplying by 0.4505.
[b]Point of intersection with absorption bed.

TABLE 16.3-XI
CHEMICAL AND MINERALOGICAL PROPERTIES FROM THREE HOLES DRILLED AT MDA T AND SHOWN IN FIG. 16.3-13[a]

		DPW-33	DPW-4	DPW-5
Ion Exchange Capacity (Me/kg)		17	7	32
Depth (ft)		12 (slant)	19	5
Clay fraction:	Feldspar	40	40	50
< 2μ minerals	Montmorillonite	30		20
(percent)	Hydrous mica	20		
	Kaolin	[b]		
	Cristobalite	[b]	40	[b]
	Tridymite	[b]	40	[b]
	Quartz	[b]	[b]	
Silt fraction:	Feldspar	40	50	[b]
2–62μ minerals	Cristobalite	40	50	[b]
(percent)	Tridymite	10	10	[b]
	Quartz		[b]	

[a]Data taken from Rogers (1977) for three holes drilled in 1953 documented in Herman (1954). All values are in percent by weight.
[b]These minerals were detected but concentration too low to quantify.

TABLE 16.3-XII. ALPHA ACTIVITY FROM HORIZONTAL CORES TAKEN FROM THE CAISSON[a]

Depth (ft)	No. Cores	Average Gross a (c/m/dry gm)	Gross α - All Cores max (C/m/dry gm)	min
6	10	3003	6613	4
8	7	1306	2850	11
10	8	1143	1872	12
12	6	821	1729	414
14	9	749	2094	1
16	9	732	1305	8
18	4	517	923	141
20	7	183	506	45
22	4	15	20	11
24	8	402	1038	175
26	10	13	88	2
28	6	28	156	2

[a]Christenson and Thomas (1962).

TABLE 16.3-XIII. GROSS ALPHA ACTIVITIES FROM VERTICAL HOLES DRILLED NEAR BED IN 1960 (SEE FIG. 16.3-14 FOR LOCATION)[a]

Hole No.	No. Cores	Depth (ft)	Gross α (c/m/dry gram) (Avg.)	(Max)	(Min)
1[b]	10	76	2	3	1
1A[b]	10	83	24	34	9
2b	11	93	698	3722	142
3	11	99	3	7	2
4b	13	99	1.5	2	1
5	7	92	3	6	1

[a]Christenson and Thomas (1962).
[b]Slant holes.

16.4. Industrial Liquid Waste Treatment Facility

16.4.1. Site Description

This section describes the field activities for the location of the former industrial liquid waste treatment facility (SWMU 21-010) located at TA-21 (Fig. 16.4-1) (LASL 1968c). This SWMU addresses a site at which a contaminated building was located. The former industrial liquid waste treatment facility was decontaminated and decommissioned, but contamination may still remain at the site from the building and its past operations. Releases from the industrial liquid waste treatment facility to the environment are documented (LANL 1990).

The SWMU Report (LANL 1990) states that the former industrial liquid waste treatment facility, TA-21-35, is designated as SWMU 21-010(a), along with seven associated structures identified as SWMUs 21-010 (b)-(h) (Fig. 16.4-1).

In addition, a radioactive container loading operation was located on the northeast side of TA-21-35, just north of structure TA-21-191. The drums containing radioactive waste and cement were stored inside of the new addition to TA-21-35, just west of structure TA-21-191 and under a covered area on the north side of the building.

There are several areas of concern at the former location of TA-21-35. Area of concern C-21-010 (see Chapter 19) documents a leak from drums that was cleaned up. It is not shown on Fig. 16.4-1 because its location is unknown. The former locations of the following four structures were added as areas of concern C-21-034 through C-21-037, which includes the following: a 1,000 gal. raffinate tank (TA-21-91), two aboveground acid holding tanks (TA-21-110 and TA-21-111), and a 2,000 gal. aboveground acid tank (TA-21-256).

Presented below is a list and brief description of structures that comprise SWMU 21-010 at the former location of TA-21-35.

Building TA-21-35

SWMU 21-10(a) addresses the former industrial liquid waste treatment facility, TA-21-35. The treatment facility began operations in 1952 and was decontaminated and decommissioned in 1967. TA-21-35 was modified and added to several times throughout its years of operation. It began as a modification to a 40- by 20-ft building with a wood frame and corrugated metal covering, originally built in 1949 (Fowler 1964). Conversion to a waste treatment facility in 1952

required a 30-ft extension of that original building. In addition, exterior waste storage facilities and a batch waste treatment facility required a 10-ft extension. In 1956, a 15- by 20-ft vacuum filter room was added with pertinent equipment to the east side of the building. This eliminated the procedure of hauling contaminated sludge to the TA-45 treatment plant for filtration (Shipman 1958).

In 1959, an americium waste treatment facility was added to TA-21-35 to fix americium waste in cement. These wastes were placed in 55-gal. drums and stored on the northeast corner of the building until they were transported to MDA G for disposal. A chemical storage addition was added in 1960. Further space was added in 1961 because of an increased volume of americium waste being treated at the plant. In 1964, a 50% caustic storage facility was completed, along with a covered area for the temporary storage of the 55-gal. drums containing americium-cement mixtures mentioned above (Fowler 1964).

Associated Structures

SWMU 21-010(b), TA-21-93, was initially a water manhole, which was changed to an acid valve pit manhole. The manhole was located on the southwest corner of TA-21-35 and has been removed.

SWMU 21-010(c), TA-21-145, was a 500 gal. underground acid tank, which was located at the southwest corner of Building TA-21-35. The tank has been removed.

SWMU 21-010(d), TA-21-147, was a 500 gal. underground acid tank, which was located adjacent to TA-21-145 and near the southwest corner of Building TA-21-35. The tank has been removed.

SWMU 21-010(e), TA-21-185, was a 390 gal. septic tank, which was located on the northeast corner of Building TA-21-35. The tank received industrial waste. Overflow from the tank went to a drain field that was located east of the septic tank. The tank has been removed. It is not known if the drain field was removed when the tank was removed.

SWMU 21-010(f), TA-21-192, was a structure known as the "Grit Chamber," which was located at the northeast corner of building TA-21-35. This structure served as a setting tank for solids in the influent and is thought to have been highly contaminated with radionuclides. The grit chamber has been removed.

SWMU 21-010(g), TA-21-255, was a 2,000 gal. aboveground acid tank, which was located at the southwest corner of TA-21-35. The acid tank has been removed.

SWMU 21-010(h), TA-21-271, was an acid manhole located at the southwest corner of building TA-21-35. The manhole has been removed.

Areas of Concern

The location of area of concern C-21-010 is unknown. It will be assumed that it will be addressed by the sampling of the Building 35 area proposed herein.

Area of concern C-21-034, TA-21-91, was a 1,000 gal. raffinate holding tank, which has been removed. It was located at the southwest corner of TA-21-35 and was installed approximately October 1957 (LASL 1957). The former location of this structure will be investigated.

Area of concern C-21-035, TA-21-110, was an aboveground acid-holding tank on the south side of TA-21-35. It was relocated to the new treatment facility, Building TA-21-257, in 1967. Its location at TA-21-257 is listed as SWMU 21-011(d). The former location of the tank at TA-21-35 will be investigated.

Area of concern C-21-036, TA-21-111, was an aboveground acid-holding tank adjacent to TA-21-110 on the south side of TA-21-35. It was relocated in 1967 to the new treatment facility, Building TA-21-257. Its location at TA-21-257 is listed as SWMU 21-011(e). The former location of the tank at TA-21-35 will be investigated.

Area of concern C-21-037, TA-21-256, was a 2,000 gal. aboveground acid tank at the southwest corner of building TA-21-35. In 1967, it was relocated to the new industrial liquid waste treatment facility, TA-21-257. Its location at TA-21-257 is listed as SWMU 21-011(h). The former location of the tank at TA-21-35 will be investigated.

16.4.1.1. Site History

Four seepage pits, or absorption beds (Sec. 16.3 MDA T, SWMU 21-016), were constructed for liquid radioactive waste disposal at TA-21 in the 1940s. Because the volume of liquid discharged to the absorption beds began to exceed their holding capacity, a liquid waste treatment facility, TA-21-35, was constructed. TA-21-35 was constructed as a facility for treatment and disposal of contaminated liquid waste from the plutonium- and ^{235}U-processing laboratories at DP site (Romero 1967). The treatment operations at the plant began in 1952 (Fowler 1964).

The facility used chemical precipitation to treat wastes and was designed to treat wastes at a maximum rate of 50 gal./min. The most efficient operation was obtained at a treatment rate of 35

gal./min (Fowler 1964). Treatment of DP Site wastes continued at TA-21-35 until 1967 when it was replaced by a new waste treatment facility, TA-21-257 (Sec. 16.5, SWMU 21-011).

The waste treatment plant received waste concentrated in "both plutonium and mineral constituents" from DP West (Shipman 1958). The method of treatment involved the addition of ferric sulfate and lime to the incoming waste stream, causing a precipitate of ferric hydroxide to form. The ferric hydroxide precipitate then settled to the bottom of settling tanks, carrying the plutonium with it (Shipman 1958). These sludges (precipitates) were buried in MDA C (Abrahams 1962). The liquid that was derived from dewatering the plutonium-contaminated sludges was stored in tanks for several hours or days for control analysis and was then discharged to DP Canyon (Abrahams 1962) [see Sec. 15.4, SWMU 21-011(k)].

Other wastes, such as concentrated residues from plutonium separations (raffinates) containing large amounts of salts and plutonium and hydrofluoric washing solutions, were treated separately by batch methods (Shipman 1958). Hydrofluoric acid was neutralized and discharged to DP Canyon (Abrahams 1962). Procedure(s) for treatment and handling of other wastes are not known.

Decommissioning of Building TA-21-35 and its associated structures was initiated on June 30, 1967, and was completed on January 5, 1968 (LASL no date). All structures associated with the decommissioning of TA-21-35 were taken to MDA G for disposal. It is unknown whether any cleanup of the former site of TA-21-35 and its associated structures occurred.

Several of the structures were relocated or connected to the new treatment facility, TA-21-257. Relocated or reconnected structures included TA-21-110 and TA-21-111, aboveground acid-holding tanks (LASL 1976b); TA-21-191, a cement storage silo (LASL no date); and TA-21-256, an aboveground acid tank (LASL 1968c). The locations of the relocated structures are addressed and investigated in Sec. 16.5.

16.4.1.2. Existing Information

Records of the approximate volume of wastes processed at TA-21-35, as well as the gross alpha and plutonium concentrations for the years 1952 through 1961, are summarized in Table 16.4-I. Table 16.4-I shows that a maximum flow of 4,712,900 gal. was treated at TA-21-35 in 1957, and a low of 2,294,900 gal. was treated in 1960. The operational data from 1961 to 1967 could not be located. The general trend in gross alpha and plutonium concentrations increased from 1952 to 1961.

The text accompanying the table states that "the highest concentration of gross alpha in soil samples collected in August of 1954, a short distance downgradient from the point of discharge into DP Canyon, was 184 disintegrations per minute per dry gram" (Abrahams 1962).

16.4.1.3. Source Term

Plutonium-processing operations and other operations at DP East and DP West produced wastes that were sent to TA-21-35 for treatment. Wastes containing uranium, plutonium, americium, and other actinides, as well as various acids (such as nitric, hydrofluoric, sulfuric, and hydrochloric), solvents, and chemicals were treated. Releases of contamination from treatment operations have not been documented, but the above-mentioned contaminants may be present in the soils at the former location of TA-21-35.

The loading and subsequent storage of 55-gal. drums of americium-cement mixtures at TA-21-35 may have resulted in contaminant releases. The drums were stored in an area on the northeast side of TA-21-35 just north of structure TA-21-191, in TA-21-35, and a covered area believed to be along the north side of TA-21-35. It is not known whether any leaks or spills resulted from the storage or loading of the drums.

16.4.2. Objectives and Data Needs

Environmental releases may have occurred as a result of past operations at the former industrial waste treatment facility or from the decommissioning of the Building TA-21-35.

SWMU 21-010 data needs are listed below as follows:

1. Determine the location of the former industrial waste treatment facility, TA-21-35, and its associated structures by surveying based on old drawings.
2. Identify the presence of contamination in the areas that were beneath the former locations of the industrial waste treatment facility and its associated structures by analysis of subsurface soil samples using Level II/III data.
3. If contaminants are identified, determine the vertical and lateral extent of contamination by additional subsurface soil sampling and analyses using Level III/IV data.

16.4.3. Sampling/Investigation Rationale

Two phases of investigation are planned for SWMU 21-010. The initial investigation consists of a land survey to mark the former locations of the waste treatment facility, TA-21-35 [SWMU 21-

010(a)], and its associated structures, TA-21-91, -93, -110, -111, -145, -147, -185, -192, -255, -256, -271 [SWMUs 21-010(b)-(h) and areas of concern C-21-034 to C-21-037], for investigation. Prior to decommissioning, Building TA-21-35 was found to have removable alpha contamination, and its waste storage tanks and waste-processing tanks were found to be highly contaminated with radionuclides. Therefore, shallow boreholes will be drilled, and subsurface soil samples will be collected at the former location of Building TA-21-35 and at the locations of the associated structures. These samples will identify the potential for residual contamination remaining after D&D of Building TA-21-35 and its associated structures.

Surface soil samples will not be taken at TA-21-35 as part of this sampling plan. Surface soil samples to characterize TA-21-35 will be obtained during the field investigation of MDA T. The MDA T surface characterization will provide surface soil samples on a 20- by 20-m grid within the fenced area of MDA T (which includes the area of Building TA-21-35) and extending to the northern edge of DP Mesa (see Sec. 16.3.4.1, MDA T Surface Sampling Plan).

Shallow borehole samples obtained during the initial investigation will be submitted for field laboratory analysis. Thirty percent of those samples will then be submitted to an analytical laboratory and subjected to the full analytical suite to determine the types and concentrations of contaminants present. Samples that are "hot" in the field laboratory will be sent to the analytical laboratory. If no samples are "hot", the analytical laboratory will be used to confirm absence of contamination.

If required, additional subsurface soil sampling will constitute a subsequent investigation of sampling to define the lateral and vertical extent of contamination. These samples will be submitted for analytical laboratory analysis and will be subjected to a full suite of analyses unless sampling results from the initial investigation allow specification of a more focused analytical suite.

16.4.4. Sampling Plan

16.4.4.1. Initial Investigation

Building TA-21-35

The former location of Building TA-21-35 [SWMU 21-010(a)] and its associated structures [SWMUs 21-010(b)-(h) and areas of concern C-21-034 to C-21-037] will be surveyed from an engineering drawing (LASL 1968) (for method see Sec. 11.4.3) and marked.

A mobile office trailer, TA-21-382, presently occupies a portion of the former site of Building TA-21-35. It is not known how much of the area is covered by the trailer, but it may be necessary to relocate the trailer during the investigation if it hinders the placement of the boreholes.

Five shallow boreholes will be drilled in the footprint of former Building TA-21-35 [SWMU 21-010(a)] (for method see Sec. 11.5.3.1) to determine whether any past releases from the building occurred. Three of the boreholes will be drilled on the center line of the long axis of the original part of the building, at equal distances from one another. The other two boreholes will be drilled in the addition that housed a radioactive container storage area. The boreholes will be drilled to a nominal depth of 10 ft at locations shown in Fig. 16.4-2. Each borehole will result in four samples (2.5-ft core interval).

In addition, two shallow boreholes will be drilled in the area directly north of the container storage addition where the drum-loading operation was carried out. These boreholes will be drilled to a nominal depth of 5 ft at the locations shown in Fig. 16.4-2. Each borehole will result in two samples (2.5-ft core interval).

Table 16.4-II identifies the screening and analysis requirements for the 24 samples to be collected.

Associated Structures

Shallow boreholes (for method see Sec. 11.5.3.1) will be drilled at former locations of structures that were associated with TA-21-35 operations. One borehole will be drilled at the center of each of the former structures TA-21-110 (area of concern C-21-035), TA-21-111 (area of concern C-21-036), and TA-21-192 [SWMU 21-010(f)]. These boreholes will be drilled to a nominal depth of 5 ft at the locations shown in Fig. 16.4-2. Each borehole will result in two samples (2.5-ft core interval).

Three vertical boreholes will be drilled (for method see Sec. 11.5.3.2) at the southwest corner of the former building to address contamination that may have resulted from a group of underground structures: TA-21-91 (area of concern C-21-034), TA-21-93 [SWMU 21-010(b)], TA-21-145 [SWMU 21-010(c)], TA-21-147 [SWMU 21-010(d)], TA-21-255 [SWMU 21-010(g)], TA-21-256 (area of concern C-21-037), and TA-21-271 [SWMU 21-010(h)]. These boreholes will be drilled to a norninal depth of 20 ft at the locations shown in Fig. 16.5-2. Each borehole will result in four samples (5-ft core interval).

Two vertical boreholes will be drilled (for method see Sec. 11.5.3.2) at the northeast corner of the former TA-21-35 to address contamination that may have resulted from septic tank TA-21-185 [SWMU 21-010(e)] and its associated drain field. These boreholes will be drilled to a nominal depth of 20 ft at the locations shown in Fig. 16.5-2. Each borehole will result in four samples (5-ft core interval).

The screening and sample analysis requirements for the 26 samples collected in this investigation are shown in Table 16.4-II.

For the Building TA-21-35 and associated structures site characterization, a total of 50 samples will be collected and processed in the field laboratory. Approximately 30% of these samples (16) will be sent to the analytical laboratory for the full suite of analyses. Samples that are "hot" as a result of field laboratory analyses will be sent to the analytical laboratory. If no samples are "hot", the analytical laboratory will be used to confirm absence of contamination. The field laboratory will also be used to define whether nominal depths for both shallow and vertical boreholes are adequate or whether boreholes need to be deepened (see Sec. 11.5.3 for borehole stopping criteria).

16.4.4.2. Subsequent Investigation

From the initial samples collected, it will be possible to determine whether contamination exists. If a subsequent investigation is required, additional boreholes will be drilled and sampled. Borehole locations will be placed at 20-ft spacings in an outward direction from sampling points in which contamination is identified. This investigation will be integrated with characterization of MDA T (See Sec. 16.3). For planning purposes, it is anticipated that no more than eight additional shallow boreholes to a nominal depth of 10 ft and no more than five additional vertical boreholes to a nominal depth of 20 ft will be required. Example locations for the additional boreholes are shown in Fig. 16.4-2. This will result in a total of 52 samples to be analyzed in the field laboratory. Twenty-five percent of those samples will be submitted to an analytical laboratory for confirmatory and additional analyses. The screening and sample analysis assumptions for the subsequent investigations are shown in Table 16.4-III.

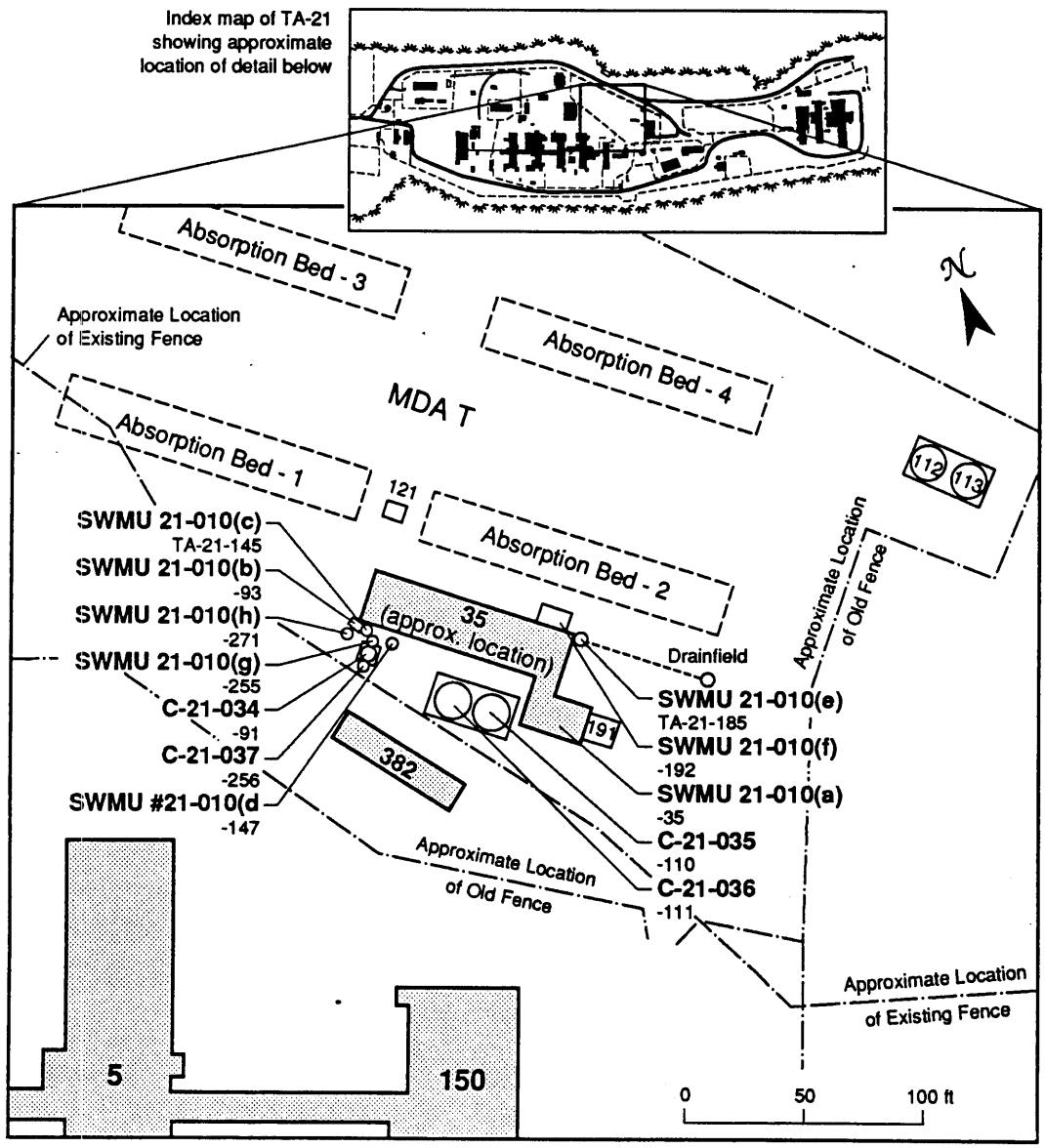


Fig. 16.4-1 Location of the former Industrial Liquid Waste Treatment Facility, TA-21-35 and its associated structures, and their approximate relationship to existing Building TA-21-382. (LASL 1976b; LANL 1983a)

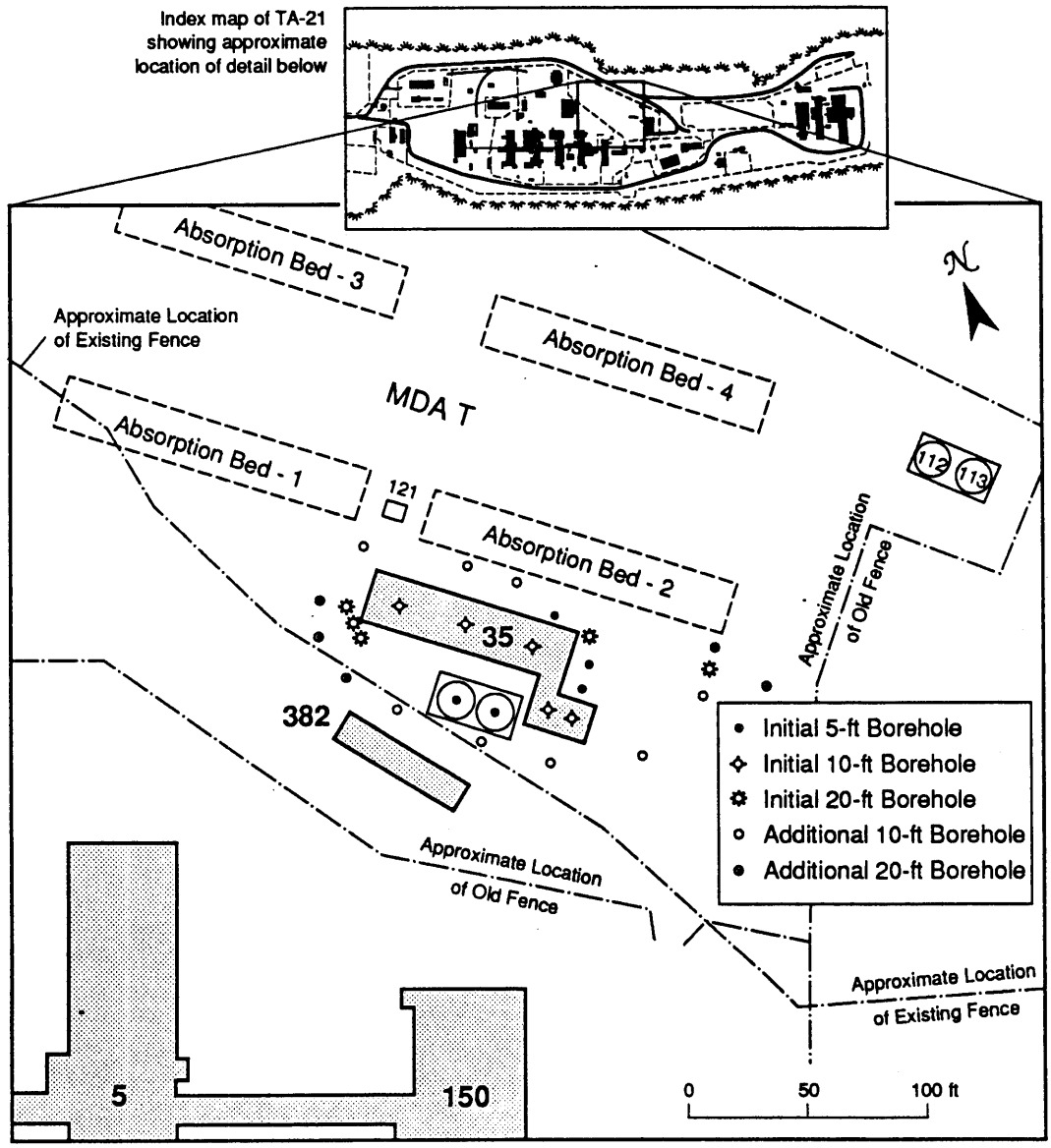


Fig. 16.4-2 Borehole locations for the initial investigation at TA-21-35. Also shown are the additional borehole locations for the subsequent investigation, if required.

TABLE 16.4-I
VOLUME OF FLOW INTO BUILDING 35 TREATMENT PLANT, AND INFLUENT AND EFFLUENT CONCENTRATIONS OF GROSS ALPHA AND PLUTONIUM[a]

Year	Volume (thousands of gallons)	Gross Alpha Influent (thousands of counts minute per liter[b])	Gross Alpha Effluent (counts per minute per liter[b])	Plutonium Influent (milligrams liter[b])	Plutonium Effluent (counts per minute per plant (mg))	Total (equivalent to)
1952	2683.0	58.2	35	8,781	35.0	8,781
1953	4043.6	421.0	52	92,378	79.0	92,378
1954	3226.8	187.0	73	33,560	93.0	37,836
1955	2,894.5	218.0	116	30,004	97.0	36,555
1956	3810.1	90.0	60	18,490	59.0	23,683
1957	4712.9	58.5	65	14,883	65.0	21,030
1958	2658.8	163.0	64	23,949	62.0	38,017
1959	2496.4	236.0	114	32,532	98.8	56,541
1960	2294.1	626.0	310	81,159	223.0	427,829[c]
1961	2488.2	661.0	695	99,154	639.0	173,938

[a]Abrahams (1962).
[b]Weighted average.
[c]Includes 1.141 grams of ^{238}Pu.

Table 16.4-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-010, INDUSTRIAL WASTE TREATMENT FACILITY.

				Field Surveys				Field Screening					Field Laboratory Measurements							Laboratory Analysis													
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
SWMU 21-010(a) TA-21-35							X																											
Shallow Borehole	1	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																	
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
	2	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E					
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
Field Duplicate																						X	X	X	X		X	X	X					
Shallow Borehole	1	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																	
Rinsate Blank																						X	X	X	X		X	X	X					
Field Blank																												X	X					
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E					
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																	
	2	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E					
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E					
	3	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																	
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E					
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																	
Trip Blank																											X							
	4	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E					
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																	
	5	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E					

Table 16.4-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-010, INDUSTRIAL WASTE TREATMENT FACILITY.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
		2.5 - 5.0 ft																															
		5.0 - 7.5 ft																															
TA-21-192 (SWMU 21-010(f))		7.5 - 10.0 ft						X	X	X	X	X	X									E	E	E	E								
Shallow Borehole	1	0.0 - 2.5 ft					X																										
		2.5 - 5.0 ft						X	X	X	X	X	X																				
TA-21-110 (SWMU 21-035)																																	
Shallow Borehole	1	0.0 - 2.5 ft				X																											
		2.5 - 5.0 ft						X	X	X	X	X	X																				
TA-21-111 (SWMU 21-036)																																	
Shallow Borehole	1	0.0 - 2.5 ft			X																	E	E	E	E								
		2.5 - 5.0 ft																															
Southwest Corner TA-21-35				X																													
Vertical Borehole	1	0.0 - 5.0 ft						X	X	X	X	X	X									E	E	E	E								
Rinsate Blank																						X	X	X	X								
Field Blank																						X	X	X	X								
		5.0 - 10.0 ft						X	X	X	X	X	X																				
		10.0 - 15.0 ft						X	X	X	X	X	X																				
		15.0 - 20.0 ft						X	X	X	X	X	X									E	E	E	E								
Trip Blank																												X				
	2	0.0 - 5.0 ft						X	X	X	X	X	X																				
		5.0 - 10.0 ft						X	X	X	X	X	X									E	E	E	E								
		10.0 - 15.0 ft						X	X	X	X	X	X									E	E	E	E								
		15.0 - 20.0 ft						X	X	X	X	X	X									E	E	E	E								
	3	0.0 - 5.0 ft						X	X	X	X	X	X									E	E	E	E								
		5.0 - 10.0 ft						X	X	X	X	X	X									E	E	E	E								

Table 16.4-II

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-010, INDUSTRIAL WASTE TREATMENT FACILITY.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
		10.0 - 15.0 ft						X	X		X	X	X	X	X	X	X																	
		15.0 - 20.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E					
Trip Blank																												X						
Northeast Corner TA-21-35							X																											
Vertical Borehole	1	0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 10.0 ft						X	X		X	X	X	X	X	X	X																	
		10.0 - 15.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E					
		15.0 - 20.0 ft						X	X		X	X	X	X	X	X	X																	
	2	0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 10.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E					
Field Duplicate																						X	X	X	X		X	X	X					
		10.0 - 15.0 ft						X	X		X	X	X	X	X	X	X																	
		15.0 - 20.0 ft						X	X		X	X	X	X	X	X	X																	
Rinsate Blank																						X	X	X	X		X	X	X					
Field Blank																												X	X					
Trip Blank																												X						

Table 16.4–III

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-010, INDUSTRIAL WASTE TREATMENT FACILITY.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals
SWMU 21-010																													
Shallow Borehole	1	0.0 - 2.5 ft						X	X		X	X	X	X	E	X	X			E	E	E	E		E	E	E		
		2.5 - 5.0 ft						X	X		X	X	X	X	E	X	X			E	E	E	E		E	E	E		
		5.0 - 7.5 ft						X	X		X	X	X	X	E	X	X			E	E	E	E		E	E	E		
		7.5 - 10.0 ft						X	X		X	X	X	X	E	X	X			E	E	E	E		E	E	E		
	2	0.0 - 2.5 ft						X	X		X	X	X	X	E	X	X			E	E	E	E		E	E	E		
		2.5 - 5.0 ft						X	X		X	X	X	X	E	X	X			E	E	E	E		E	E	E		
		5.0 - 7.5 ft						X	X		X	X	X	X	E	X	X			E	E	E	E		E	E	E		
		7.5 - 10.0 ft						X	X		X	X	X	X	E	X	X			E	E	E	E		E	E	E		
	3	0.0 - 2.5 ft						X	X		X	X	X	X	E	X	X			E	E	E	E		E	E	E		
Field Duplicate		2.5 - 5.0 ft						X	X		X	X	X	X	E	X	X			E	E	E	E		E	E	E		
		5.0 - 7.5 ft						X	X		X	X	X	X	E	X	X			E	E	E	E		E	E	E		
		7.5 - 10.0 ft						X	X		X	X	X	X	E	X	X			E	E	E	E		E	E	E		
Rinsate Blank																				X	X	X	X		X	X	X		
Field Blank	4	0.0 - 2.5 ft						X	X		X	X	X	X	E	X	X			E	E	E	E		E	E	E		
		2.5 - 5.0 ft						X	X		X	X	X	X	E	X	X			E	E	E	E		E	E	E		
		5.0 - 7.5 ft						X	X		X	X	X	X	E	X	X			E	E	E	E		E	E	E		
		7.5 - 10.0 ft						X	X		X	X	X	X	E	X	X			E	E	E	E		E	E	E		
Trip Blank																				X	X	X	X		X	X	X		
	5	0.0 - 2.5 ft						X	X		X	X	X	X	E	X	X			E	E	E	E		E	E	E		
		2.5 - 5.0 ft						X	X		X	X	X	X	E	X	X			E	E	E	E		E	E	E		
		5.0 - 7.5 ft						X	X		X	X	X	X	E	X	X			E	E	E	E		E	E	E		
		7.5 - 10.0 ft						X	X		X	X	X	X	E	X	X			E	E	E	E		E	E	E		
	6	0.0 - 2.5 ft						X	X		X	X	X	X	E	X	X			E	E	E	E		E	E	E		

Table 16.4-III

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-010, INDUSTRIAL WASTE TREATMENT FACILITY.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals				
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E								
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E								
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E								
	7	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E								
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E								
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E								
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E								
	8	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E								
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E								
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E								
Rinsate Blank																																				
Field Blank											X	X		X	X	X	X																			
Trip Blank		7.5 - 10.0 ft																											X							
Vertical Borehole	1	0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E								
		5.0 - 10.0 ft						X	X		X	X	X	X	X	X	X																			
		10.0 - 15.0 ft						X	X		X	X	X	X	X	X	X																			
		15.0 - 20.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E								
	2	0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E								
		5.0 - 10.0 ft						X	X		X	X	X	X	X	X	X																			
		10.0 - 15.0 ft						X	X		X	X	X	X	X	X	X																			
		15.0 - 20.0 ft						X	X		X	X	X	X	X	X	X																			
Trip Blank																													X							
	3	0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E								
		5.0 - 10.0 ft						X	X		X	X	X	X	X	X	X																			
		10.0 - 15.0 ft						X	X		X	X	X	X	X	X	X																			

Table 16.4–III

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21–010, INDUSTRIAL WASTE TREATMENT FACILITY.

Sample Type	Sampling Location	Interval	Sample Identification		
		15.0 – 20.0 ft			Gross Gamma
					Low–Energy Gamma
					Electromagnetic
					Land Survey
	4	0.0 – 5.0 ft		Field Surveys	Gross Gamma
		5.0 – 10.0 ft			Gross Alpha
		10.0 – 15.0 ft			
		15.0 – 20.0 ft			Organic Vapor
Trip Blank					Combustible Gas/Oxygen
	5	0.0 – 5.0 ft		Field Screening	Lithological Logging
		5.0 – 10.0 ft			Gross Alpha
		10.0 – 15.0 ft			Gamma Spectrometry
		15.0 – 20.0 ft			Tritium
Trip Blank					Volatile Organics
		0.0 – 5.0 ft			PCB
		5.0 – 10.0 ft		Field Laboratory Measurements	Soil Moisture
		10.0 – 15.0 ft			
		15.0 – 20.0 ft			
Rinsate Blank					Gamma Spectrometry
Field Blank					Tritium
Trip Blank					Total Uranium
					Isotopic Plutonium
Rinsate Blank					Isotopic Uranium
Field Blank					Strontium 90
Trip Blank					VOA (SW 8240)
				Laboratory Analysis	Semivolatiles (SW 8270)
					Metals (SW 6010)
					PCB (SW 8080)
					TCLP Metals

16.5. New Industrial Waste Treatment Plant

16.5.1. Site Description

This section describes the field activities for the collection of environmental data associated with the new industrial waste treatment plant, TA-21-257 (Fig. 16.5-1) (LASL 1967b; LASL 1976b; LANL 1983a), including both SWMUs and areas of concern.

The Solid Waste Management Unit (SWMU) report (LANL 1990a) states that the new industrial waste treatment plant, TA-21-257, is designated as SWMU 21-011(a) and contains nine associated structures identified as SWMUs 21-011(b)-(j). The plant includes a clarifier/flocculator, four vertical storage tanks, a pumping station, several pumps that were part of MDA T disposal operations, several above-ground storage tanks, raw waste storage tanks, and several chemical holding tanks (LANL 1990a). A cement silo also existed at the treatment plant. In addition, two radioactive container storage areas were located at TA-21-257 (SWMU 21-001). The first storage area, identified in the SWMU report (LANL 1990a), has been described as active and is located outside at the southwest corner of the building. The second storage area (probably a staging area) is located south of the building along the fence, as identified in LANL photograph #83038K-162 (LANL 1983b). Detailed descriptions of each SWMU subunit follow.

Building TA-21-257

SWMU 21-011(a), the new industrial waste treatment plant (TA-21-257), was put into operation in 1967 after TA-21-35 ceased operations (Fig. 16.5-1). TA-21-257 treated liquid waste produced from operations associated with DP West and DP East.

Associated Structures

SWMU 21-011(b), a sump pump (TA-21-223), was built in 1965 and is located approximately 400 ft east of TA-21-257 (Fig. 16.5-2) (LASL 1976a). It transports waste from DP East to TA-21-257 via a 3-in.-diameter cast iron line. Before TA-21-257 was built, the same line connected the sump pump with the former industrial liquid waste treatment facility, TA-21-35. The sump pump is connected to Buildings TA-21-152, TA-21-155, and TA-21-209 6-in.-diameter cast iron drain lines.

The sump may have discharged to DP Canyon on occasion through a drain pipe before two 3,000 gal. holding tanks, TA-21-346, were installed. That situation is discussed in detail in Sec. 14.3, SWMU 21-004(b) and (c) and Sec. 15.8, SWMU 21-004(d).

SWMU 21-011(c) includes an acid holding tank (TA-21-120) and an acid sump (TA-21-121) (Fig. 16.5-1). These two structures will not be included in the characterization of SWMU 21-011 because they are located inside MDA T (see Sec.16.3, SWMU 21-016).

SWMU 21-011(d) is an acid holding tank (TA-21-110) located on the west side of TA-21-257 (Fig. 16.5-1) (LASL 1967b; LASL 1976b; LANL 1983a). The tank was relocated from TA-21-35 to TA-21-257 in 1967 (LANL 1990a). The tank is aboveground, inactive, and has a 13,500 gal. holding capacity (LASL 1968a). The tank received waste from DP East (Romero and Vigil 1990). The years that the tank received waste are not known.

SWMU 21-011(e) is an acid-holding tank (TA-21-111) located on the west side of TA-21-257 (Fig. 16.5-1) (LASL 1967b; LASL 1976b; LANL 1983a). The tank was relocated from TA-21-35 to TA-21-257 in 1967 (LANL 1990b). The tank is aboveground, inactive, and has a 13,500 gal. holding capacity (LASL 1968b). The tank received waste from DP West and from the "General's Tanks" at MDA A (Roy F. Weston 1990b). The years that the tank received waste are not known.

SWMUs 21-011(f) and (g) are two final effluent-holding tanks (TA-21-112 and TA-21-113) located northwest of TA-21-257 (Fig. 16.5-1) (LASL 1967c; LASL 1976b; LANL 1983a). The tanks are aboveground (LASL 1968b) and have a capacity of 12,700 gal. each (LASL 1967a). Before 1967, underground piping connected these two tanks to TA-21-35 (the former industrial liquid waste treatment facility). After 1967, underground piping from the two tanks was routed to TA-21-257 (the new industrial waste treatment plant). Before 1982, treated effluent was retained in the tanks for 3-to-5-day periods before being discharged to DP Canyon (Romero and Vigil 1990). Since 1982, the treated effluent contained in the tanks has been pumped to TA-50 for disposal. The two tanks are plumbed together (LASL 1968b) allowing effluent to be transferred from one tank to the other, to prevent overflows.

SWMU 21-011(h) is a 2,000 gal. above-ground acid storage tank (Pug Mill Tank, TA-21-256). It was relocated from TA-21-35 to the southwest corner of TA-21-257 (LASL 1977; LANL 1983a) in 1967 (Fig. 16.5-1) (LASL 1967b; LASL 1976b; LANL 1983a). The tank was removed in 1986 (LASL no date).

SWMU 21-011(l) is an inactive 50% sodium hydroxide storage tank (TA-21-288) located on the west side of TA-21-257, immediately north of the americium raffinate storage tank, TA-21-289 (Fig. 16.5-1) (LASL 1967b; LASL 1976b; LANL 1983a). This aboveground tank was installed in 1968 and has a 1,000-gal. holding capacity (LASL 1968b). At present, the tank has an undetermined amount of liquid in it (Romero and Vigil 1990).

SWMU 21-011(j) is an inactive americium raffinate storage tank (TA-21-289) located on the west side of TA-21-257, immediately south of TA-21-288 (Fig. 16.5-1) (LASL 1967c; LASL 1976b; LANL 1983a). This run-off tank was installed in 1968 and has a 1,600-gal. holding capacity (LASL 1968b). According to LANL employees, when the americium storage tank was in operation, the area west of the tank was not asphalted (LASL 1967d). Tanker trucks would back up to the americium tank and transfer waste into the tank. The hose line that transferred the waste from the tanker truck to the americium tank would occasionally break apart, thereby spilling untreated waste on the ground. The area was finally asphalted, approximately 1 year before the tank was taken out of operation. The exact dates for when the tank was taken out of operation and when the area was asphalted are not known (Romero and Vigil 1990).

The parts of TA-21-257 listed below are not specifically identified as SWMU subunits but were part of the SWMU description.

Vertical storage tanks refer to two below-ground raw waste storage (RWS) tanks located immediately north of the plant (LASL 1967e; LASL 1968b). These tanks do not have structure numbers, but within the treatment system they are referred to as RWS 1 and 2. The tanks are active, and both have a 28,000 gal. holding capacity. From 1967 to 1984, the storage tanks received waste from DP West. After 1984, the two storage tanks received waste from both DP West and DP East (Roy F. Weston 1990). These tanks are clearly shown on engineering drawings ENG C-36383, -36384, and -36387.

Several sumps include an active grit chamber used to separate solid materials from the liquid influent waste stream before it enters RWS 1 and 2. The grit chamber does not have a structure number. It is clearly shown on engineering drawings ENG C-36383, -36384, and -36387.

The pumping station reference in the SWMU description refers to two valve pits/pumps (TA-21-204 and TA-21-205), located immediately north of holding tanks TA-21-112 and TA-21-113 (LANL 1983a), that transfer effluent from the holding tanks to TA-50 for final disposal.

SWMU 21-001 is defined as an active radioactive container storage area located outside, at the southwest corner of TA-21-257 (LANL 1990a) (Fig. 16.5-1). During the TA-21 site reconnaissance walk-through (Roy F. Weston 1990), 20 55-gal. drums of unused thermal oil from TA-50 were observed to be staged in the area. No drums of radioactive waste were observed. The thermal oil stored at the site is product and has reportedly never been opened (Salazar 1990). One employee currently working at LANL stated that drums containing filter media are occasionally stored at the southwest corner of TA-21-257 but only for periods of about one week (Salazar

1990). The LANL employee also stated that a number of drums of mixed waste were also stored along the fence south of TA-21-257 for about 1 year; however, he could not recall the specific year (Salazar 1990). Documentation from a 1983 LANL photograph (LANL 1983b), which shows nine drums lined up along the fence, seems to confirm this statement.

From 1968 until 1983, disposal operations at TA-21-257 included a direct flow system, which was used to pipe radioactive wastes mixed with cement from TA-21-257 to asphalt-lined disposal shafts at MDA T (see Sec. 16.3). During certain periods (i.e., during routine maintenance of the cement-waste piping system, drilling additional disposal shafts, etc.), the wastes that were generally disposed of at MDA T were drummed and stored at the southwest corner.

Areas of Concern

Area of concern C-21-005, was a spill between Buildings 5 and 257 resulting from a 1959 fire in a filter in Building 5. The resulting contamination was cleaned up (LANL 1989).

Area of concern C-21-007, refers to a 1982 spill from a tank vent at TA-21-257. This leak contaminated the building's roof, wall, and surrounding area with low levels of plutonium, americium, and uranium. This spill was reportedly cleaned up (LANL 1989).

Area of concern C-21-033, refers to a 1976 cement paste spill which occurred when radioactively contaminated cement was being pumped from TA-21-257 into shafts between absorption beds 1 and 3 at MDA T (see Sec. 16.3). The exact location where this spill occurred in unknown (LANL 1989).

16.5.1.1. Site History

In the 1940s, four absorption beds were constructed (which became known as MDA T) at TA-21 for disposal of liquid radioactive waste. From 1945 to 1952, the four absorption beds received untreated waste. In 1952, the untreated liquid waste was diverted to the newly constructed industrial liquid waste treatment facility, TA-21-35. Treated wastes were then sent from TA-21-35 to the absorption beds until 1967 when operations at TA-21-35 were discontinued and the new industrial waste treatment plant, TA-21-257, came on line (see Fig. 16.5-1) (LASL 1976b; LANL 1983a).

Coprecipitation of plutonium with ferric sulfate has been, and currently is, the basis of the treatment process at TA-21-257 (Romero and Vigil 1990). The following is a brief description of the treatment process:

> A "continuous stream" of influent is received at TA-21-257 and is temporarily retained in two, raw waste storage tanks. Feed pumps lift the waste in the storage tanks to a flash mixer where lime, ferric sulfate, and coagulant aids are added (Christenson and Emelity 1970). The waste flows to a flocculator and on to a settling (or sedimentation) tank. Settled effluent is pumped through a pressure filter and, at this point, sampled to verify treatment. If the effluent is determined to be adequately treated, it is pumped to two final effluent holding tanks and sent to TA-50 for final disposal. If the effluent is not sufficiently treated, it is recirculated through the treatment system.

In addition to the routine waste stream treatment process described above, a variety of other wastes classified as "batch wastes" were treated at TA-21-257 from 1967 to 1984 (Romero and Vigil 1990). Some of the batch wastes sent to TA-21-257 via 1.5-in., stainless steel lines were rich in americium. These wastes were collected and contained in stainless steel or concrete holding tanks (Christenson and Emelity 1970). Highly acidic solutions were also delivered to TA-21-257 in 270-gal. tanker trailers. Most of these wastes were treated by neutralization in special stainless steel, water-cooled tanks (Warren 1983). Batch wastes that required the greatest treatment were those that had high-dissolved solids or were highly acidic. Treatment of these types of batch wastes included neutralization with 50% sodium hydroxide, then mixing with cement in a pug mill, and finally, pumping the cement paste to asphalt-lined shafts at MDA T, located west of TA-21-257 (Christenson and Emelity 1970). This type of disposal was in operation from 1968 until 1983 when it was discontinued (LANL 1990a). According to LANL employees, during the pumping of the cement paste to the asphalt-lined disposal shafts at MDA T, the fire hose lines that were used to transport the cement paste would occasionally break apart or leak, thereby spilling the cement paste on the ground (Romero and Vigil 1990). Although documentation is not available, another LANL employee reported that an operational release of cement paste occurred approximately 100 ft west-northwest of TA-21-257, as a result of a break in the fire hose transfer line (Romero and Vigil 1990). These types of releases were reportedly cleaned up immediately after each spill occurred; however, a few such releases have been identified as areas of concern (see Table 16.5-I).

Sludges that accumulated from chemical treatment of the continuous (main) waste stream were also added to the pug mill feed for eventual disposal to the absorption beds at MDA T (Christenson and Emelity 1970). Other wastes treated at TA-21-257 included americium-plutonium solutions that were alkaline and rich in fluorides, chlorides, and radionuclides. These wastes were mixed with cement via the pug mill and pumped to the asphalt-lined disposal shafts at MDA T along with the other wastes discussed previously.

At present, the wastes produced at DP East and DP West are transported to TA-21-257 through cast iron lines (Romero and Vigil 1990). The 3-in., cast iron line that carries waste from DP East

to TA-21-257 originates at Buildings TA-21-155 and TA-21-209 (LASL 1967c; Romero and Vigil 1990). The DP East liquid waste is sent to TA-21-257 via a sump pump, TA-21-223 (LASL 1975). The sump pump (TA-21-223) has a 6-in. overflow line, which trends north and is connected to two 3,000-gal. holding tanks [SWMUs 21-004(b) and (c)]. The tanks serve as emergency storage if the sump is inoperative or if it overflows (see Sec. 14.3). Before the tanks were installed, wastes that overflowed from TA-21-223 went to an outfall near the edge of DP Canyon [see Sec. 15.8, SWMU 21-004(d)]. At DP West, a 4-in., mild steel (or possibly glass) line and three 1.5-in., stainless steel lines transport liquid waste from Buildings TA-21-2, TA-21-3, TA-21-4, TA-21-5, and TA-21-150 to Building TA-21-257 (LASL 1968a; LASL 1975; LASL 1976b) (Fig. 16.5-1) (LASL 1967b; LASL 1976b; LANL 1983a).

Additional waste lines that may exist include a 6-in. cast iron waste line and a 3-in. cast iron waste line. These lines presently deliver, or have delivered, liquid wastes from DP East, DP West, and the former industrial liquid waste treatment facility, TA-21-35, to the new industrial waste treatment plant, TA-21-257 (Fig. 16.5-1) (LASL 1967b; LASL 1976b; LANL 1983a) (see Sec. 18.5).

16.5.1.2. Existing Information

The following summarizes and evaluates existing data from TA-21-257 and provides the basis for determining whether additional information is needed to complete characterization and assessment of the site.

On October 4, 1972, an alpha radiation survey was performed at TA-21-257 (Stafford 1972). A Ludlum Model 139 alpha meter was used for the survey. Counts of up to 250,000 counts/minute were recorded outside of the building on the surface at a location under the americium raffinate storage tank (TA-21-289) (Fig. 16.5-3) (Stafford 1972). The highest recorded readings inside of the building were 25,000 counts/minute obtained at the Pug Mill (TA-21-256). Because the average gross alpha concentration per gram for this area is 3.2 counts/minute (Purtymun et al. 1987), these readings are believed to be well above background levels.

Radiation surveys performed by LASL employees in 1978 identified plutonium, ^{137}Cs, ^{241}Am, and tritium surface contamination inside the exclusion fence at TA-21-257 and across the public access road north of the building (Romero 1978). Radionuclide contamination was identified in run-off ditches to DP Canyon and from the TA-21-257 outfall to DP Canyon (LASL 1967d).

A soil and phoswich radiation survey was performed outside of the TA-21-257 exclusion fence in

April 1986 by HSE-1. Seven soil samples were taken on the north and south side of the paved public access road near the building (Wenzel and Romero 1986). Table 16.5-II shows the radiochemical and radiation counting results for the seven samples. Conclusions made by Wenzel and Romero (1986) from their investigation indicate above-background radionuclide contamination and downgradient movement of ^{238}Pu, $^{239/240}Pu$, ^{137}Cs, and tritium from the building area above the paved road surface and also in culverts and ditches leading to DP Canyon. However, based on the comparison with background levels (Purtymun et al. 1987) shown in Table 16.5-II, it is clear that all radionuclides analyzed were present at above-background concentrations in almost all of the seven soil samples that were collected.

In June 1987, three soil samples were collected around a leaking pipe at the northwest corner of TA-21-257 (Soholt 1987). The exact sampling locations are not known. Americium contamination was confirmed in all three samples, with a maximum concentration of 56.1 nCi/g. The area investigated by the sampling has not been remediated or backfilled (Soholt 1987).

No additional information on either the radioactive container storage area (SWMU 21-001) or the areas of concern exists.

16.5.1.3. Source Term

TA-21-257 began operations in 1967 and continues to receive both radioactive and hazardous liquid wastes for treatment. In 1968, it received 244,900 gal. of waste with an average gross alpha activity of 562 counts/minute/liter (LASL 1969). Of the 244,900 gal. received, 40% was discharged to DP Canyon without treatment. Table 16.5-III shows the types of radioactive wastes that were treated at the plant from January through May 1973 and the chemical composition and average monthly radioactivity of each waste. These wastes are presumably similar in composition to wastes that have been processed at the plant from the time it first came on line in 1967.

The plant also has treated large volumes of tritium-contaminated waste (Table 16.5-IV). In 1970, a total of 2,866,300 gal. of tritium waste, which contained a total activity of approximately 51 mCi, was treated. The volume of tritium-contaminated waste currently being treated is not known. It is, therefore, not known if the volume of tritium-contaminated waste that was treated in 1970 is representative of the volumes of tritium-contaminated waste that have been treated annually since that time.

Over the years, the outfall from Building TA-21-257 (currently permitted as NPDES No. EPA050050) discharged an undetermined amount of untreated waste (LASL no date) into DP

Canyon. This resulted in the need for a chemical and radionuclide investigation of the outfall drainage (see Fig. 15.4-4). This outfall is further discussed in Sec. 15.4, SWMU 21-011(k).

Operational Data at Building TA-21-257. The Waste Management Group (HSE-7) records raw data for treatment operations conducted at Building TA-21-257. The available data include the volumes of influent processed and the chemical quality of influent and effluent for the years 1967 to 1972 and 1978 to 1989. Data for the years 1973-1977 are not available.

Tables 16.5-V through 16.5-VII are a summary of the raw data tables. The summary tables show comparisons of influent and effluent sample concentrations for gross alpha and beta, radionuclides, and selected inorganic constituents, respectively. The information provided in the three tables is based on the best collection of data available at this time and is assumed to be representative of the more complete data set. The data provided are not consistent between years and do not provide both influent and effluent data in all cases.

Data in Table 16.5-V show that influent flow was greatest in 1970 at 2,863,700 gal. and was at a low of 484,000 gal. in 1979, which was the year after the plutonium-processing operations moved to TA-55. The general trend in flow has decreased from 1967, when the plant first came on line, to the present. The removal efficiency for gross alpha and beta from 1978 to 1989 appears to be between 97 and 99%. There is a wide variation in influent concentrations from 1978 to 1989. The concentrations in gross alpha and beta vary over approximately three orders of magnitude with no apparent pattern or trend.

In general, the data in Table 16.5-VI show that the greatest concentration of radionuclides in influent wastes was between 1979 and 1983. Since 1983, substantial decreases of two to three orders of magnitude are recorded in the influent concentrations of radionuclides. Removal efficiencies of radionuclide concentrations in the effluent range from 89% to greater than 99% of the influent radionuclide concentrations.

In general, the data in Table 16.5-VII show that concentrations of selected inorganic constituents (selected on the basis of toxicity, etc.) were low, except for values recorded for cadmium in 1981 and 1987 (3.4 and 418 mg/L, respectively). Removal efficiencies of inorganic constituents in effluent ranged from less than 1% for hexavalent chromium (which exhibited low influent concentrations) compared to 94 to 99% for most of the other inorganic constituents.

16.5.2. Objectives and Data Needs

In the course of operations at TA-21-257, documented leaks and spills have occurred outside in the area surrounding the facility. Two areas were also used for drum storage of radioactive materials. Although cleanup of leaks and spills at areas of concern has been performed, surface and subsurface soil contamination may still exist. Stored drums may also have leaked and released contaminants.

SWMU 21-011 data needs are listed below as follows:

1. Determine the location and below-ground dimensions of underground structures TA-21-223, the two 28,000 gal. raw waste storage tanks, the grit chamber, TA-21-204, and TA-21-205 from engineering drawings.

2. Identify the presence of contamination beneath the foundation of Building TA-21-257 by analysis of subsurface soil samples using Level II/III data.

3. Identify the presence of contamination at selected waste treatment and storage tanks and at locations of historical spills and leaks by Level II/III analysis of surface and subsurface soil samples.

4. If contaminants are identified, determine the vertical and lateral extent of contamination by additional surface and subsurface soil sampling and Level III/IV analysis.

16.5.3. Sampling/Investigation Rationale

Two phases of investigations are planned for SWMU 21-011. Building TA-21-257 and the other associated tanks and structures are in active use; therefore, field sampling for both phases will be conducted only around the building exterior. Investigation of the two radioactive container storage areas (SWMU 21-001) and three areas of concern will be performed in conjunction with the investigation of SWMU 21-011.

The initial investigation will consist of surveying and marking existing underground structures, a field survey for radiological surface contamination, and angled and shallow boreholes for subsurface soil sampling. All underground structures and the foundation of Building TA-21-257 will be surveyed and the subsurface depth recorded in order to assure structural integrity during drilling at these locations. The field radiological survey will identify any surface contamination remaining from past leaks and spills. Angled drilling beneath Building TA-21-257 will investigate the potential presence of contamination resulting from operations. Shallow drilling will investigate potential environmental contamination at the two radioactive container storage areas, selected waste treatment and storage tanks, and at locations of historical spills and leaks.

Soil samples collected from the initial investigation will be field-screened and submitted for selected field laboratory measurements to determine the general types and concentrations of contaminants present. Approximately 30% of the total number of samples collected will then be submitted to an analytical laboratory for confirmation of contaminants and a full suite of additional analyses.

All samples will be analyzed in the field laboratory. These analyses will be used to define whether the nominal borehole depth has reached the edge of the contaminant plume or whether each borehole needs to be deeper. Because this investigation presupposes the Building 257 area is contaminated, the purpose of samples sent to the analytical laboratory is twofold: 1) to define the source term and 2) to define the edges of the contaminant plume. Therefore, samples sent to the analytical laboratory for confirmatory analysis will include "hot" samples for source term definition and samples from the edges of the plume to confirm absence of contamination.

Additional investigation will be needed if contaminants are identified in the angled boreholes beneath Building TA-21-257. A subsequent investigation may also include additional boreholes and subsurface sampling to define the lateral and vertical extent of contamination. The analytical suite in the subsequent investigation, based on initial investigation results, may be narrowed to specific analytes.

16.5.4. Sampling Plan

16.5.4.1. Initial Investigation

The area of investigation surrounding Building TA-21-257 is bounded on the north and east by security fences, by MDA T on the west, and by a road to the south (Fig. 16.5-2) (LASL 1976a, 1976b). Figure 16.5-2 (LASL 1967d) also shows the location of the sump pump TA-21-223 [SWMU 21-011(b)].

Underground structures TA-21-223, the two 28,000 gal. raw waste storage tanks, the grit chamber, TA-21-204 and TA-21-205, will be surveyed and marked from engineering drawings (LASL 1967e; LASL 1968b; LANL 1983a) (for method see Sec. 11.3.3). The depth below ground surface for these structures and the foundation of Building TA-21-257 will also be determined from engineering drawings in order to assure structural integrity during the drilling program.

A radiological field survey (for methods see Sec. 11.4.1.1 and Sec. 11.4.1.2) will be conducted in the area surrounding Building TA-21-257. Because some areas are now covered by asphalt, it is

anticipated that surface radioactivity from previous spills and leaks will be identified at no more than five locations. Up to five locations will be evaluated by the collection and analysis of near-surface soil samples to a 30-in. depth (for method see Sec. 11.5.2.2). If five locations are sampled, this will result in 25 samples sent to be processed in the field laboratory. Approximately 30% of the samples collected will be sent to the analytical laboratory. The field screening, field laboratory and sample analysis requirements are shown in Table 16.5-VIII.

Four angle boreholes (for method see Sec. 11.5.3.3), one on each side, will be drilled beneath the foundation of Building TA-21-257 at the locations shown in Fig. 16.5-1 (LASL 1976b). The angle of borehole penetration will be 45 degrees. Nominal length of these boreholes will be 20 ft. Sixteen samples (5-ft core intervals) will be processed in the field laboratory. Approximately 30% of these samples will be sent to the analytical laboratory. The field screening, field laboratory, and sample analysis requirements are shown in Table 16.5-VIII.

Seven shallow boreholes will be drilled (for method see Sec. 11.5.3.1). Six of the boreholes will be at locations surrounding Building TA-21-257 as shown in Fig. 16.5-1 (LASL 1976b). The seventh borehole will be drilled near the sump pump, TA-21-223, as shown in Fig. 16.5-1 (LASL 1976a). Nominal depth of these boreholes will be 10 ft (four 2.5-ft soil cores). Twenty-eight samples will be collected and processed in the field laboratory. Of these samples, approximately 30% will be sent to the offsite analytical laboratory. The field screening, field laboratory, and sample analysis requirements are shown in Table 16.5-VIII.

16.5.4.2. Subsequent Investigation

If contaminants are identified during the initial investigation, additional subsurface soil sampling and analyses will be necessary to determine the vertical and lateral extent of contamination. Samples obtained from the subsequent investigation will be submitted for a full suite of laboratory analyses, except if results from the initial investigation indicate a more focused analytical suite is appropriate.

Additional angled drilling may be required if sources of contamination are identified beneath Building TA-21-257. These boreholes will be positioned at 20-ft spacings on either side of initial angled borehole locations that were determined to be contaminated. Drilling will be performed at a 45° angle according to the method in Sec. 11.5.3.3. For planning purposes, it is anticipated that no more than four additional angled boreholes be drilled to a nominal length of 20 ft. If four additional angled boreholes are drilled and sampled, a total of 16 samples will be collected.

Additional shallow boreholes may also be required to determine the vertical and lateral extent of contamination near the two radioactive container storage areas, waste treatment and storage tanks, or at the locations of historical spills and leaks. These boreholes (for method see Sec. 11.5.3.1) will be positioned at 20-ft spacings outward from sampling points at which contamination is identified. For planning purposes, it is anticipated that no more than 10 additional boreholes to a nominal depth of 10 ft will be required. If 10 additional boreholes are drilled and sampled, a total of 40 samples will be collected.

For planning purposes, it is assumed that the analytical program will be the same as for the initial investigation. Table 16.5-IX gives the screening and analysis assumptions for the 56 samples that are assumed for the subsequent investigations.

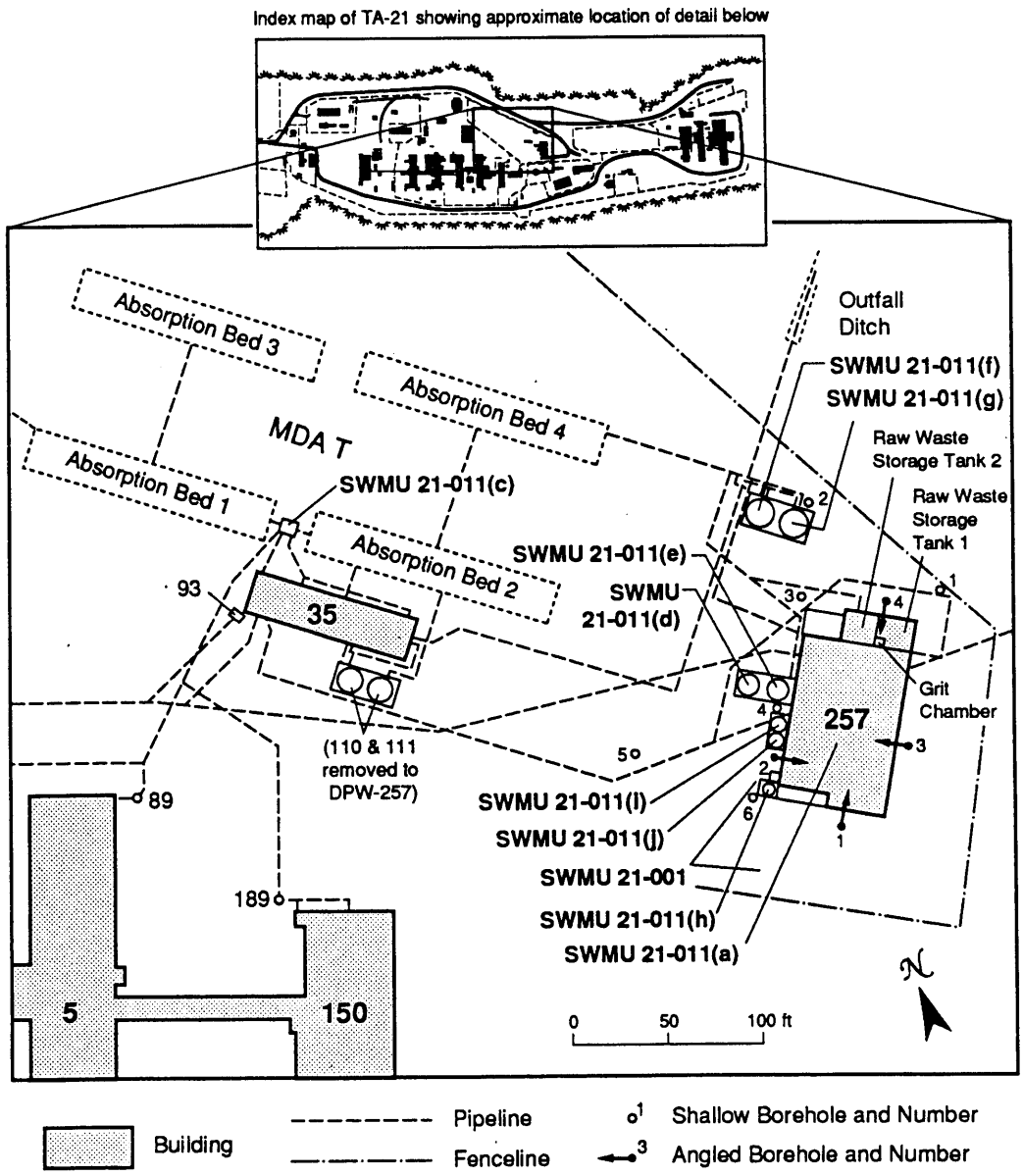


Fig. 16.5-1 SWMU and borehole locations for the New Industrial Waste Treatment Plant TA-21-257. (LASL 1976b; LANL 1983a)

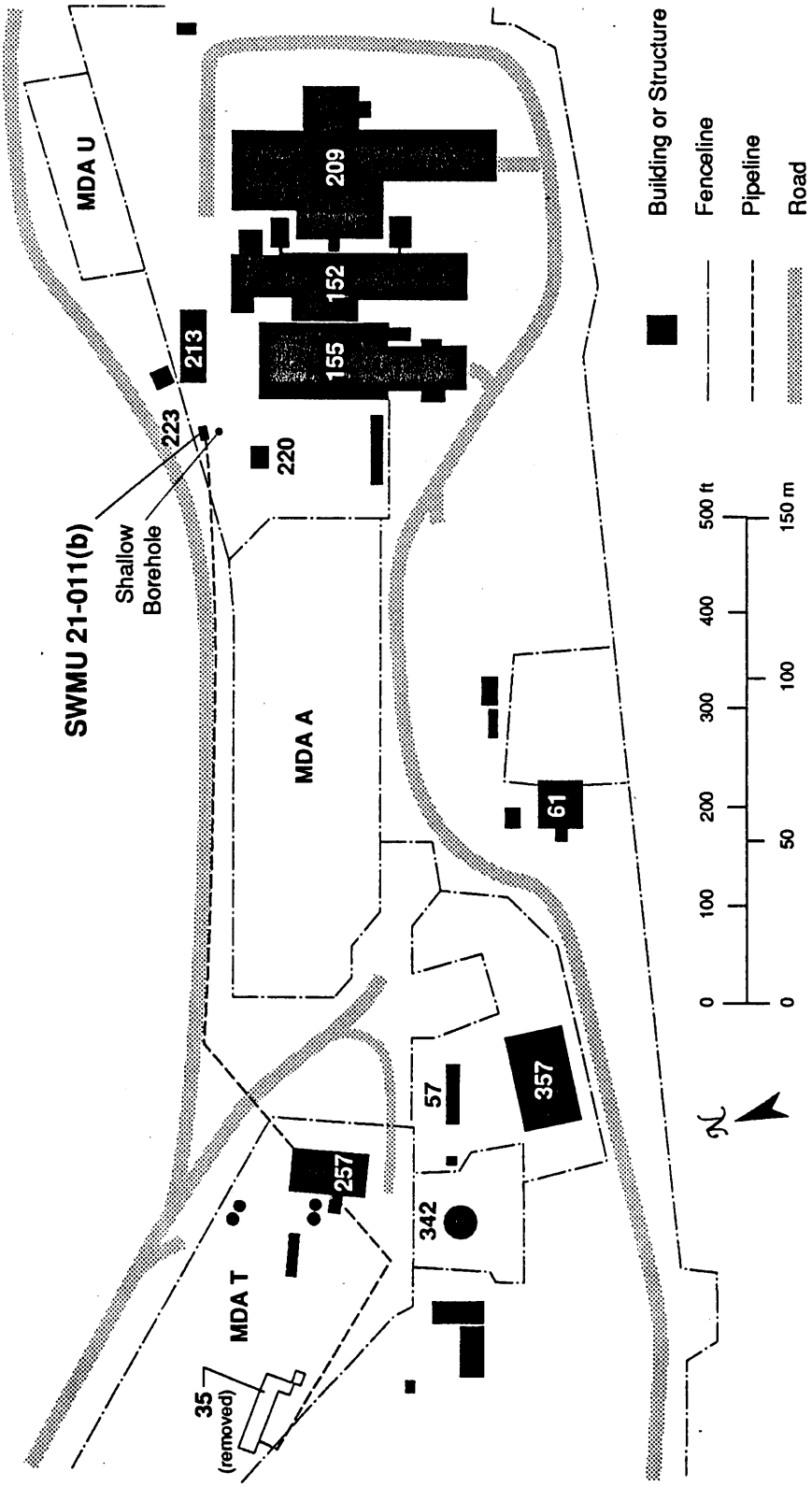


Fig. 16.5-2 Sump TA-21-223, SWMU 21-011(b), and borehole location, approximately 400 ft east of the New Industrial Waste Treatment Plant TA-21-257. (LASL 1976b, c)

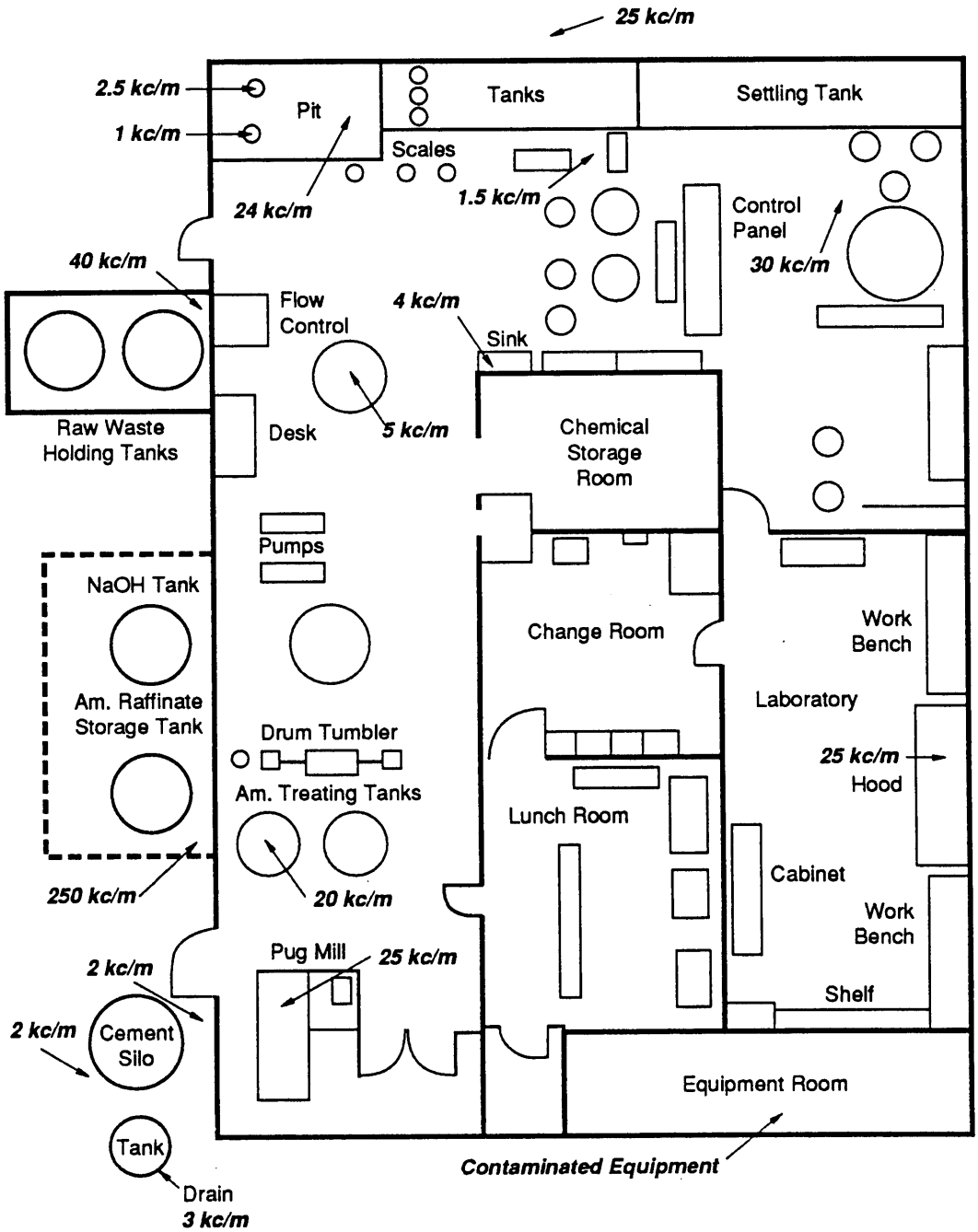


Fig. 16.5-3 Alpha survey at the New Industrial Waste Treatment Plant TA-21-257. (Stafford 1972)

TABLE 16.5-I
AREAS OF CONCERN ASSOCIATED WITH TA-21-257[a]

Site Number	Description
C-21-005	Release of ^{241}Am and plutonium on west side of building; soil was decontaminated. (RFA Unit 21.018, Task 10, Record 180) Addressed as part of 21-011.
C-21-007	Release of plutonium, americium, and uranium from a tank vent. (CEARP ID No. TA21-8-CA-I-RW/HW; Task 10, Record 183) Addressed as part of 21-011.
C-21-033	1976 TRU cement paste spill. (Task 10, Record 181) Addressed as part of 21-011.

[a]Data source in parentheses is TA-21 Release Site Data Base, LANL 1989.

TABLE 16.5-II
RADIONUCLIDE CONCENTRATION IN SOIL SAMPLES NEAR TA-21-257[a]

Constituent	Upper Limit of Background $\bar{X} + 2s$[b]	Sample No. 1	Sample No. 2	Sample No. 3	Sample No. 4	Sample No. 5	Sample No. 6	Sample No. 7
Tritium (pCi/ml)	0.0072	4.8	1.9	140	240	3.1	2.6	2.8
239/240Pu (pCi/g)	0.025	13.3	5.1	5.7	6.1	10.5	6.9	0.366
238Pu (pCi/g)	0.005	0.30	0.24	0.21	0.92	1.80	0.23	0.109
137Cs (pCi/g)	0.44	4,320	13.7	1.45	1.48	45.1	1.99	0.0547
90Sr (pCi/g)	0.88	1,510	4.0	0.13	0.79	17.3	0.54	0.25
Total U (µg/g)	3.4	4.49	3.49	3.52	3.08	3.94	5.95	2.64
241Am (pCi/g)	Not reported	0.082	ND[c]	ND	ND	ND	ND	ND

[a]Wenzel and Romero (1986).
[b]Purtymun et al. (1987).
[c]Not detected.

TABLE 16.5-III. WASTE STREAM COMPOSITION TO DP-257 JANUARY THROUGH MAY 1973.

Type of Wastes	Av Vol/Mo Gallons	Chemical Composition	Radioactivity Av/Mo
Main flow stream, DPW	129,300	pH 11.4; TS-1, 580 mg/l; Na-400 mg/l; NO_3-73 mg/l; Cl-57 mg/l	1.38×10^{-1} µCi/l gross a 1.32×10^{-3} mCi/l Sr
Main flow stream, DPE	13,700	Incl. above	Incl. above Low ^{235}U
Am-Pu acid wastes	2,500	HNO_3 + metals	22.15g ^{239}Pu, 20.4g ^{241}Am, ~0.01g ^{238}Pu
Bldg 2, NaOH wastes	400	(from recovery oper.) NaOH, Fe, Cl, NO_3, plus various others	188 mg total a include ^{239}Pu, ^{241}Am
Bldg 4, KOH	130	KOH, used to scrub HF lines	246mg ^{235}U + 2mg ^{239}Pu + trace ^{238}Pu
Bldg 5, KOH wastes	480	(scrubbing sol.), KOH, F^-	1.36g ^{239}Pu
Distillate	1,130	$-NO_3$	11.4g ^{235}U (incl. in main stream)
Scrub tank, Distillate	40	NO_3^-, Cl^-, Neut. KOH + misc. organics	800 mg ^{235}U
Alcohol	8	Ethyl Alcohol	1.78g ^{239}Pu
Strip wastes	255	Na, Mg, Al, Fe, Cr, Ni, NH_3 SO_4, NO_3	15.2g ^{235}U, trace amounts of ^{90}Sr and ^{137}Cs (MFP)
Organics, solvents	9	Acetone, Chlorethylene, etc.	^{235}U, ^{238}Pu, ^{239}Pu
Oils	8	Vacuum pump oil	^{238}Pu, ^{239}Pu

TABLE 16.5-IV
TRITIUM DISCHARGED FROM TA-21-257 IN 1970[a]

Dated	Liters[b] x 10^3	mCi[c]
Jan	898	2
Feb	919	2
Mar	886	25
April	799	1
May	685	11
June	1,073	4
July	1,200	1
Aug	809	1
Sept	889	2
Oct	858	1
Nov	679	<1
Dec	1,153	1
TOTAL	10,849	51
Mo. Av.	904	4.2

[a]LASL (1971).
[b]Bldg. 257 average = 4.7×10^{-6} µCi/ml.
[c]mCi of tritium were calculated using DP-East volumes and analyses and assuming that the DP-West wastes contain no tritium.

TABLE 16.5-V
COMPARISONS BETWEEN INFLUENT AND EFFLUENT CONCENTRATIONS
FOR GROSS ALPHA AND BETA

Statistic	Influent Flow[a] (Liters)	Gross Alpha (mCi)[b] Influent	Effluent	Gross Beta (mCi)[b] Influent	Effluent
Minimum	1,832,300	6.38	1.24	3.28	3.01
Maximum	10,839,300	5353.50	6.41	1030.64	20.44
Average	4,948,806	904.14	2.60	276.69	7.62
St. Deviation	3,088,736	1976.45	2.06	833.76	7.69
% Reduction			99		97

[a]Includes years 1967 - 1989.
[b]Includes years 1978 - 1989.

TABLE 16.5-VI
COMPARISONS BETWEEN INFLUENT AND EFFLUENT CONCENTRATIONS FOR RADIONUCLIDES

Statistic[a]	^{89}Sr (mCi)		^{90}Sr (mCi)		^{238}Pu (mCi)		$^{239/240}Pu$ (mCi)		^{241}Am (mCi)		^{234}U (mCi)		^{137}Cs (mCi)	
	Inf	Eff	Inf	Eff	Inf	Eff	Inf	Eff	Inf	Eff	Inf	Eff	Inf	Eff
Minimum	0.03	0.03	0.0	0.07	0.87	0.04	1.35	0.06	1.06	0.59	0.50	0.89	0.19	0.16
Maximum	5.48	0.16	31.30	0.87	486.27	0.45	622.11	0.70	5022.74	1.72	813.30	31.60	48.27	0.97
Average	0.74	0.08	4.67	0.34	107.16	0.14	109.53	0.21	747.69	0.90	148.95	6.57	5.43	0.45
St. Deviation	2.04	0.06	11.63	0.33	202.40	0.17	230.54	0.27	1869.79	0.46	297.20	13.60	18.36	0.32
% Reduction		89		93		99		99		99		96		92

[a]Includes years 1979 - 1989 (not all years have complete data).

TABLE 16.5-VII
COMPARISONS BETWEEN INFLUENT AND EFFLUENT CONCENTRATIONS
FOR SELECTED INORGANIC CONSTITUENTS

Statistic	Cd (mg/L)		Cr-VI(mg/L)		Pb (mg/L)		Hg(mg/L)	
	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
Minimum	0.01	0.0	0.013	0.026	0.1	3.99E-3	0.01	4.0E-4
Maximum	418.20	0.32	0.3	0.15	0.89	3.30E-2	0.05	1.0E-3
Average	42.51	0.14	0.077	0.076	0.31	1.81E-2	0.02	5.94E-4
St. Deviation	161.00	0.15	0.103	0.051	0.29	1.21E-2	0.01	2.28E-4
% Reduction		99		4		94		97

Table 16.5-VIII

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-011, NEW INDUSTRIAL WASTE TREATMENT PLANT.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Subsurface Investigation																																		
Survey				X	X		X																											
Near Surface Soil	1	0.0 - 0.5 ft						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E				
		0.5 - 1.0 ft						X	X		X			X	X	X	X																	
		1.0 - 1.5 ft						X	X		X			X	X	X	X																	
		1.5 - 2.0 ft						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E				
		2.0 - 2.5 ft						X	X		X			X	X	X	X																	
	2	0.0 - 0.5 ft						X	X		X			X	X	X	X																	
		0.5 - 1.0 ft						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E				
		1.0 - 1.5 ft						X	X		X			X	X	X	X																	
		1.5 - 2.0 ft						X	X		X			X	X	X	X																	
		2.0 - 2.5 ft						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E				
	3	0.0 - 0.5 ft						X	X		X			X	X	X	X																	
Field Duplicate																						X	X	X	X		X	X	X	X				
		0.5 - 1.0 ft						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E				
		1.0 - 1.5 ft						X	X		X			X	X	X	X																	
		1.5 - 2.0 ft						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E				
		2.0 - 2.5 ft						X	X		X			X	X	X	X																	
	4	0.0 - 0.5 ft						X	X		X			X	X	X	X																	
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
		0.5 - 1.0 ft						X	X		X			X	X	X	X																	
		1.0 - 1.5 ft						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E				
		1.5 - 2.0 ft						X	X		X			X	X	X	X																	
		2.0 - 2.5 ft						X	X		X			X	X	X	X																	

Table 16.5-VIII

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-011, NEW INDUSTRIAL WASTE TREATMENT PLANT.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture				Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
	5	0.0 - 0.5 R						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
		0.5 - 1.0 R						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
		1.0 - 1.5 R						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
		1.5 - 2.0 R						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
		2.0 - 2.5 R						X	X		X			X	X	X	X					E	E	E	E		E	E	E	E			
Trip Blank																																		
TA-21-257																																		
Angled Borehole	1	0.0 - 5.0 R						X	X					X	X	X	X					E	E	E	E		E	E	E	E			
		5.0 - 10.0 R						X	X					X	X	X	X					E	E	E	E		E	E	E	E			
		10.0 - 15.0 R						X	X					X	X	X	X					E	E	E	E		E	E	E	E			
		15.0 - 20.0 R						X	X					X	X	X	X					E	E	E	E		E	E	E	E			
	2	0.0 - 5.0 R						X	X					X	X	X	X					E	E	E	E		E	E	E	E			
		5.0 - 10.0 R						X	X					X	X	X	X					E	E	E	E		E	E	E	E			
		10.0 - 15.0 R						X	X					X	X	X	X					E	E	E	E		E	E	E	E			
		15.0 - 20.0 R						X	X					X	X	X	X					E	E	E	E		E	E	E	E			
Trip Blank																																		
	3	0.0 - 5.0 R						X	X					X	X	X	X					E	E	E	E		E	E	E	E			
		5.0 - 10.0 R						X	X					X	X	X	X					E	E	E	E		E	E	E	E			
Rinsate Blank																						X	X	X	X		X	X	X	X			
Field Blank																						X	X	X	X		X	X	X	X			
		10.0 - 15.0 R						X	X					X	X	X	X					E	E	E	E		E	E	E	E			
		15.0 - 20.0 R						X	X					X	X	X	X					E	E	E	E		E	E	E	E			
	4	0.0 - 5.0 R						X	X					X	X	X	X					E	E	E	E		E	E	E	E			
		5.0 - 10.0 R						X	X					X	X	X	X					E	E	E	E		E	E	E	E			
		10.0 - 15.0 R						X	X					X	X	X	X					E	E	E	E		E	E	E	E			
		15.0 - 20.0 R						X	X					X	X	X	X					E	E	E	E		E	E	E	E			

Table 16.5-VIII

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-011, NEW INDUSTRIAL WASTE TREATMENT PLANT.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Field Duplicate																						X	X	X	X		X	X	X	X			
Trip Blank																												X				
Shallow Borehole	1	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					X	X	X	X		X	X	X	X			
Rinsate Blank																						X	X	X	X		X	X	X	X			
Field Blank																												X	X	X			
		0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																
	2	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			
		0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			
	3	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																
		0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																
	4	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			
		0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			
Trip Blank																											X						
	5	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																
		0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X																
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			
	6	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X																

Table 16.5-VIII

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-011, NEW INDUSTRIAL WASTE TREATMENT PLANT.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
		0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																	
	7	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
		0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
Trip Blank																												X						

Table 16.5-IX

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-011, NEW INDUSTRIAL WASTE TREATMENT PLANT.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis														
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
TA-21-257																																			
Angled Borehole	1	0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X																		
		5.0 - 10.0 ft						X	X		X	X	X	X	X	X	X																		
		10.0 - 15.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E					
		15.0 - 20.0 ft						X	X		X	X	X	X	X	X	X																		
	2	0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X																		
		5.0 - 10.0 ft						X	X		X	X	X	X	X	X	X																		
		10.0 - 15.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E					
		15.0 - 20.0 ft						X	X		X	X	X	X	X	X	X																		
Trip Blank																													X					
	3	0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X																		
		5.0 - 10.0 ft						X	X		X	X	X	X	X	X	X					X	X	X	X		X	X	X	X					
Rinsate Blank																												X	X					
Field Blank																						E	E	E	E		E	E	E	E				
		10.0 - 15.0 ft						X	X		X	X	X	X	X	X	X																		
		15.0 - 20.0 ft						X	X		X	X	X	X	X	X	X																		
	4	0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E					
		5.0 - 10.0 ft						X	X		X	X	X	X	X	X	X																		
		10.0 - 15.0 ft						X	X		X	X	X	X	X	X	X																		
		15.0 - 20.0 ft						X	X		X	X	X	X	X	X	X													X					
Trip Blank																																		
Other Areas																																		
Shallow Borehole	1	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E					
Field Duplicate																						X	X	X	X		X	X	X	X				
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																		

Table 16.5-IX

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-011, NEW INDUSTRIAL WASTE TREATMENT PLANT.

Sampling Location	Interval	Sample Identification	Sample Type	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals		
	5.0 - 7.5 ft							X	X		X	X	X	X	X	X	X															
	7.5 - 10.0 ft							X	X		X	X	X	X	X	X	X															
2	0.0 - 2.5 ft							X	X		X	X	X	X	X	X	X	E				E	E	E	E		E	E	E	E			
	2.5 - 5.0 ft							X	X		X	X	X	X	X	X	X															
	5.0 - 7.5 ft							X	X		X	X	X	X	X	X	X															
	7.5 - 10.0 ft							X	X		X	X	X	X	X	X	X															
3	0.0 - 2.5 ft							X	X		X	X	X	X	X	X	X	E				E	E	E	E		E	E	E	E			
	2.5 - 5.0 ft							X	X		X	X	X	X	X	X	X															
	5.0 - 7.5 ft							X	X		X	X	X	X	X	X	X															
	7.5 - 10.0 ft							X	X		X	X	X	X	X	X	X															
4	0.0 - 2.5 ft							X	X		X	X	X	X	X	X	X	E				E	E	E	E		E	E	E	E			
Rinsate Blank																						X	X	X	X	X	X	X	X				
Field Blank																						X	X	X	X	X	X	X	X				
	2.5 - 5.0 ft							X	X		X	X	X	X	X	X	X															
	5.0 - 7.5 ft							X	X		X	X	X	X	X	X	X															
	7.5 - 10.0 ft							X	X		X	X	X	X	X	X	X															
Trip Blank																																	
5	0.0 - 2.5 ft							X	X		X	X	X	X	X	X	X	E				E	E	E	E		E	E	E	E			
	2.5 - 5.0 ft							X	X		X	X	X	X	X	X	X															
	5.0 - 7.5 ft							X	X		X	X	X	X	X	X	X															
	7.5 - 10.0 ft							X	X		X	X	X	X	X	X	X															
6	0.0 - 2.5 ft							X	X		X	X	X	X	X	X	X	E				E	E	E	E		E	E	E	E			
	2.5 - 5.0 ft							X	X		X	X	X	X	X	X	X															
	5.0 - 7.5 ft							X	X		X	X	X	X	X	X	X															
	7.5 - 10.0 ft							X	X		X	X	X	X	X	X	X															
7	0.0 - 2.5 ft							X	X		X	X	X	X	X	X	X	E				E	E	E	E		E	E	E	E			

Table 16.5-IX

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-011, NEW INDUSTRIAL WASTE TREATMENT PLANT.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture				Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X						E	E	E		E	E		E				
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X						E	E	E		E	X		X				
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X						E	E	E		E	X		X				
	8	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X						E	E	E		E	E		E				
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X						E	E	E		E	X		X				
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X						E	E	E		E	X		X				
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X						E	E	E		E	X		X				
Trip Blank															E	E	X						E	E	E		E	E	X	E				X
	9	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X						E	E	E		E	X		X				
Rinsate Blank															X	X	X						X	X	X		X	X	X	X				X
Field Blank															X	X	X						X	X	X		X	X	X	X				X
	0.0 - 5.0 ft							X	X		X	X	X	X	X	X	X						X	X	X		X	X	X	X				X
	2.5 - 5.0 ft							X	X		X	X	X	X	X	X	X						X	X	X		X	X	X	X				X
	7.5 - 10.0 ft							X	X		X	X	X	X	X	X	X						X	X	X		X	X	X	X				X
	10	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X						X	X	X		X	X	X	X				X
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X						X	X	X		X	X	X	X				X
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X						X	X	X		X	X	X	X				X
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X						X	X	X		X	X	X	X				X
Trip Blank															X	X	X						X	X	X		X	X	X	X				X

16.6 SWMU 21-017 Material Disposal Area (MDA) U

16.6.1 Site Description

Material Disposal Area U (MDA U) covers an area of 1,200 m^2 (0.2 acre) (Hansen 1980) and contains two absorption beds [SWMUs 21-017(a) and (b)] that were used for subsurface disposal of radioactively contaminated liquid wastes from 1948 to 1968 (Hakonson 1987; Hansen 1980). An associated sump, TA-21-164 [SWMU 21-017(c)], was located between the two beds. Figure 16.6-1 shows the location of MDA U at TA-21. A 1945 memo (Veltman 1945) described in some detail what are believed to be the design requirements for the MDA U absorption beds as follows:

> ... provision would be made to handle the so-called process sewage from Buildings 2, 3, 4, 5 and 52 in the following manner. A pit will be dug on the north side of the mesa approximately 6-ft deep and 10 x 50 ft in area for Building 52. A graded gravel bed will fill this pit with relatively large stones in the bottom and ordinary soil on top. This arrangement will allow satisfactory draining of process sewage.[1]

As constructed, the two absorption beds have a surface area of approximately 167 m^2 (1800 ft^2) with an estimated volume of about 510 m^3 (18000 ft^3). Figure 16.6-1 shows the absorption beds and Buildings 152 and 153. Process sewage was drained from these buildings to the absorption beds.

16.6.1.1 Site History

Historical records for MDA U are lacking. As a result, the amount of liquid wastes discharged to MDA U is unknown. However, the primary contaminant released was ^{210}Po (Christenson 1973). Records also indicated that about 2.5 Ci of ^{227}Ac were discharged into these beds in 1953 (Christenson 1973c).

There were early problems with the pits; they did not function properly, and it was reported that "the oil washing down from the precipitrons is lying on top of the ground. This [oil] is very definitely contaminated to a high degree (Drager 1946)."

MDA U became an inactive site in 1968 (Hakonson 1987). Site stabilization efforts began in 1985, with the pits remaining uncovered until that time and receiving some cooling water effluent

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[1]Buildings 52 and 53 were remembered to 152 and 153. This quote is referring to what is called building 52 in this Section.

until sometime after 1976 (Purtymun 1976). Site stabilization included the removal of an undocumented drain line. The drain line, apparently from the Tritium Systems Test Assembly (TSTA) cooling tower, drained into the west absorption bed (Mayfield 1985a). As part of the stabilization activities, a trench 20-ft wide, 100-ft long, and 4- to 13-ft deep was dug (presumably through the length of the beds), and soil contaminated with actinium was removed to MDA G (Hakonson 1987). Not all contaminated soil was removed because of lack of time and money. A plastic lining was placed in the trench to indicate the excavation boundary, and then the trench was filled with uncontaminated tuff. The excavated area was covered with 6 in. of top soil, and surface stabilization was conducted to remedy several drainage problems.

In 1987, additional site stabilization was completed (Salazar 1987). Stabilization included placement of ditches along the south fence of MDA U to prevent runon; topsoil, gravel mulch, and reseeding inside the fence; and placement of four brass markers at the corners of the site. In 1990, additional run-off collection drainage ditches were added to prevent run-off from the surrounding area from flowing across MDA U (Hakonson 1990).

16.6.1.2 Existing Information

16.6.1.2.1 Waste Discharge Information

Existing information on waste discharge is scant. It is known that the primary contaminant of waste discharged to the two beds was ^{210}Po (Christenson 1973c). Although the amount of ^{210}Po discharged is unknown, its half-life of 138.4 days indicates that it has decayed to undetectable levels. Christenson (1973) also stated that these beds received 2.5 Ci of ^{227}Ac in 1953. Actinium-227 came principally from the effluents of filter building 153, which scrubbed ^{227}Ac out of the air in several process buildings at TA-21 (Department of Energy 1979). Identification of other wastes at MDA U must come from sampling data.

A Purtymun (1976) memo stated that on December 18, 1975, water from a cooling process was being released into the west pit from a nearby building. At that time, there appeared to be permanent water in the west pit, although no overflow into the adjacent drainage was observed. A handwritten note on this memo stated "12/17/85 Purtymun states that liquid effluent used to run down into the canyon and pond in a swampy area there."

16.6.1.2.2 Historical Surface Sampling Data

A 1946 memo (Tribby 1946) reported results of analyses of various effluents for plutonium and polonium (Table 16.6-I). Data given therein for chemical sewer numbers 22 and 23, which drained into Los Alamos canyon after passing through MDA U, indicated contaminant levels that were released from MDA U, probably at higher concentrations than in the effluent. Assuming the units of disintegrations per minute per liter (dpm) imply that the measurements were calibrated properly, a conversion to pCi/L can be made, as given in Table 16.6-I. These range from 35 to 645 pCi/L of plutonium in the effluent.

In 1976, soil samples were taken outside of and within the pits, which were still uncovered at the time. These samples showed elevated gross alpha levels both inside and outside the fence (Purtymun 1976). The locations of the samples are given in Fig. 16.6-1 (LASL 1976a). Gross alpha values are given in Table 16.6-II. Purtymun recommended that "...consideration should be given to end release of water into the pits from near-by buildings."

Soil, tar, and vegetation samples were collected in 1980 (Mayfield 1985). The analytical results are given in Table 16.6-III. Three sampling locations were noted: U-1 at the west end of the west absorption bed, U-2 at the east end of the east absorption bed, and U-3 at the northeast corner just outside the fenced area (Fig. 16.6-1). The soil data show low-level plutonium contamination on the west absorption bed (e.g., 17.5 pCi/g) and ^{227}Ac daughters in the tar on the east absorption bed. The tar may have originated from oil from precipitrons (Drager 1946). Tritium was also observed in elevated concentrations (e.g., 37,000 pCi/L) in soil from the east absorption bed. Uranium concentration was highest on the west absorption bed (e.g., 26 µg/g). Tritium concentrations in vegetation from the absorption beds indicated low levels of contamination (e.g., 7,200 pCi/L). Gamma radiation levels ranged up to ten times background level on absorption bed surfaces (Mayfield 1985). The elevated levels appeared to be associated with the measured elevated levels of radioactive contaminants.

In 1984, soil samples were taken at 12 locations around MDA U; only one location was within the fence (Figs. 16.6-2 --16.6-4). Samples were collected at three depths (0-1 cm, 1-10 cm, and 10-30 cm). Samples were assayed for tritium, uranium, and $^{239/240}Pu$. Not all locations and depths were assayed for each radionuclide. The most complete data is for the 0-1-cm profile.

For the 0-1 cm profile, the maximum background levels for tritium, uranium, and $^{239/240}Pu$ were exceeded in 42, 83, and 100% of the samples, respectively. Figures 16.6-5 through 16.6-7 show the spatial prediction surfaces generated from the data at depth 0-1 cm for each of the radionu-

clides. These contours are for concentration levels above the maximum background levels. Because only 12 data points were available, the kriged contours have large uncertainties. However, the contour plots graphically illustrate that the tritium concentration was highest at the southeast end outside MDA U (Fig. 16.6-5) and that $^{239/240}Pu$ was highest inside MDA U and appears to migrate north (Fig. 16.6-6). The $^{239/240}Pu$ contours also indicate that plutonium may have migrated outside the fence to the north (Fig. 16.6-7).

Generally, for all three radionuclides, the contaminant levels present in the 0-1-cm depth were also present in the 1-10-cm depth. However, in the 10-30-cm-depth interval, $^{239/240}Pu$ contamination only exceeded maximum background levels in one sample. Uranium remained present at the same concentration as in the previous two depth intervals. No data were available for tritium for the 10-30-cm interval.

Tritium concentrations in vegetation (Fig. 16.6-8) ranged from 3,100 to 10,000 pCi/L, well above a background level of 800 pCi/L.

16.6.1.2.3 Historical Subsurface Sampling Data

The 1983 subsurface sampling study took samples from two holes outside of MDA U as shown in Fig. 16.6-3. At each location, samples were collected at 12 depths ranging from 0 to 16.2 m. The samples were assayed for tritium, uranium, and ^{137}Cs. The data for this study are reported in Table 16.6-IV. Tritium values in both holes at all depths exceeded the maximum background level. In the east hole, tritium levels were increasing with depth ranging from 19,000 pCi/l to 78,000 pCi/l (Fig. 16.6-9). In both holes, uranium values exceeded the maximum background level in over 80% of the values. Concentrations did not decrease with depth. All ^{137}Cs values were below the maximum background level.

16.6.1.2.4 Summary of Historical Data

Historical data suggest tritium, $^{239/240}Pu$, and uranium surface contamination extend beyond the MDA U fence; and tritium and uranium contamination exists to a depth of 16m in two holes just north of the MDA U fence. These conclusions are based on very little data with few locations sampled within the fenced area. The spatial and temporal resolution of the data does not adequately define source distribution; nor evidence of transport that may have occurred in the past. The source of the tritium contamination is not known, but it may be caused by the TSTA. The uranium "contamination" is very low-level and may actually be indicative of background in the tuff.

16.6.1.3 Source Term

Radioactively contaminated liquid waste was disposed of at MDA U from 1948 to 1968. Records on the volume and composition of the waste do not exist. It is only known that about 2.5 Ci of ^{227}Ac was added to MDA U in 1953 (Christenson 1973c). Actinium-contaminated soil was partially removed in 1985. Subsequent surface and subsurface sampling has found tritium, uranium, and plutonium contamination. The source concentration of these contaminants is unknown. Whether organics or metals were present in the waste stream to MDA U is unknown.

16.6.2 Objectives and Data Needs

The objective is to define the extent of source term migration and determine whether capping and stabilization-in-place is a possible remedial alternative at this site. Specific data required to assess MDA U include the following:

1. Identify the contaminants present using Level III/IV analyses. Several radionuclides have been found in surface and subsurface samples from MDA U. Whether organics or metals are present is unknown. However, the potential for contaminants other than radionuclides cannot be ruled out because oil washing down from precipitrons was observed in the absorption beds and tar was sampled in 1980.

2. Determine the lateral and vertical extent of contaminant migration by surface and subsurface soil sampling and analysis, both within and beyond the MDA U fence, using Level II screening and Level III/IV laboratory analyses. Subsurface radionuclide data to a depth of 16 m indicate low-level radioactive contamination and some vertical migration. Subsurface lateral migration is undefined. Existing surface sampling data indicate lateral migration or erosion effects beyond the MDA U fence. Additional surface sampling is required to define surface lateral migration. Therefore, drainages from MDA U need to be identified and sampled.

3. Determine the primary migration pathways through the evaluation of sample analysis results. The primary migration pathways are expected to be surface erosion and subsurface transport. Therefore, drainages from MDA U need to be identified and sampled, and vadose zone sampling is needed.

16.6.3 Sampling/Investigation rationale

No information is available on surface contamination because MDA U underwent site stabilization in 1987. Surface sampling data on a 10- by 10-m grid within MDA U and extending outside MDA U to the canyon rim will be analyzed in conjunction with the TA-21 OU surface-sampling done on a 40- by 40-m grid (see Chapters 12 and 13). This data will be augmented by the detailed

drainage data as described in Sec. 16.1.4.

As discussed in Sec. 16.1.5, because MDA U was a liquid disposal area, both vertical boreholes to define the source term and its depth and angle boreholes to define the lateral and vertical extent of contamination will be drilled. Because all contaminant species in MDA U cannot be identified at this time, a full analytical suite will be specified for surface and subsurface samples.

Dependent upon results of initial sampling, the sampling program may need to be expanded to include a larger area. In these additional investigations, the analytical suite will be focused to specific contaminants identified in the initial sampling.

16.6.4 Sampling Plan

Detailed tables have been prepared to identify the sample screening and analysis requirements for each planned investigation planned at MDA U. However, due to the large number of pages these tables have been placed in Section F.6 of Appendix F, Analytical Tables.

16.6.4.1 Surface Sampling Plan

In 1987, MDA U underwent site stabilization activities, which have been discussed in Sec. 16.6.1.1. Because MDA U was covered with top soil and graded inside the fence, the previous surface data are no longer appropriate but represent a layer beneath the surface. The data collected here should help determine the effectiveness of this stabilization activity and give insight into erosion patterns.

16.6.4.1.1 Initial Investigation

The MDA U sampling plan will be sequential. The initial investigation will consist of 40 samples from a 10-m by 10-m grid over the entire MDA and extending to the DP canyon edge. The sampling will be coordinated with the OU-wide surface sampling plan. (Fig. 16.6-10). Radioactive survey instruments will be used within the gridded area to confirm that no areas of elevated radioactivity are present between grid points. If such areas are detected, up to 10 samples to further characterize the extent of contamination will be collected. These sample data will be combined with the drainage data (Sec. 16.1.4) and the data from the TA-21 OU surface sampling (Chapters 12 and 13) in the vicinity of MDA U to develop spatial prediction surfaces such as those described for the 1984 data (Figs. 16.6-5 to 16.6-7).

Five sample locations within the MDA and five off the MDA will be sampled at 3 m from the grid locations to allow an assessment of spatial variability.

All samples will be analyzed in an analytical laboratory for radionuclides, metals, and semivolatiles. The screening and analysis requirements are identified in Table F.6-I (see Appendix F).

16.6.4.1.2 Subsequent Investigation

Any need for additional sampling and the identification of the numbers and locations of additional samples will be dictated by the results of the initial investigation and the accuracy requirements for the prediction surfaces.

For planning purposes, it is assumed that 20 surface samples on either a 10- by 10-m or 5- by 5-m grid, as appropriate, surrounding MDA U will be required in the subsequent investigation. A reduced analytical suite, determined by analyzing the results from the initial investigation will be used. Table F.6-II (see Appendix F) gives the assumed screening and analysis requirements for the subsequent investigations.

16.6.4.2 Subsurface Sampling Plan

The characterization targets at MDA U are the two former liquid waste absorption beds. Both absorption beds were largely excavated in 1985, and the contaminated soil was removed to MDA G. Excavation was terminated before the absorption beds could be completely removed, and the area of excavation was lined with plastic before being covered with uncontaminated soil.

16.6.4.2.1 Initial Investigation

The subsurface investigation will focus on source term characterization, determining the vertical extent of contamination, and identifying transport pathways beneath the absorption beds. Four vertical drill holes with nominal depths of 50 ft are sited in the absorption beds. Each absorption bed will be initially characterized by two drill holes located at the extreme eastern and western ends of the beds. The number and placement of these source-term holes may be modified based on the results of the source term holes into absorption beds at MDA V that will be drilled prior to the holes at MDA U.

A full suite of analyses in an analytical laboratory will be conducted on all core samples. The screening and analysis requirements are presented in Table Table F.6-III (see Appendix F).

Samples for both contaminant characterization and soil moisture determination will be collected at 5-ft intervals along the length of the drill holes. The nominal depth for each drill hole is 50 ft. The borehole stopping criteria in Sec 11.5.3 will be applied to all boreholes, and the field laboratory will be used to make these determinations. One vertical hole will be extended 50 ft below the contamination plume to determine whether the liquid waste infiltration beneath MDA U altered rock properties. Samples will be analyzed at 10-ft intervals in this 50-ft extension for geochemical parameters and mineralogy (Table F.6-IV, see Appendix F).

An objective of this investigation is to evaluate the importance of fractures as potential preferential transport pathways. When fractures are encountered, they will be preferentially sampled. When a fracture is encountered over a 5-ft-sampling interval, two samples will be taken from that sampling interval to allow a comparison of analytical results for fracture and nonfracture intervals. This sampling is included in Table F.6-III (see Appendix F).

Geochemical parameters and mineralogy will be characterized in all initial investigation boreholes on 20-ft intervals of core and on additional contaminant zones to define the geochemical parameters associated with particular contaminants. For planning purposes, it is assumed that 20% additional sampling within contaminant zones will be needed to define mineralogical and geochemical control on contaminants. Geochemical analysis is summarized by borehole in Table F.6-IV (see Appendix F).

One 300-ft borehole will be drilled at MDA U (see Fig. 16.6-VI) for geohydrological parameter characterization and geophysical logging as detailed in Sec. 12.5.1.

16.6.4.2.2 Subsequent Investigation

Six additional drill holes are tentatively identified for subsequent investigation (Fig. 16.6-11). Four of these holes will be inclined 15 to 20° from horizontal and two holes will be vertical (Figs. 16.6-11 and 16.6-12). The four inclined drill holes will be used to define the extent of the contaminant plumes and to further characterize contaminant pathways adjacent to and beneath the absorption beds. The inclination and orientation of these drill holes will be modified, if necessary, to take into account the data gathered during initial drilling. The two vertical holes, located on the canyon slope north of the site, will be drilled to determine if contaminants are moving laterally northward towards DP Canyon.

Samples from subsequent investigation holes will be collected at 5-ft intervals. The analytical suite will be reduced in scope, as appropriate, based on initial investigation analytical results.

However, for planning purposes, it is assumed that a full analytical suite will be used. Table F.6-V (see Appendix F) gives the assumed screening and analysis requirements for the subsequent investigations.

Depending on results of hydrogeological parameter determinations in both the planned OU-wide 300-ft vertical boreholes and the MDA U initial investigation 300-ft vertical borehole, an additional 300-ft borehole for hydrogeological parameter determination may be drilled. If so, analyses detailed in Sec. 12.5.2 would be conducted.

The necessity for additional subsequent investigation for characterization will be determined after results from the initial and subsequent drilling are evaluated. Surface geophysics will be used to locate the buried solid waste disposal pits if the results indicate a need for more detailed source term characterization. Placement of additional drill holes will be based on results from the surface geophysics and all earlier drill holes.

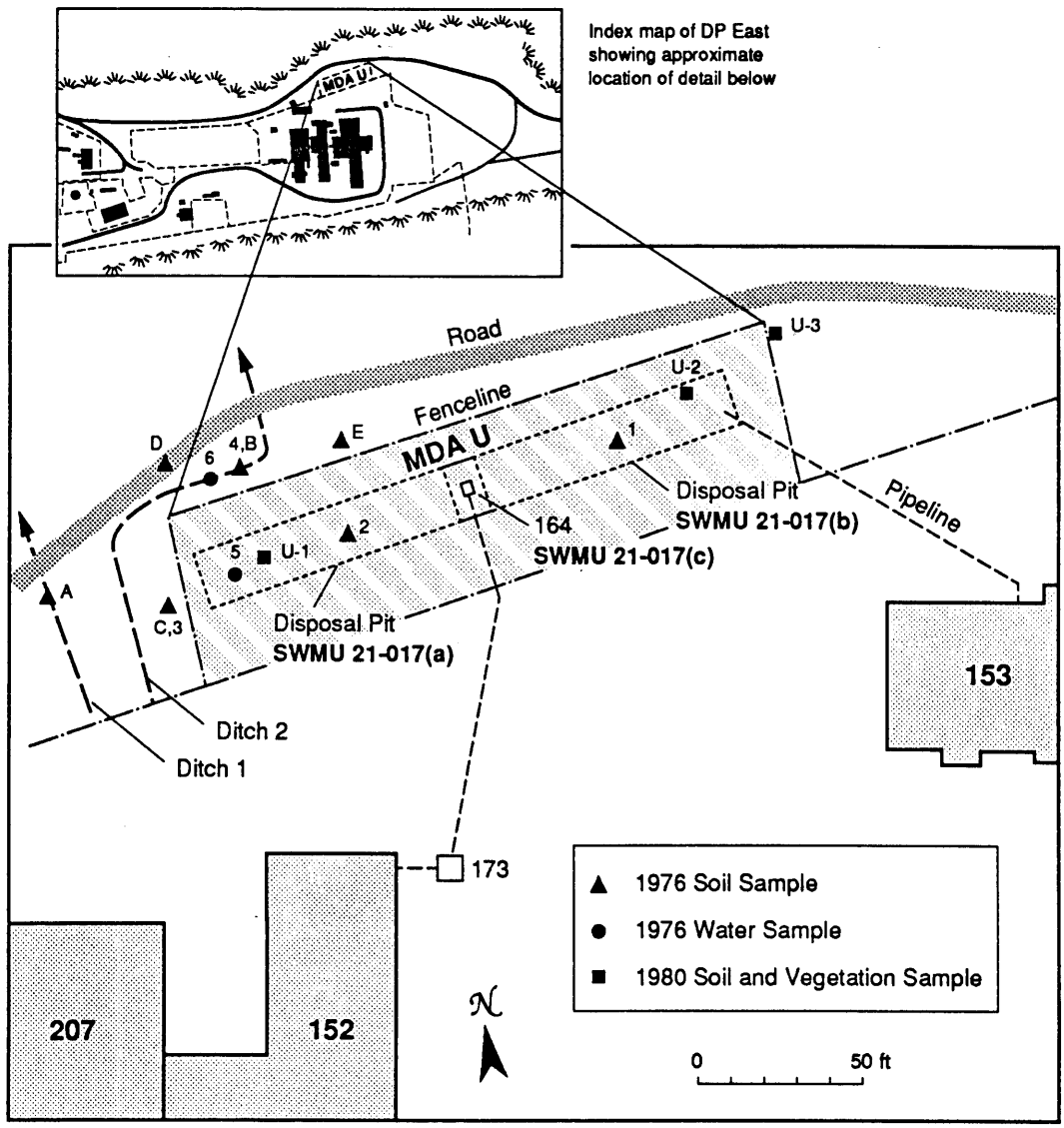


Fig. 16.6-1 Soil, water, and vegetation samples taken at MDA U in 1976 and 1980. (LASL 1976a)

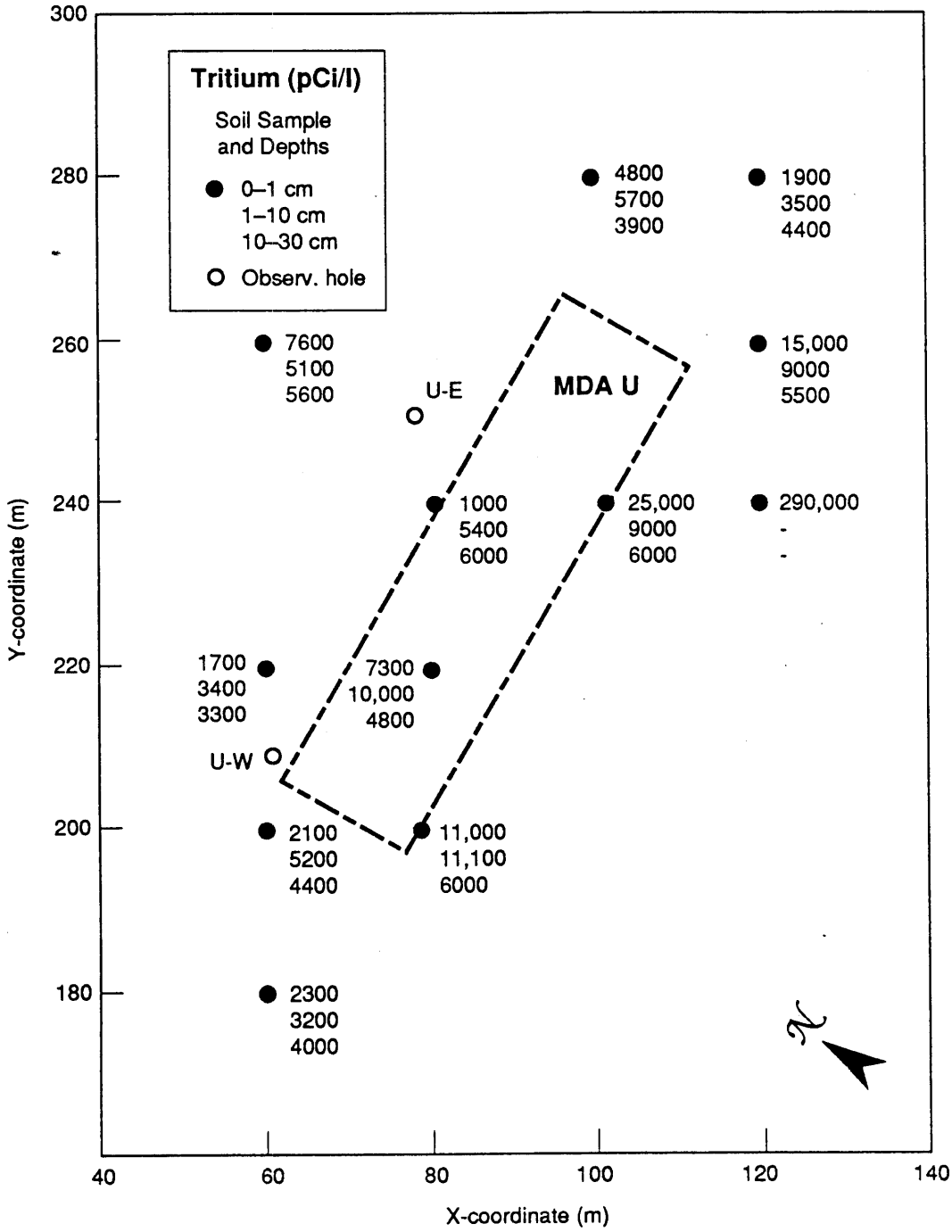


Fig. 16.6-2 1984 MDA U tritium data for soils (pCi/l).

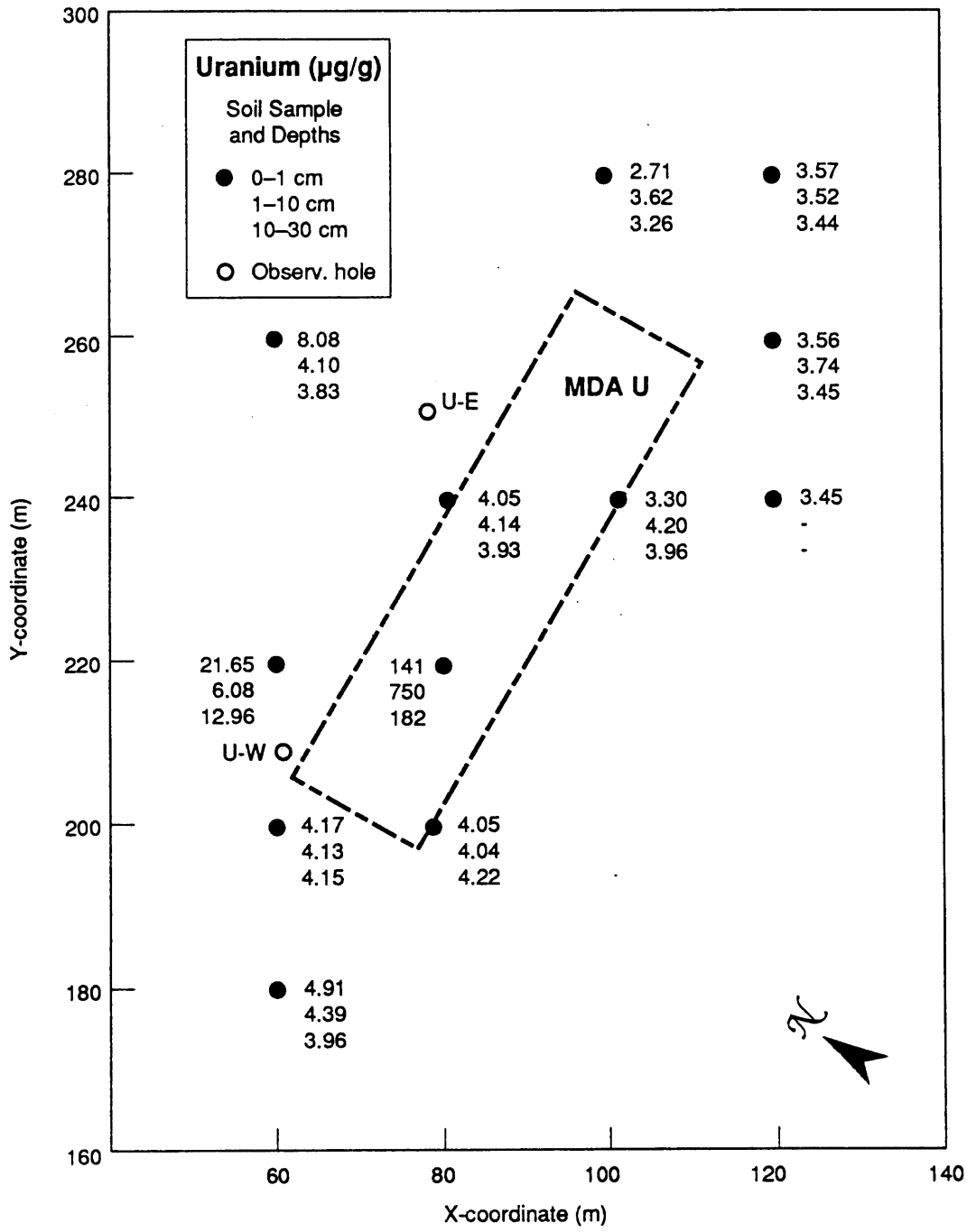


Fig. 16.6-3 1984 MDA U uranium data for soils (µg/g).

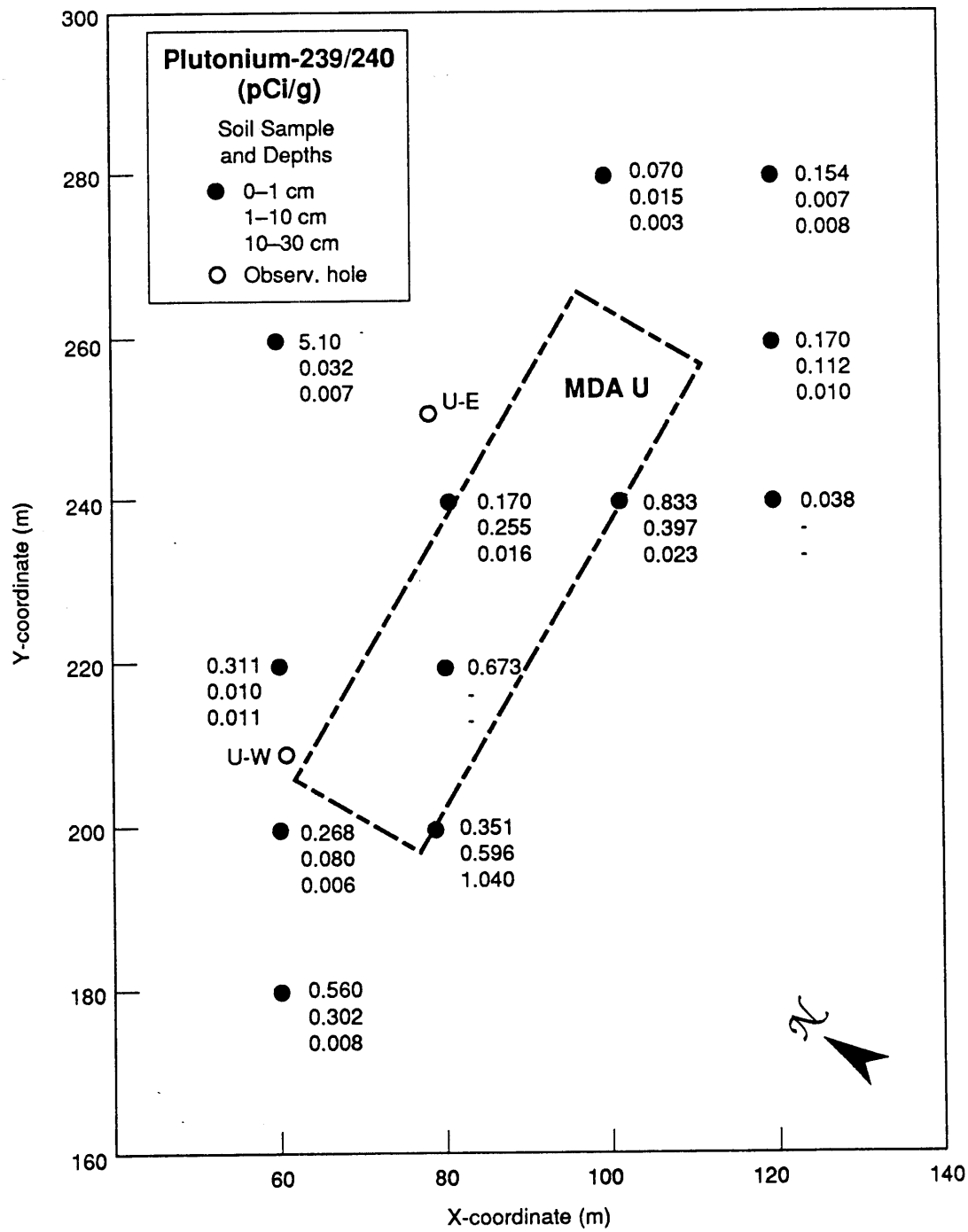


Fig. 16.6-4 1984 MDA U plutonium-239/240 data for soils (pCi/g).

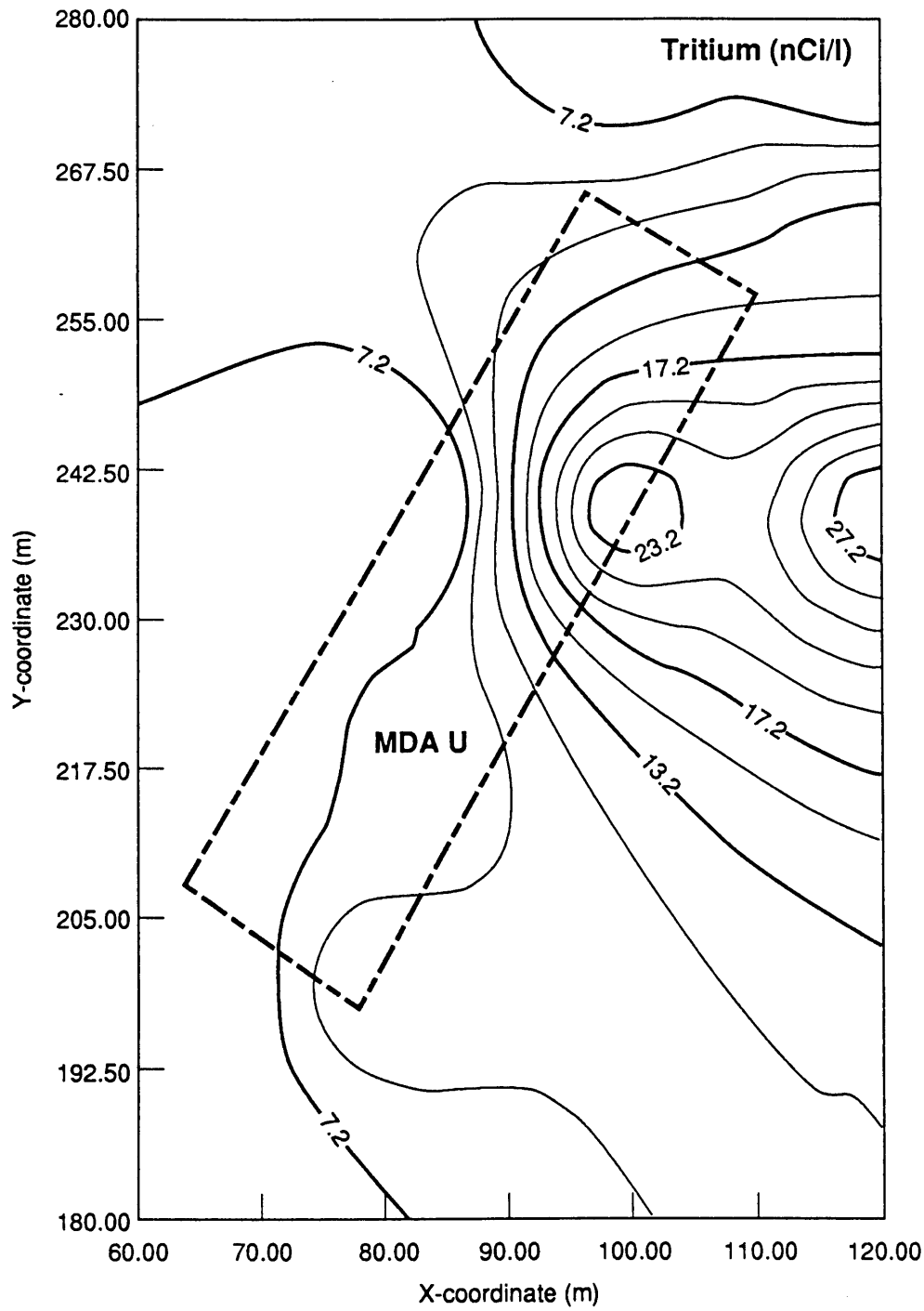


Fig. 16.6-5 Concentration contours for tritium from the 1984 surface soil samples on MDA U.

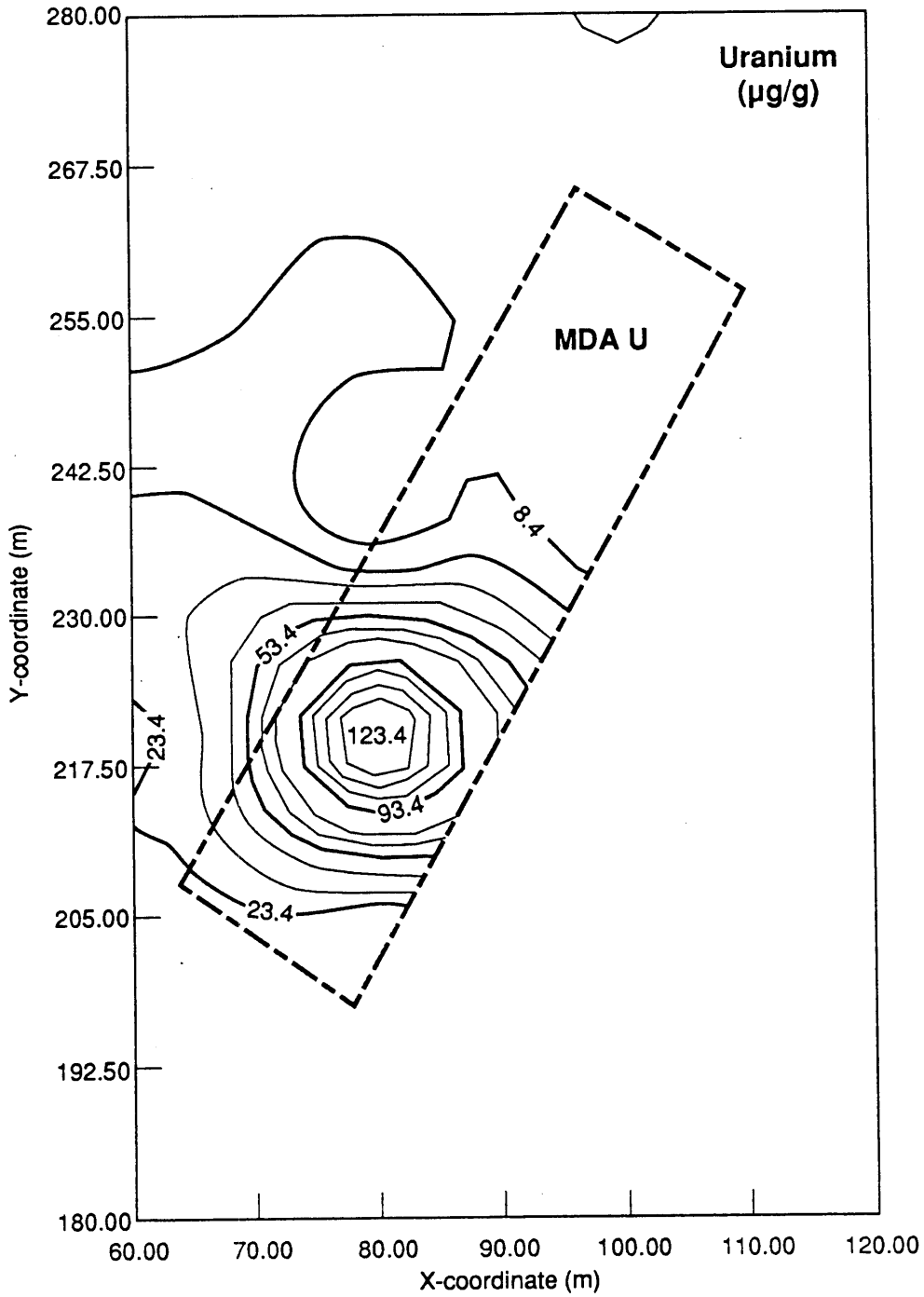


Fig. 16.6-6 Concentration contours for uranium from the 1984 surface soil samples on MDA U.

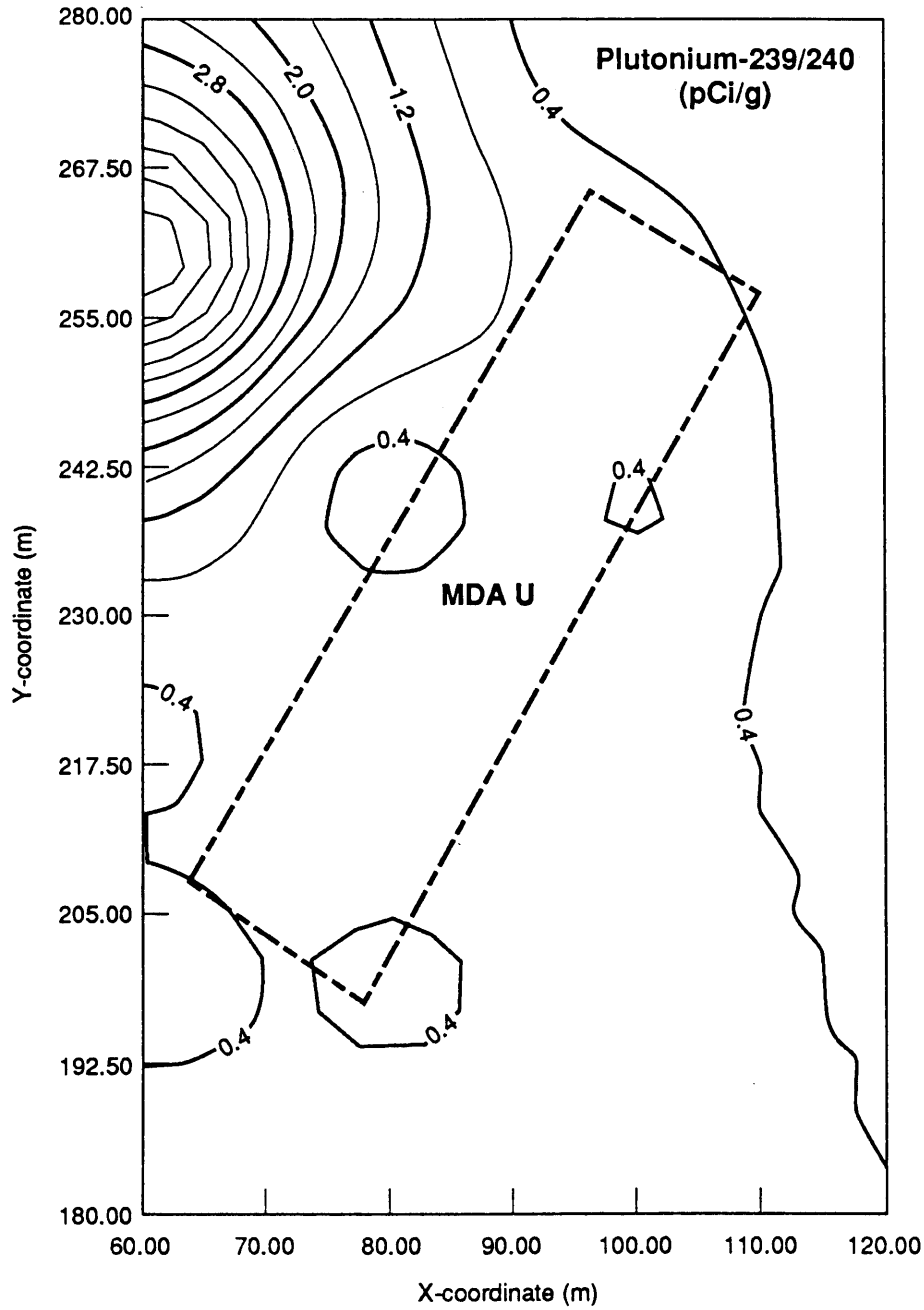


Fig. 16.6-7 Concentration contours for plutonium-239/240 from the 1984 surface soil samples on MDA U.

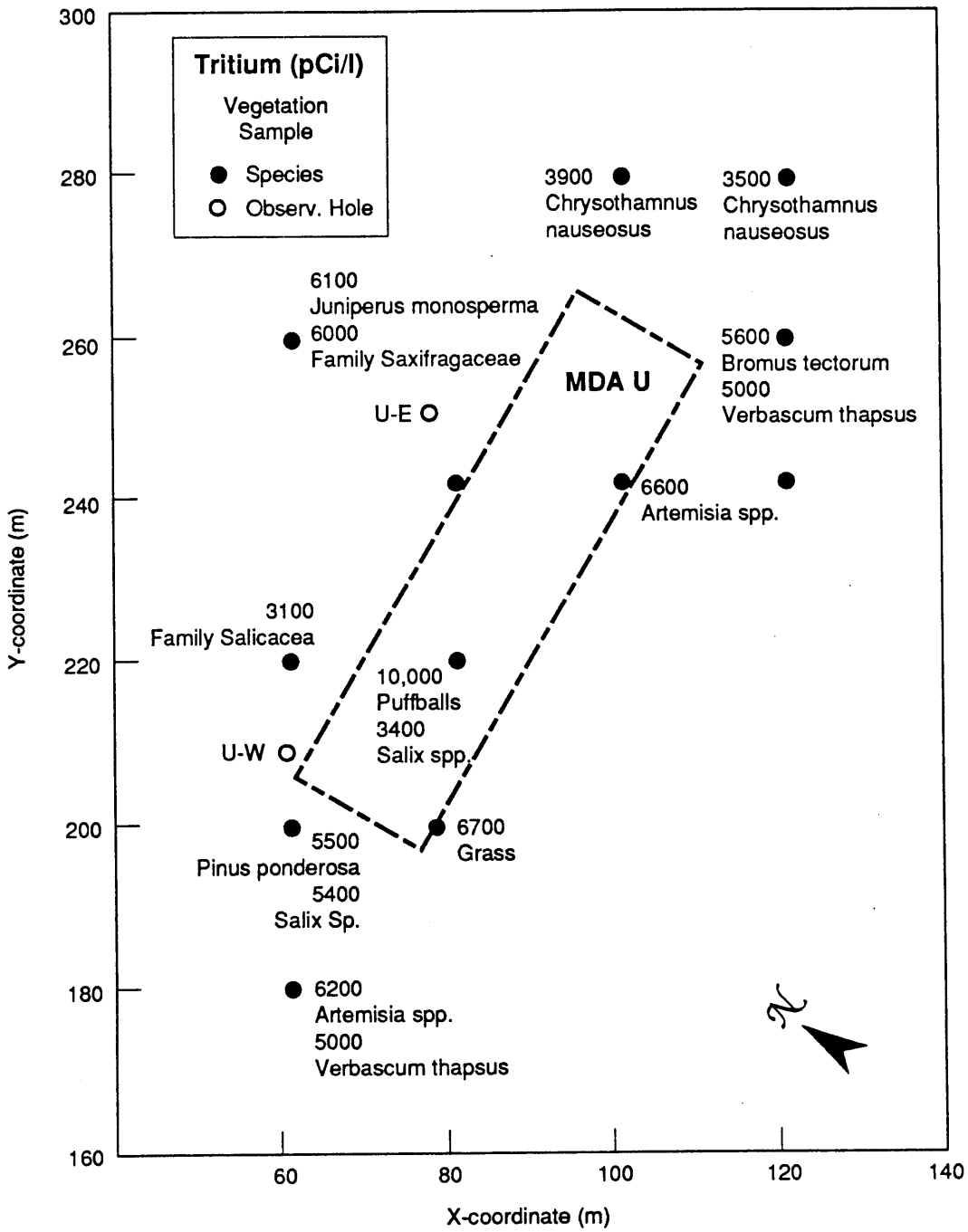


Fig. 16.6-8 1984 MDA U tritium data for vegetation (pCi/l).

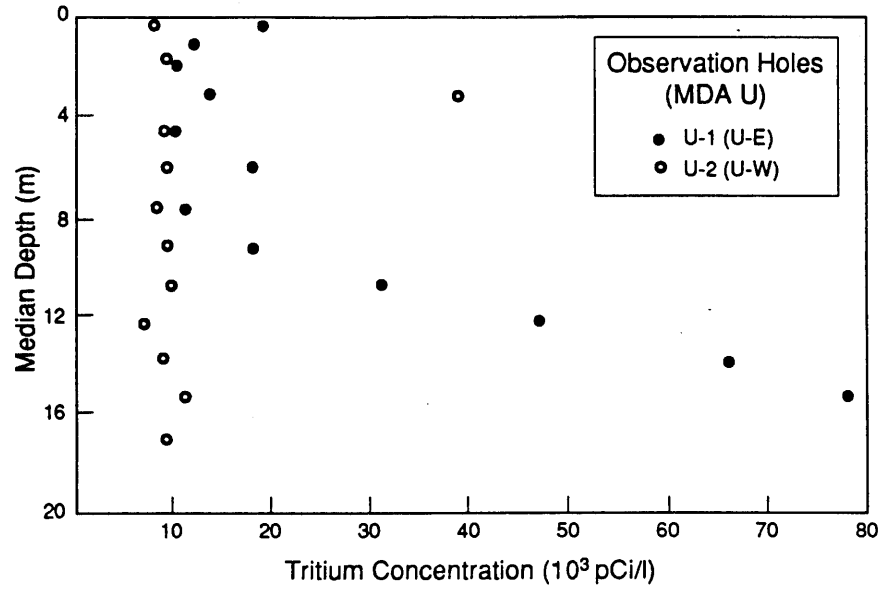


Fig. 16.6-9 1983 MDA U tritium data

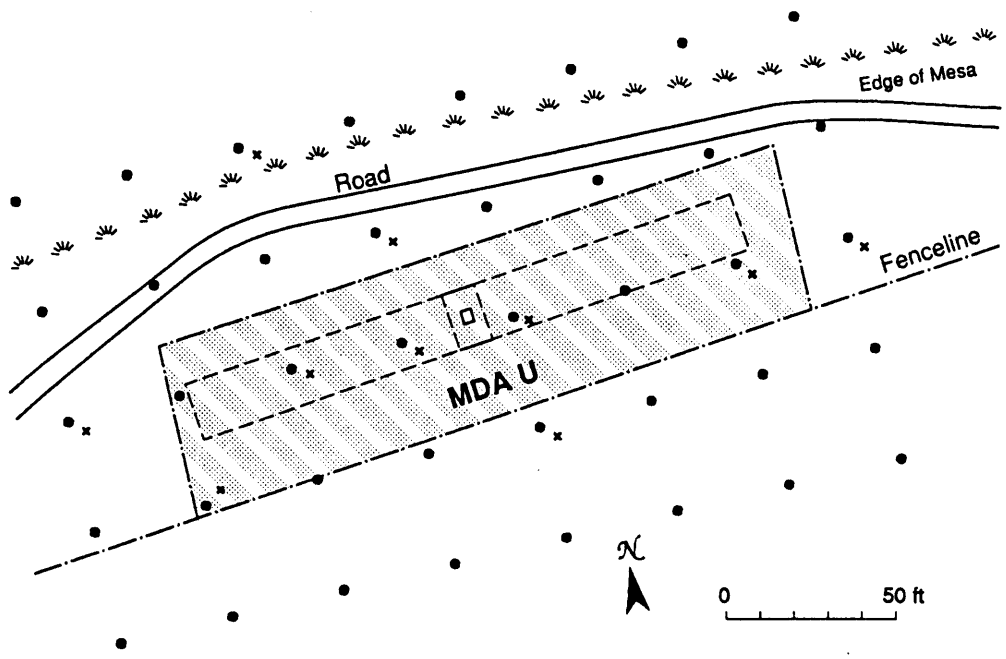


Fig. 16.6-10 Ten-meter by ten-meter surface sampling grid for MDA U. The x's indicate possible replicate samples.

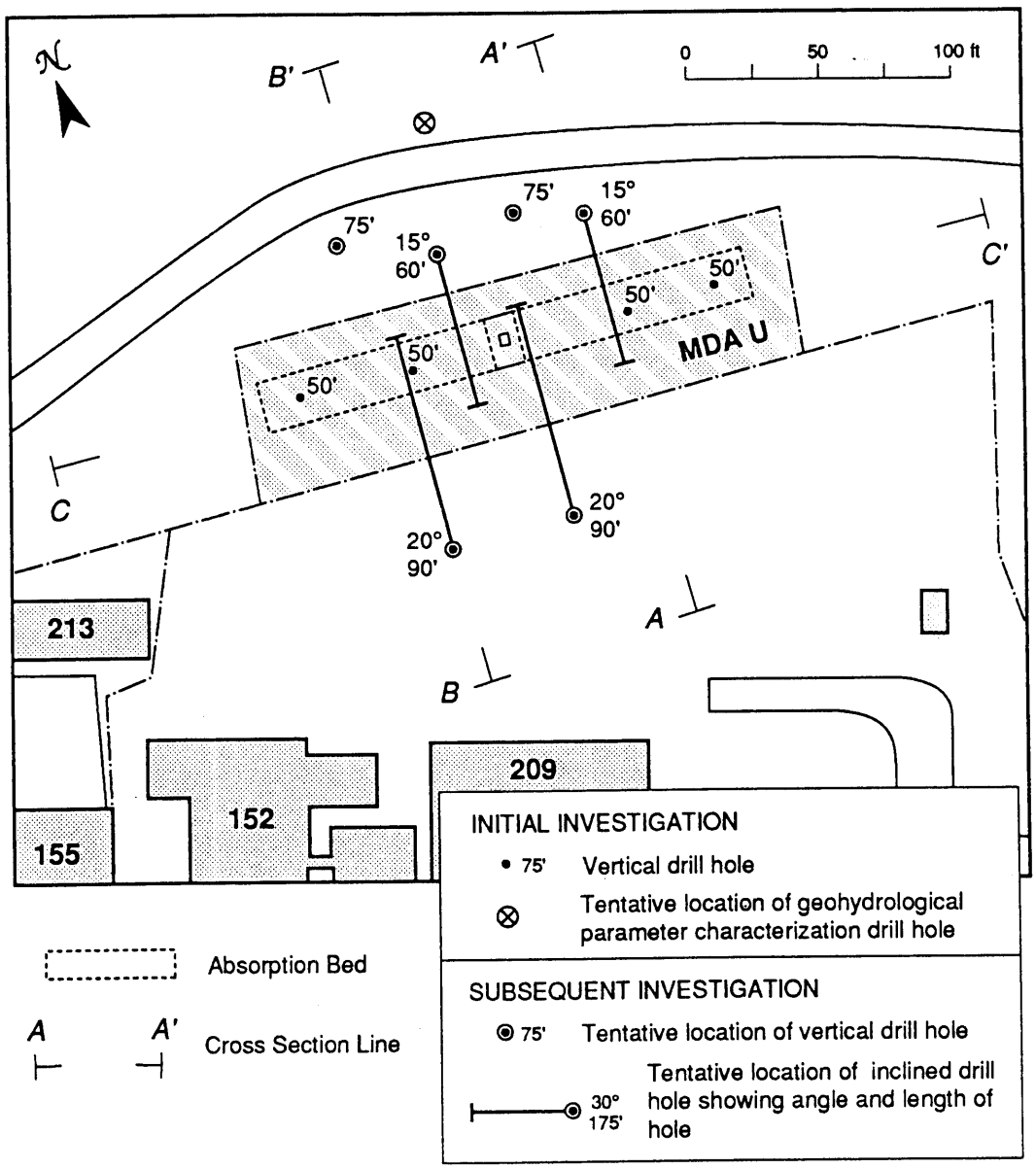


Fig. 16.6-11 Approximate location of excavated absorption beds and initial and subsequent investigation drill holes at MDA U.

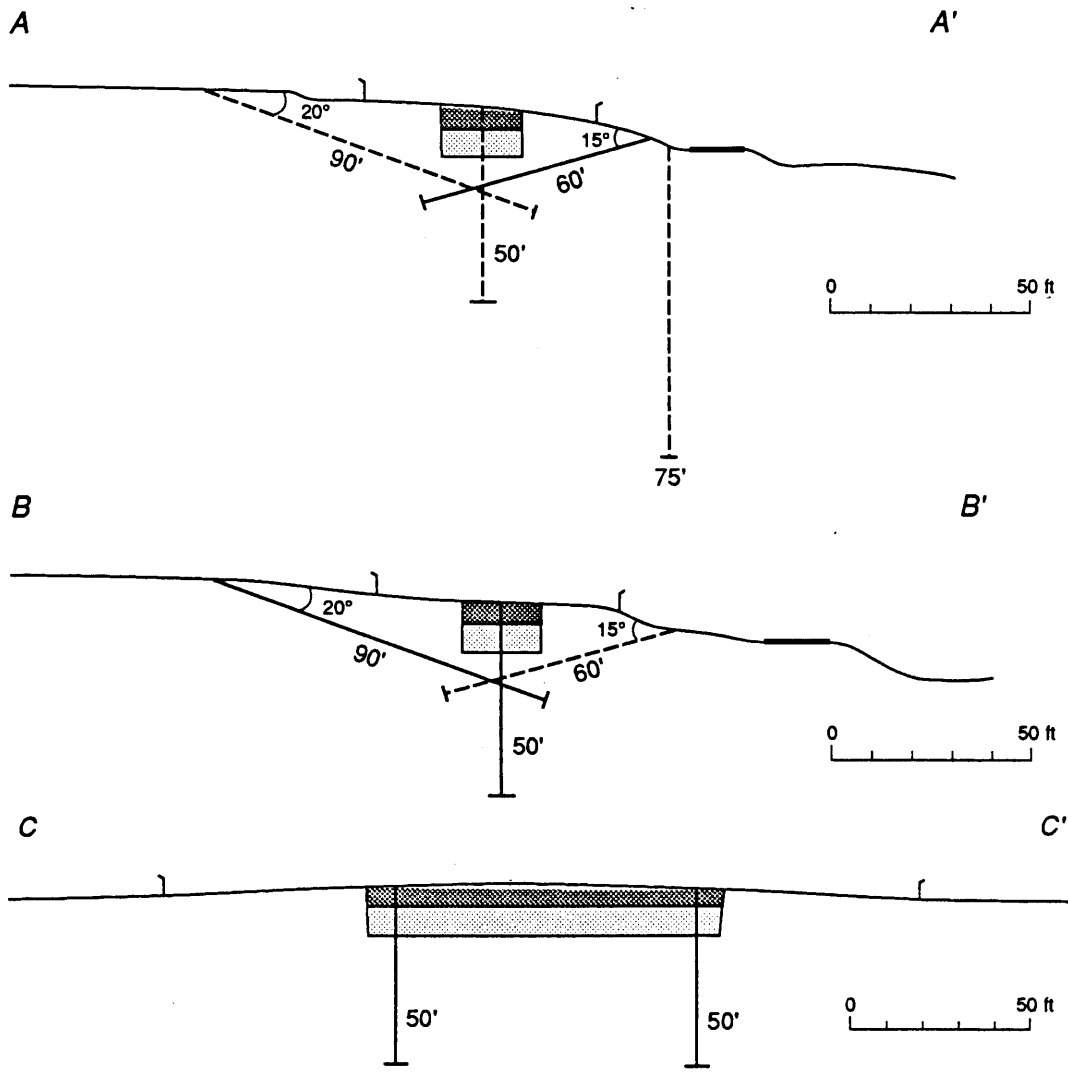


Fig. 16.6-12 Cross sections for MDA U showing appoximate location of excavated absorption beds and of initial and subsequent investigation drill holes. Drill holes outside the plane of the section are dashed.

TABLE 16.6-I
PLUTONIUM AND POLONIUM CONCENTRATION FROM VARIOUS EFFLUENTS AT TA-21

Sewer Number	Exits of drain into canyon	Source of sewage	Vol of fluid (liters)	Po (pCi/L)	Pu (pCi/L)
#22 chemical	Into LA Canyon after passing through seepage pits north of Bldg. 153, DP East	Bldg. 153 Filter House	2	21,200	645
#23 chemical	West end of #22	Floor drain in Bldg. 152, DP East	2	109	36

TABLE 16.6-II
1976 ANALYTICAL RESULTS FOR GROSS ALPHA AT MDA U
(SEE FIG.16.6-1 FOR SAMPLE LOCATIONS)

Group H-7 Analysis (12-12-75)

Location	Description	Gross Alpha[a] (d/m/g)	Gross Alpha[c] (pCi/g)
1	Soil 0 - 2" (East Pit)	7360	3345
1	Soil 2 - 4" (East Pit)	730	331
2	Muck Surface (West Pit)	1990	904
3	Soil Surface (Outside Fence)	12.5	6
4	Soil Surface (Drain 2)	7.4	3
5	Water (West Pit)	40	18
6	Water (Drain 2)	148	67

Group H-8 Soil Analyses (12-22-75)

Location	Description	Gross Alpha[b] (d/m/g)	Gross Alpha[c] (pCi/g)
A	Surface (Drain 1)	<44	<20
B	Surface (Same H-7 Loc. 4)	120	55
C	Surface (Same H-7 Loc. 3)	<44	<20
D	Surface (Composite Road)	<44	<20
E	Surface (Slope)	<44	<20

[a]Acid Leach
[b]Direct soil counting with a ZnS gross alpha detection system.
[c]Assuming original measurements were properly calibrated to d/m/g.

TABLE 16.6-III
SELECTED RADIONUCLIDE ANALYSES FOR 1980 SOIL AND VEGETATION SAMPLES

Location BKGD[c]	Depth (cm)	Tritium (pCi/L[a]) 7200[c]	Soil Total U (µg/g[b]) 3.4c	$^{239/240}Pu$ (pCi/g[b]) 0.023[c]	Gamma Spectra
U-1	0-1	2700 ± 400	26.1±2.6	tracer swamped	Total U is high enriched with ^{235}U
	1-10	3900 ± 400	25.6±2.6	17.5±0.3	
	10-30	3800 ± 400	10.9±1.1	2.2±0.0	
U-2	0-1	37200 ± 800	7.0±0.7	2.4±0.1	^{227}Ac daughters in great abundance
	1-10	11800 ± 500	6.3±0.6	2.2±0.1	
	10-30	27300 ± 700	4.3±0.5	0.1±0.0	
U-3	0-1	10600 ± 500	4.7±0.5	1.6±0.0	Normal
	1-10	6500 ± 500	4.4±0.5	2.5±0.1	Normal
	10-30	5400 ± 500	4.5±0.5	2.0±0.1	Normal

[a]liter of soil moisture
[b]gram of soil
cUpper limit background levels from Purtymun (1987).

Location BKGD+	Species	Vegetation Tritium (pCi/L[d]) 800+	$^{239/240}Pu$ (pCi/g[e]) .00023[f]
U-1	Salix sp. (willow)	7200 ± 400	0.8±0.1
U-2	Pinus pon. (ponderosa)	5800 ± 300	0.6±0.0
	Bromus tec. (downychess)	-9800 ± 1300	1.1±0.1
U-3	Guttierezia s. (snakeweed)	3300 ± 300	0.2±0.0
	Bromus tec. (downy chess)	-800 ± 300	2.3±0.1
	Artemesia car. (wormwood)	300 ± 300	1.8±0.0

[d]liter of tissue moisture
[e]gram of ash
[f]Upper limit background levels from The Environmental Surveillance Group (1987).

TABLE 16.6-IV
1983 VERTICAL DISTRIBUTION OF SELECTED RADIONUCLIDES IN TEST HOLES NORTH OF MDA U

Test Hole U-E				Test Hole U-W			
Depth (m)	Tritium (pCi/L)	Total U (µg/g)	^{137}Cs (pCi/g)	Depth (m)	Tritium (pCi/L)	Total U (µCi/g)	^{137}Cs (pCi/g)
BKGD[a]	7200[a]	3.40[a]	1.09[a]		7200[a]	3.40[a]	1.09[a]
0–0.9	19000±2000	3.79±0.18	0.18±0.07	0–0.9	7800±800	4.75±0.18	0.16±0.07
0.9–1.5	11700±1200	3.76±0.18	0.10±0.04	0.9–2.4	9200±1000	3.88±0.18	0.01±0.04
1.5–2.4	10100±1000	3.46±0.18	0.09±0.04	2.4–4.0	39000±4000	3.70±0.18	0.02±0.07
2.4–4.0	13500±1400	3.75±0.18	0.03±0.03	4.0–5.5	9000±900	3.80±0.18	0.07±0.03
4.0–5.5	10200±1000	3.49±0.18	0.08±0.04	5.5–7.0	9300±1000	3.63±0.18	0.06±0.05
5.5–7.0	17700±1800	3.65±0.18	0.06±0.05	7.0–8.5	8300±900	3.27±0.18	0.10±0.05
7.0–8.5	11100±1100	3.19±0.18	0.04±0.07	8.5–10.1	9600±1000	3.70±0.18	0.02±0.04
8.5–10.1	18100±1800	3.09±0.18	0.02±0.03	10.1–11.6	9300±1000	3.52±0.18	0.06±0.03
10.1–11.6	31000±3000	3.75±0.18	0.06±0.03	11.6–13.1	7100±700	3.51±0.18	0.08±0.04
11.6–13.1	47000±5000	3.41±0.18	0.06±0.03	13.1–14.6	8900±900	3.55±0.18	0.16±0.06
13.1–14.6	66000±7000	3.67±0.18	0.08±0.04	14.6–16.2	11400±1200	3.51±0.18	0.04±0.03
14.6–16.2	78000±8000	3.48±0.18	0.09±0.05	16.2–17.6	8900±900	3.11±0.18	0.04±0.03

[a]Upper limit background levels from Purtymun (1987).

16.7 SWMU 21-018 Material Disposal Area (MDA) V

16.7.1 Site Description

Material Disposal Area V [SWMU 21-018(a)] is a 3561-m^2 (0.88-acre) site containing three absorption beds that occupy 1390 m^2 (15,000 ft^2) and a volume of 4250 m^3 (150,000 ft^3) (Walker et al. 1981). Figure 16.7-1 shows MDA V's location on the north side of a tributary to Los Alamos Canyon and details the layout of the three absorption beds. The absorption beds were used for liquid waste disposal from a laundry operation at Building 20 [SWMU 21-018(b)] and were in continuous use from October 1945 to 1961.

16.7.1.1 Site History

An early memo (Veltman 1945) documented that the layout of MDA V (presumed to be the engineering drawings) was completed in early 1945. This memo stated that three 7.6- by 61-m (25 by 200 ft) pits were located on the south side of the laundry, immediately adjacent to Los Alamos Canyon. The first pit was to act as a "grease sump," whereas the second and third were to receive "ordinary seepage." The pits were designed on a "conservative 1/2 gal. per square foot per day" (20.37 $L/m^2/d$) percolation rate. The latter statement probably meant that the pits and underlying tuff were expected to absorb in excess of 1/2 gal. effluent/ft^2/day. More recent estimates of the saturated conductivity of the tuff underlying the pits indicate about one-fourth of the original design rate (Abeele et al. 1981). Therefore, the pits may have been underdesigned for the volumes of liquid wastes expected.

In Abrahams (1962), further details about the site suggested that the pits were 244-cm (8 ft) deep and were dug adjacent to a small tributary canyon feeding Los Alamos Canyon. The pits were filled with 152-183 cm (5 to 6 ft) of large gravel with layers of small gravel, soil, and tuff above. The capacity of each pit was estimated as 227,100 L (60,000 gal.).

Abrahams (1962) also estimated that the average discharge of laundry waste to MDA V between October 1945 to 1961 was 22,710 to 30,280 L (6,000-8,000 gal.) per day, 7.57 million L per year (2 million gal. per year), or about 151.4 million L (40 million gal.) over the use history. Other unaveraged estimates of flow, based on data from 1951 to 1952, ranged from 1,514 to 83,270 L/d (400 to 22,000 gal./d) (Tribby 1946). All of the discharge was into pit 1, which overflowed into pit 2 and then pit 3. The volume of water reaching pits 2 and 3 is unknown, but relatively little is thought to have reached pit 3 (Abrahams 1962). Only one reference to effluent overflow into pit 3 appears in the archives (Drager 1946).

A pond, which contained emergent aquatic vegetation (cattails, rushes), formed on pit 1 in the early 1950s. There are several possible explanations for this pond: the overflow pipe may have clogged; permeability to downward flow may have decreased; and/or the initial design specifications on percolation rates into the tuff may have been overly optimistic (Abrahams 1962). Other studies (Drager 1946) reported that the pits did not perform as expected. For example, "a large amount of contaminated water was lying above the ground in the pits." This observation would be consistent with the overestimation of seepage rates used in designing the pits.

Liquid waste disposal to MDA V ceased in 1961, and the facility was placed on standby until September 1963 (Property Group Office 1962). It is unknown when a soil cover was first placed over the absorption beds. However, in 1985, a soil cover was placed on the site to repair erosion damage (Hakonson 1987).

MDA V is currently maintained under the Environmental Surveillance Group's low-level radioactive waste management program for MDAs. The site is fenced and is inspected annually to identify and remedy maintenance problems.

16.7.1.2 Existing Information

16.7.1.2.1 Waste Discharge Information

The following data were taken from a variety of sources predating 1980. The data are highly qualitative and are presented here to identify radionuclides present in the waste.

Periodic grab sampling for contaminants in the pits dates back to 1946 when Tribby (1946) reported plutonium and polonium concentrations in pit water of 460 dpm/L (207 pCi/L) and 2,000 dpm/L (909 pCi/L) respectively. In 1954, Hermann reported that MDA V soils contained 26,000 dpm Pu/g (11,712 pCi/g Pu/g) dry soil at the surface to 120 dpm Pu/g (54 pCi/g Pu/g) dry soil at a depth of 135 cm (53 in.). The exact location of the Hermann samples is not known.

In a memo by Mead and Newell (no date), the laundry effluent was reported to average 1,500 cpm/L gross alpha (primarily plutonium), 750 ppm total solids, and have a biological oxygen demand (BOD) of 500 ppm. The memo also stated that no synthetic detergents were used in the laundering operation at that (unspecified) time.

Beginning in 1955, daily laundry effluent samples were composited each week and analyzed for selected radionuclides. Based on an analysis of that data, Abrahams (1962) estimated that plutonium accounted for 1/3 to 1/2 of the gross alpha activity, whereas strontium accounted for 1/

10 to 1/25 of the gross beta activity. Further analysis by Christenson (1973c) indicated that 0.0035 Ci/y Pu (mostly $^{239/240}Pu$) was added to the pits from 1952 to 1961 (0.0315 Ci during those 9 years). Christenson (1973c) estimated ^{90}Sr additions of 0.002 Ci/y from 1945 to 1961 (or 0.034 Ci total). He reported that about 3 Ci of ^{89}Sr, ^{140}Ba and ^{140}La were also added to MDA V from 1945 to 1961, but because of their short half-lives (less than 50 days), they will not be detectable in present samples from the site.

16.7.1.2.2 Historical Surface Sampling Data

In 1980, surveillance activities were initiated to characterize the distribution of radionuclides within the near-surface environment of MDA V and particularly within 0.5 m of the ground surface. A chronological history of surveillance activities at MDA V is summarized in Table 16.7-I. These data range from low-resolution, qualitative field instrument surveys to higher-resolution quantitative soil and vegetation sampling. Some of these data collection efforts were poorly documented, and only incomplete data sets are available from sampling activities in the early 1980s.

A summary of radiochemical analytical data on soils and vegetation samples collected from 1982 to 1984 are given in Tables 16.7-II and 16.7-III. In 1982 soil samples were collected at locations V-1, V-2, and V-3 (Fig. 16.7-1). In 1984, samples were taken at 16 locations on what appears to be a 20- by 20-m grid. Unfortunately, the information is not available to place the grid locations on the site. In all cases, samples were collected at three depths; 0-1 cm, 1-10 cm, and 10-30 cm. In 1982, soil samples were analyzed for tritium, uranium, ^{238}Pu, and $^{239/240}Pu$, and in 1984, for tritium, uranium, and $^{239/240}Pu$.

The 1982 soils data show that concentrations of all radionuclides for which samples were analyzed (i.e., tritium, U, ^{238}Pu, $^{239/240}Pu$) were elevated above the maximum background level in over 80% of the samples. The 1984 data show tritium levels within the background level range for all samples except four at the 10-cm to 30-cm depth. The levels for these four samples range from 10,000 pCi/L to 22,000 pCi/L. Uranium levels are reported for only one depth (depth not specified) and are generally above background, ranging from 4.5 to 17.3 mg/g. Plutonium-239 and -240 levels are also generally above background levels. The maximum value observed for plutonium is 7.8 pCi/g.

It is interesting to note that the 1982 tritium levels are considerably elevated over the 1984 levels. There are no records of tritium being put into MDA V. This may indicate some other source for tritium contamination.

In 1980, vegetation samples were analyzed for tritium, uranium, ^{238}Pu, and $^{239/240}Pu$ (Table 16.7-III). Concentrations of all of these radionuclides were elevated above the maximum background levels in all samples. In 1984, the vegetation samples were analyzed for only ^{137}Cs. All sample concentrations were below the maximum background level for ^{137}Cs.

The radionuclide concentration data for soils and vegetation in Tables 16.7-II and 16.7-III do not reflect current site conditions because a soil cover was placed on the site in 1985 to repair erosion damage (Hakonson 1987). Consequently, the data in Tables 16.7-II and 16.7-III now apply to an unspecified zone beneath the current surface of the site.

16.7.1.2.3 Historical Subsurface Sampling Data

The only subsurface information available for MDA V is from a 17.7-m deep hole drilled in pit 2 in 1983. The location of this borehole is shown in Fig. 16.7-1. Core samples were collected at 0.9-m (3-ft) and at 1.5-m (5-ft) intervals down to 17.7 m (58 ft). The samples were analyzed for tritium, uranium, ^{238}Pu and $^{239/240}Pu$, and cesium. These data are presented as a function of depth zone in Table 16.7-IV.

The 0.9- to 2.4-m sample, which corresponds to the interface between the bottom of the pit and the underlying tuff, had the highest concentrations of uranium, ^{137}Cs, and $^{239,240}Pu$. The elevated levels of contaminants at the pit/tuff interface may be explained by noting that the highly permeable rock layer above the interface and the relatively impermeable tuff below the interface provide a physical (and possibly chemical) barrier to downward movement of low-solubility contaminants.

Cesium-137 was within background levels in all samples. Uranium concentrations were within a factor of 2 of background levels, with the exception of the pit/tuff interface.

Tritium and $^{239/240}Pu$ concentrations exceeded background level at all sampling depths. A large body of literature suggests that plutonium mobility in the unsaturated subsurface environment is minimal (Watters et al. 1980). The presence of plutonium at the lower sampling depths in the tuff beneath MDA V probably reflects the influence of the large amount of effluent water added to the site that enhanced the downward migration of plutonium. The presence of plutonium at the 16.2- to 17.7-m depth suggests that more mobile contaminants may have migrated to greater depths. The extent of this migration, if it has occurred, is completely unknown at this time.

16.7.1.2.4 Summary of Historical Data

Available data suggest a low-level contamination of soils and vegetation with tritium, uranium, and plutonium exists in MDA V, including the underlying tuff. Qualitative data indicate that ^{90}Sr may be present. The spatial and temporal resolution of the data does not adequately define source distribution or evidence of transport that may have occurred in the past. The limited available data also suggest that certain contaminants, i.e., uranium, and $^{239/240}Pu$, have elevated levels at the pit/tuff interface. The borehole sampling conducted in 1983 suggests that transport of some radionuclides into the tuff has occurred to at least 16 m. A very limited amount of data suggests that transport of radionuclides into vegetation is low.

No data are available on whether contaminants other than radionuclides (i.e., organics, semivolatiles, metals, or any other hazardous constituents) are present in the absorption beds. As mentioned previously, Mead and Newell (no date) stated that no synthetic detergents were used in the laundering operation; however, pit 1 was to act as a "grease sump" (Veltman 1945). Therefore, the presence of hazardous constituents cannot be ruled out.

16.7.1.3 Source Term

About 3 Ci of ^{89}Sr, ^{140}Ba, ^{140}La (now decayed to undetectable levels), 0.1 Ci of plutonium, and 0.034 Ci of ^{90}Sr were released into the pits (Balo and Warren 1983; DOE 1979). Other radionuclides, such as uranium, were released, but the total amounts are unknown. Whether organics or metals were part of the waste stream is unknown. Recall that the first pit was to act as a "grease sump" (Veltman 1945), an indication that the waste may not have been purely radioactive.

16.7.2 Objectives and Data Needs

The objective is to define the extent of source term migration and to determine whether capping and stabilization-in-place is a possible remedial action at this site. No chemical data exist for MDA V, and radionuclide data with depth exist to 17.7 m for one drill hole in pit 2. The data required to assess MDA V include the following:

1. Identification of contaminants present using Level III/IV analyses. Although this MDA received laundry waste, the presence of hazardous constituents (e.g., solvents) cannot be ruled out with the existing data.

2. Determination of vertical and lateral distribution of contaminants both within and beyond the MDA V fence using Level II surveys and Level III/IV

laboratory analyses. Some surface radionuclide data exist, and radionuclide data with depth exist to 17.7 m. The radionuclide data indicate low-level contamination and some vertical migration. Because this was a liquid waste disposal area, both vertical and lateral migration are likely. To assess lateral migration and to help understand erosion effects, surface samples will be taken. To assess vertical migration, boreholes for subsurface samples are required.

3. Characterization of all contaminant migration pathways. The vertical and lateral pathways are believed to be most important, both because MDA V was a liquid waste disposal site and because of its proximity to the rim of an auxiliary canyon to Los Alamos Canyon.

4. Determination of the geologic stability of the site, particularly with respect to erosion. Because this MDA is adjacent to a canyon side, the geologic stability of the site must be determined to evaluate whether capping and *in situ* stabilization of waste is a viable remedial alternative at this site.

16.7.3 Sampling/Investigation rationale

MDA V surface sampling on a 10- by 10-m grid was conducted in October 1990. Additional sampling from MDA V will include detailed drainage samples as described in Sec. 16.1.4. Whether additional surface sampling at MDA V is required will be determined by evaluating these combined data.

In the initial investigation, combined data from samples collected in the investigations described above will be used to determine spatial prediction surfaces, such as kriging surfaces for MDA V and the surrounding area. These surfaces will be used to determine radionuclide contaminant levels and study migration patterns and erosion effects. Requirements for additional radionuclide sampling and the numbers and locations of those additional sample units will be dictated by the accuracy requirements for the prediction surfaces. These accuracy requirements reflect the degree of uncertainty that will be acceptable for comparisons to action levels, for the risk assessments, and for migration and erosion modeling.

Because MDA V was a liquid disposal area, boreholes will be drilled to define the lateral and vertical extent of contamination as discussed in the rationale given in Sec. 16.1.1. Because contaminant species in MDA V cannot be identified at this time, a full analytical suite will be specified for surface and subsurface samples.

The sampling program may need to be expanded to include a larger area, depending upon results of initial sampling. In these subsequent investigations, the analytical suite will be focused on specific contaminants identified in the initial investigation.

16.7.4 Sampling Plan

Detailed tables have been prepared to identify the sample screening and analyses requirements for each planned investigation of MDA V. However, due to the large number of pages, these tables have been placed in Section F.6 of Appendix F, Analytical Tables.

16.7.4.1 Surface Sampling Plan

16.7.4.1.1 Current Surface Sampling

MDA V was sampled for surface radionuclide contamination in October 1990. This sampling effort is part of the Environmental Surveillance Group's environmental surveillance of low-level radioactive waste program. Sample locations are on a 10- by 10-m grid. As shown in Fig. 16.7-2, several areas have additional sample locations based on a 3- by 3-m grid. These additional samples allow for characterization of the local variability, increasing precision for the prediction of contaminant concentration distributions. Phoswich and μR counts will be determined for each sample location and samples are being analyzed for radionuclide contamination.

16.7.4.1.2 Initial Investigation

Data from the TA-21 OU surface sampling plan described in Chapters 12 and 13 will be used, in conjunction with the 1990 MDA V data and the detailed drainage samples, to study migration patterns and erosion effects and to determine what, if any, subsequent investigations are needed.

16.7.4.1.3 Subsequent Investigation

For planning purposes, it is assumed that 20 surface samples on a 20- by 20-m grid surrounding MDA V will be required in the subsequent investigation. Additionally, radioactive survey instruments will be used within the gridded area to confirm that no areas of elevated radioactivity are present between grid points. Up to 10 additional samples will be taken of any such areas detected.

For planning purposes, it is assumed that all samples will be sent to an analytical laboratory for radionuclide, metals and semivolatiles analysis. The actual analytical suite will be determined by the results from initial sampling. Table F.7-I (see Appendix F) presents the assumed screening and analysis requirements for subsequent investigations.

16.7.4.2 Subsurface Sampling Plan

The subsurface sampling at MDA V will examine potential contaminant migration from the three liquid waste absorption beds that received radioactive effluent from the DP laundry facility. Bed 1 received effluent directly from laundry operations and acted as a "grease sump." Overflow from bed 1 entered bed 2, which in turn overflowed into bed 3. Beds 1 and 2 are believed to contain most of the radioactive contaminants. Only small amounts of laundry effluent reached bed 3, and contamination levels are expected to be low. Previous studies indicated that tritium and plutonium concentrations are generally above background levels to depths of at least 17.7 m beneath bed 2 (Table 16.7-IV). Therefore, preliminary characterization activities will focus on determining the extent of contamination, identifying transport pathways, and deriving source term information.

16.7.4.2.1 Initial Investigation

Vertical drill holes are sited in the three absorption beds to characterize the source term for contaminant transport modeling to determine the vertical extent of the contaminant plume and to determine the suite of contaminants that should be analyzed during the subsequent investigation (Fig. 16.7-3). Three holes are located in bed 1, two holes are in bed 2, and one hole is in bed 3. The three holes in bed 1 will be used to evaluate the homogeneity of contaminants in that liquid waste absorption bed. All source term holes will be drilled to a nominal depth of 75 ft.

MDA V will be the first liquid waste MDA that is drilled for this OU. Results of the source term characterization in bed 1 at MDA V will be used to evaluate, and if necessary, modify the number and types of source-term drill holes at the other liquid waste MDAs (e.g., MDAs U and T) at TA-21.

Samples for contaminant characterization will be collected at varying intervals along the length of the drill holes. More closely spaced samples will be taken at the interface between the floor of the absorption bed and the underlying tuff because the highest levels of contaminants were observed here, and there is indication that there may be some natural barrier to downward movement at this interface (See Sec. 16.7.2.3). Samples will be collected at 2.5-ft intervals in the absorption beds and across the interface separating the absorption beds and the underlying tuffs. Below the absorption beds, samples will be collected at 5-ft intervals. These sample intervals may be modified because of variable amounts of core recovery and requirements for greater sample volumes for laboratory analyses. Samples for soil moisture determination will be collected at 5-ft intervals.

All core samples collected in the initial investigation will be submitted for the full suite of analyses in an analytical laboratory will be conducted on all core samples. The screening and analysis requirements for the initial investigation are given in Table F.7-II (Appendix F).

The nominal depth of the drill holes is given in Fig 16.7-3. The borehole stopping criteria in Sec. 11.5.3 will be applied to all boreholes, and the field laboratory will be used to make these determinations. One vertical hole in absorption bed 1 at MDA V will be extended 50 ft below the contamination plume to determine whether the liquid waste additions altered rock properties. In this region of this hole, samples will be analyzed at 10-ft intervals for geochemical parameters and mineralogy as detailed in Sec. 12.5.1.5 and given in Table F.7-III (Appendix F).

An objective of this investigation is to evaluate the importance of fractures as potential preferential transport pathways. When fractures are encountered, they will be preferentially sampled. When a fracture is encountered within a 5-ft-sampling interval, two samples will be taken from that sampling interval to allow a comparison of analytical results for fracture and nonfracture intervals. This sampling is included as a contingency in Table F.7-II (Appendix F).

Geochemical parameters and mineralogy (as detailed in Sec. 12.5.1.5) will be characterized in all initial boreholes on 20-ft-core intervals and within contaminant zones to define the geochemical parameters associated with particular contaminants. For planning purposes it is assumed that 20% additional sampling within contaminant zones will be needed to define mineralogical and geochemical control on contaminants. Geochemical analysis is summarized by borehole in Table F.7-III.

One 300-ft borehole will be drilled at MDA V (see Fig. 16.7-3) for geohydrological parameter characterization and geophysical logging as detailed in Sec. 12.5.1.

16.7.4.2.2 Subsequent Investigation

The subsequent investigation includes nine drill holes at tentative locations around the perimeter of the site. Five of these holes are inclined 10 to 30° (Fig. 16.7-3 and Fig. 16.7-4) and are designed to determine the shape and extent of the contaminant plume. The angles and orientation of these inclined holes will be adjusted to provide the best characterization of the contaminant plume by incorporating information derived from initial drill holes. Four vertical holes are also tentatively sited west, south, and east of the MDA V fence to determine if contaminants are migrating laterally towards Los Alamos Canyon. These vertical drill holes are tentatively planned

for total depths of 75 ft. Samples for contaminant characterization will be collected at 5-ft intervals along the length of all subsequent investigation drill holes.

The analytical suite for subsequent investigations will be reduced in scope, as appropriate, based on analytical results from the initial investigation. However, for planning purposes, it is assumed that a full analytical suite will be used. Table F.7-IV (Appendix F) gives the assumed screening and analysis requirements for the subsequent investigations.

Depending on results of hydrogeological parameter determinations in both the OU-wide 300-ft vertical boreholes and the MDA V initial investigation 300-ft vertical borehole, an additional 300-ft borehole for hydrogeological parameter determination may be drilled. If so, analyses detailed in Sec. 12.5.2 would be conducted.

The necessity for additional characterization will be determined by evaluating results from the initial and subsequent investigations. Placement of additional drill holes will be based on results from these holes.

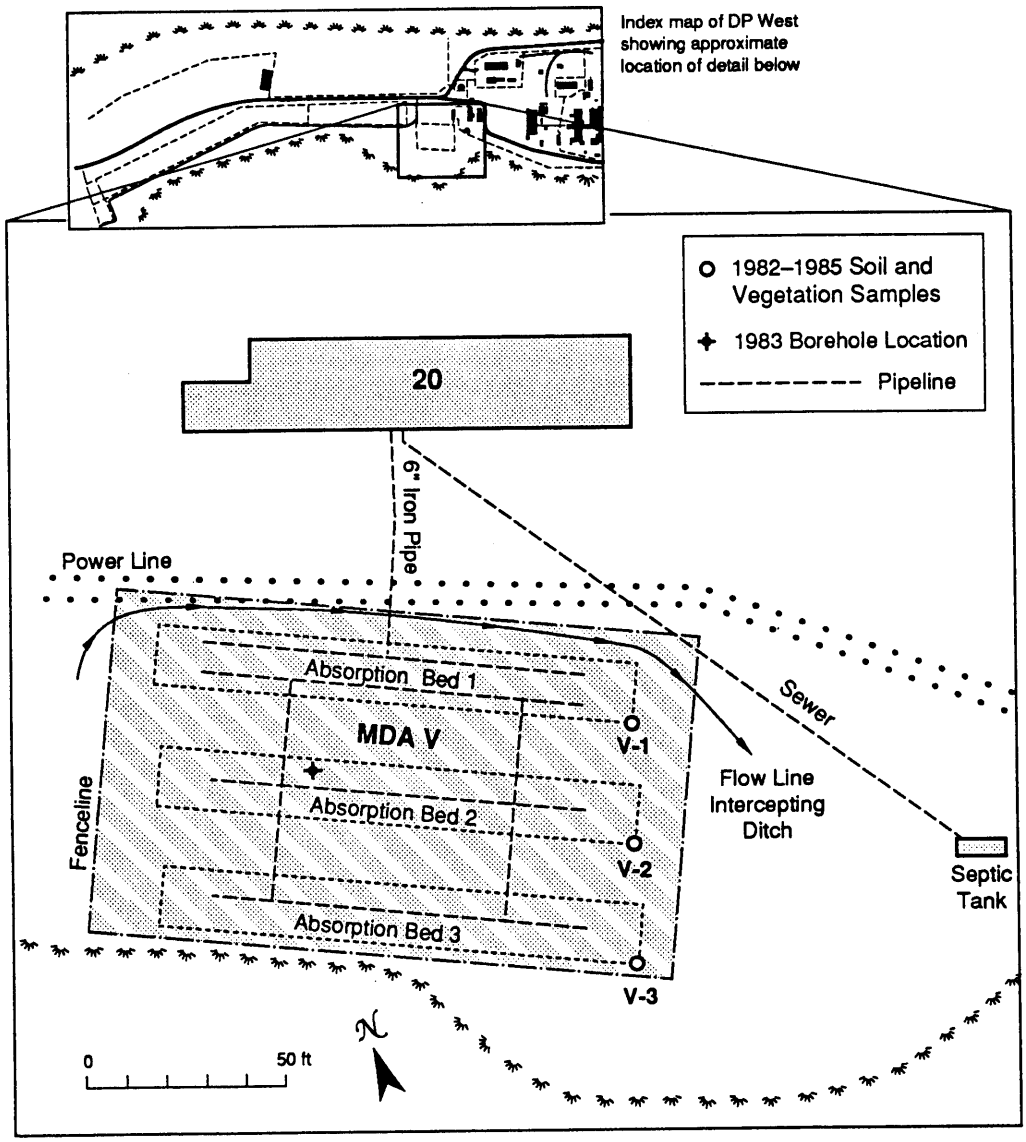


Fig. 16.7-1 General site map of MDA V showing former location of Building 20 and associated lines, and soil and vegetation sampling locations.

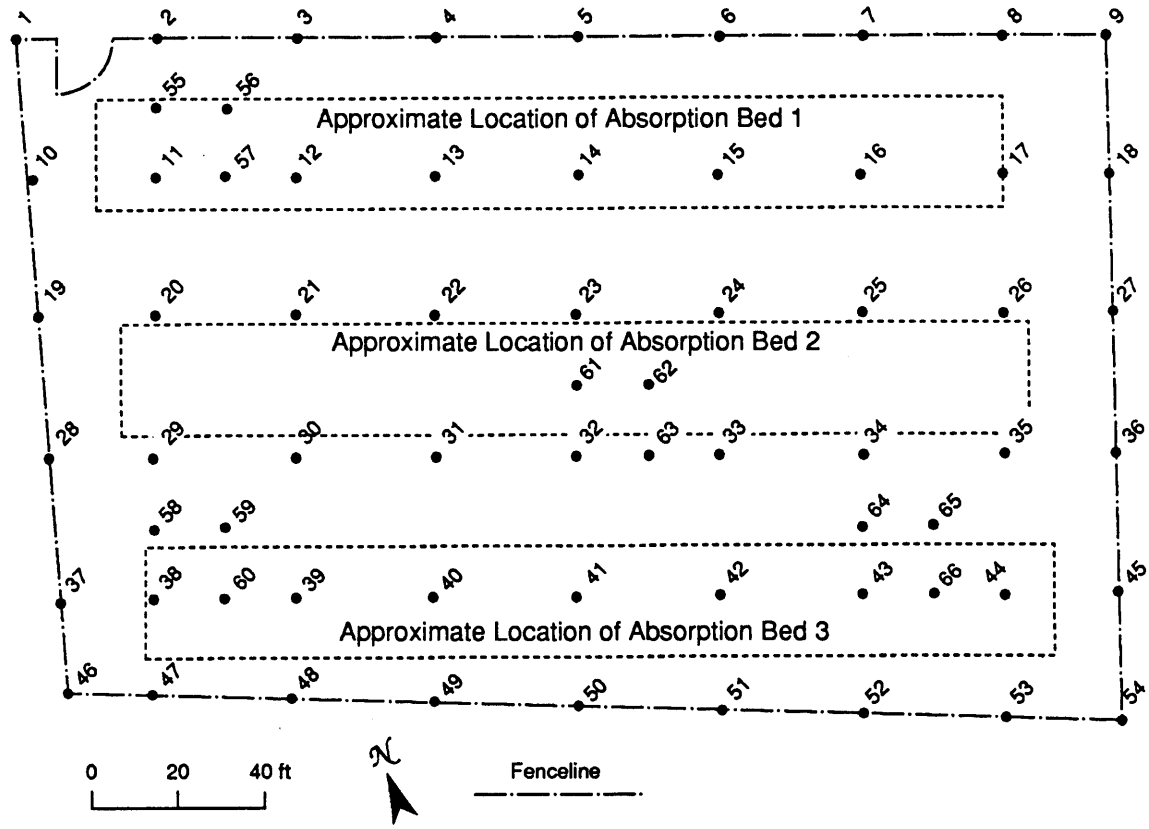
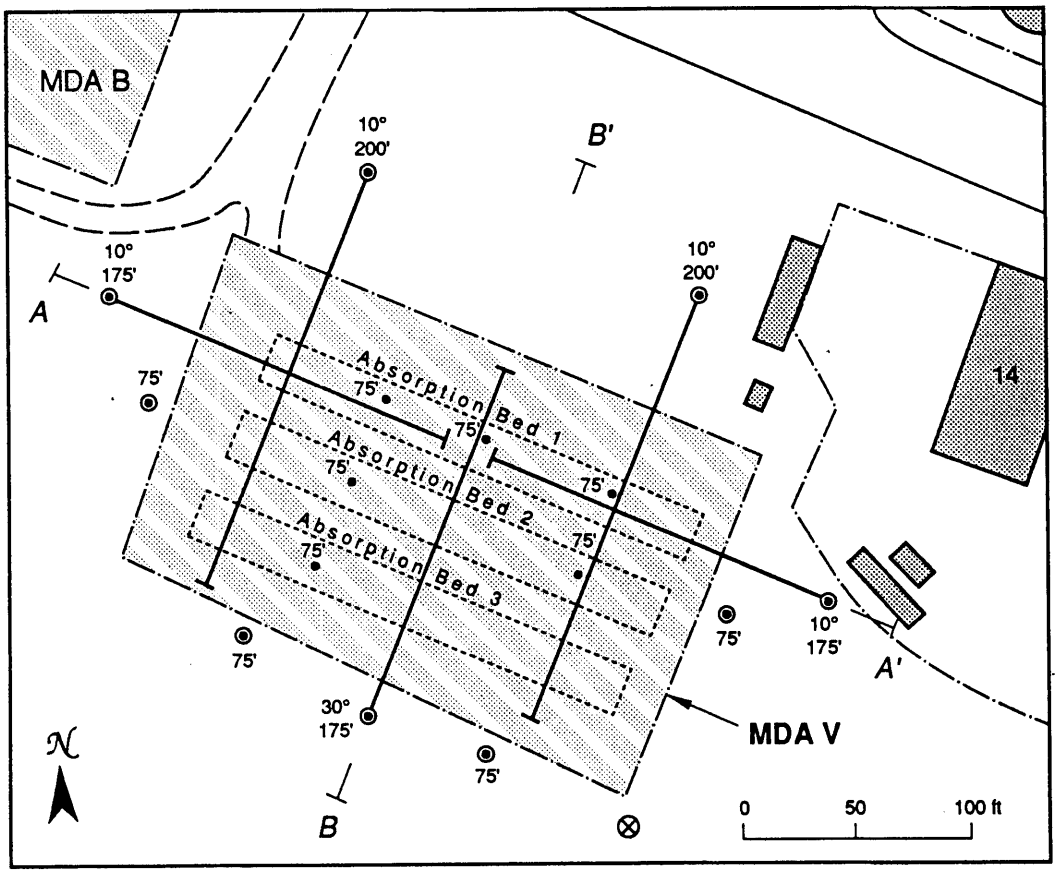


Fig. 16.7-2 Surface sampling grid for 1990 low-level radioactive waste surveillance program for MDA V.



Building or Structure

Fenceline

Paved Road

Dirt Road

A A' Cross Section Line

INITIAL INVESTIGATION

• 75' Vertical drill hole

⊗ Tentative location of geohydrological parameter characterization drill hole

SUBSEQUENT INVESTIGATION

⊙ 75' Tentative location of vertical drill hole

30° 175' Tentative location of inclined drill hole showing angle and length of hole

Fig. 16.7-3 Approximate location of absorption beds and initial and subsequent investigation drill holes for MDA V.

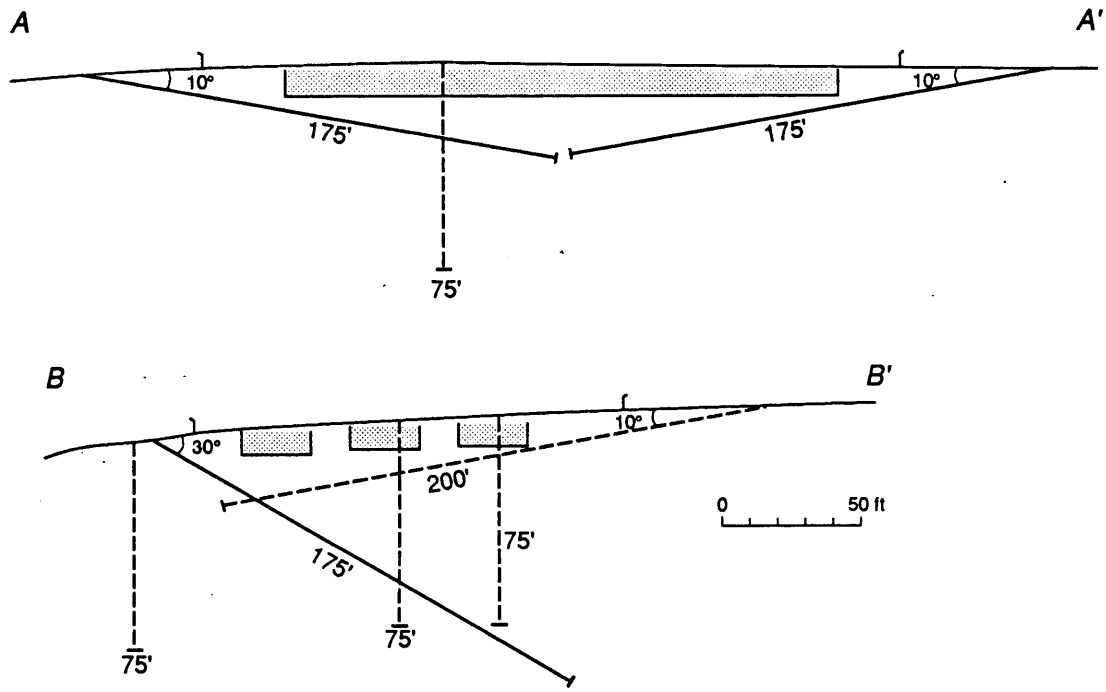


Fig. 16.7-4 Cross sections for MDA V showing the layout of absorption beds and initial and subsequent investigation drill holes. Drill holes outside the plane of the section are dashed.

TABLE I6.7-I. CHRONOLOGICAL EVENTS AT MDA V

Date	Location	Reference	Data Collected
1980	MDA V	Los Alamos Notebook	Vegetation
files	3 sampling locations ^{3}H, U, ^{238}U, $^{235}U/^{238}U$,	A411	^{238}Pu, $^{239/240}Pu$
			Soil (surface) $^{239/240}Pu$, ^{3}H, U
			Gamma scan
			Areal Survey Phoswich, Gamma µR-meter
1982	MDA V	Los Alamos Notebook A411 Files	Soil (surface) Tritium, U, ^{238}Pu, $^{239/240}Pu$
		Los Alamos Notebook No.23820	TLD
1983	MDA V On location	Los Alamos Notebook A411 Files	Soil (subsurface) Tritium, U, $^{235}U/^{238}U$, ^{238}Pu, $^{239/240}Pu$, ^{137}Cs
		Los Alamos Notebook No. 23820	TLD
1984	MDA V	Los Alamos Notebook A411 Files	Soil (subsurface) ^{238}Pu, $^{239/240}Pu$
			Vegetation ^{137}Cs

TABLE 16.7-I. CHRONOLOGICAL EVENTS AT MDA V (CONTINUED)

Date	Location	Reference	Data Collected
1984 (cont.)		Los Alamos Notebook No. 23820	TLD
			Soil (surface) Tritium, U, $^{239/240}Pu$
1985	MDA V	Los Alamos Notebook A411 Files	Soil (surface) Gamma spectrum
		Los Alamos Notebook No. 23820	TLD
1986	MDA V	Los Alamos Report LA-10992-ENV	TLD

TABLE 16.7-II
SUMMARY OF MDA V RADIOCHEMICAL DATA FOR SOILS[a]

Sample Number	Sample Location	Sample Depth (cm)	Tritium Value (pCi/L)	+/-	Uranium Value (µg/g)	+/-	^{238}Pu Value (pCi/g)	+/-	$^{239/240}$Pu Value (pCi/g)	+/-	^{137}Cs Value (pCi/g)	+/-
	BKGD.[b]		7200[b]		3.4[b]		0.0050[b]		0.025[b]		1.09[b]	
82.09433	V-1	0-1	17800	400	3.300	0.300	0.0230	0.0030	2.5300	0.0400		
82.09434	V-1	1-10	20100	500	4.200	0.400	0.0110	0.0010	1.1400	0.0200		
82.09435	V-1	10-30	14900	400	4.200	0.400	0.0220	0.0030	2.8400	0.0400		
82.09436	V-2	0-1	28300	600	4.500	0.500	0.0067	0.0010	0.5130	0.0150		
82.09437	V-2	1-10	64700	1100	4.000	0.400	0.0068	0.0010	0.5040	0.0150		
82.09438	V-3	0-1	10700	2000	3.800	0.400	0.0037	0.0010	0.5350	0.0140		
82.09439	V-3	1-10	19900	500	4.200	0.400	0.0180	0.0030	2.3300	0.0400		
82.09440	V-3	10-30	13400	400	3.800	0.400	0.0410	0.0040	6.6500	0.0800		
85.03529	-80,20	0-1	1400	400								
85.03530	-80,20	1-10	2400	400								
85.03531	-80,20	10-30	1000	300								
85.03532	-60,60	0-1	3200	500								
85.03533	-60,60	1-10	2200	400								
85.03534	-60,60	10-30	3600	500								
85.03535	-60,40	0-1	4700	600								
85.03536	-60,40	1-10	4200	600								
85.03537	-60,40	10-30	5800	700								
85.03538	-60,20	0-1	600	300								
85.03539	-60,20	1-10	1700	400								
85.03540	-60,20	10-30	2500	400								
85.03541	-60,0	0-1	-400	300								
85.03542	-60,0	1-10	2200	400								
85.03543	-60,0	10-30	4300	600								
85.03544	-40,60	0-1	2200	400								
85.03545	-40,60	10-30	2800	400								
85.03546	-40,40	0-1	2400	400								
85.03547	-40,40	1-10	2500	400								
85.03548	-40,40	10-30	3100	500								
85.03549	-40,20	0-1	2100	400								
85.03550	-40,20	1-10	3400	500								
85.03551	-40,20	10-30	10000	1000								
85.03552	-40,0	1-10	5800	700								
85.03553	-40,0	10-30	22000	2000								
85.03554	-40,40	0-1	5400	700								

TABLE 16.7-II
SUMMARY OF MDA V RADIOCHEMICAL DATA FOR SOILS[a]

Sample Number	Sample Location	Sample Depth (cm)	Tritium Value (pCi/L)	+/-	Uranium Value (µg/g)	+/-	^{238}Pu Value (pCi/g)	+/-	$^{239/240}Pu$ Value (pCi/g)	+/-	^{137}Cs Value (pCi/g)	+/-
	BKGD.[b]		7200[b]		3.4[b]		0.0050[b]		0.025[b]		1.09[b]	
85.03555	-40,40	1-10	4100	500								
85.03556	-40,40	10-27	3400	500								
85.03557	-20,60	0-1	3100	500								
85.03558	-20,60	1-10	2000	400					0.0035	0.0014		
85.03559	-20,60	10-30	3600	500					0.1280	0.0105		
85.03560	-20,40	0-1	2900	500								
85.03561	-20,40	1-10	3100	500					0.4390	0.0232		
85.03562	-20,40	10-20	2900	500					2.2900	0.0800		
85.03563	-20,20	0-1	1200	400								
85.03564	-20,20	1-10	3400	500					0.1940	0.0142		
85.03565	-20,20	10-30	6400	700					0.2960	0.0190		
85.03566	-20,0	0-1	200	300								
85.03567	-20,0	1-10	2400	400					2.2600	0.0997		
85.03568	-20,0	10-30	11000	1000					5.9800	0.3600		
85.03569	-20,-20	0-1	33000	3000								
85.03570	-20,-20	1-10	5800	700					4.3600	0.1840		
85.03571	-20,20	10-30	18000	2000					7.2000	0.4800		
85.03572	0,0	0-1	2300	400								
85.03573	0,0	1-10	2000	400					1.9600	0.0923		
85.03574	0,0	10-30	900	300					0.2140	0.0156		
85.03575	0,20	0-1	3000	500								
85.03576	0,20	1-10	2200	400					0.0134	0.0030		
85.03577	0,20	10-30	2800	400					0.0221	0.0034		
85.03650					4.93	0.40						
85.03651					4.83	0.40						
85.03652					4.53	0.40						
85.03653					4.61	0.40						
85.03654					4.54	0.40						
85.03655					4.67	0.40						
85.03656					4.67	0.40						
85.03657					4.50	0.40						
85.03658					5.14	0.40						
85.03659					7.89	0.60						
85.03660					6.53	0.60						
85.03661					4.80	0.40						

TABLE 16.7-II
SUMMARY OF MDA V RADIOCHEMICAL DATA FOR SOILS[a]

Sample Number	Sample Location	Sample Depth (cm)	Tritium Value (pCi/L)	+/-	Uranium Value (µg/g)	+/-	^{238}Pu Value (pCi/g)	+/-	$^{239/240}$Pu Value (pCi/g)	+/-	^{137}Cs Value (pCi/g)	+/-
	BKGD.[b]		7200[b]		3.4[b]		0.0050[b]		0.025[b]		1.09[b]	
85.03662					5.03	0.40						
85.03663					4.51	0.40						
85.03664					4.76	0.40						
85.03665					4.46	0.40						

[a]Sample numbers 85.03529 to 85.03665 are for data collected in 1994. The +/- values reported for each radionuclide are analytical laboratory uncertainty.
[b]Upper background levels from Purtymun (1987).

TABLE 16.7-III
SUMMARY OF MDAA V RADIOCHEMICAL DATA FOR VEGETATION[a]

Sample Number	Sample Location	Sample Depth (cm)	Species	Tritium Value (pCi/L)	+/-	^{235}U Value (ppb)	+/-	^{238}Pu Value (pCi/g)	+/-	$^{239/240}Pu$ Value (pCi/g)	+/-	^{137}Cs Value (pCi/g)	+/-
	BKGD.[b]			800[b]		156[b]		.00015[b]		.00023[b]		1.0[6b]	
80.05326	V-1		Bromus anomalous	3600	300	430	50	0.0030	0.0040	0.0760	0.0090		
80.05327	V-1		Andropogon desetorum	3300	300	180	50	-0.0020	0.0020	0.0800	0.0080		
80.05328	V-2		Yucca clauca	6400	400	810	80	0.0021	0.0013	0.0800	0.0050		
80.05329	V-2		Bromus tectorum	5600	300	2910	290	0.0045	0.0013	0.0980	0.0050		
80.05330	V-5		Juniperus monosperma	5700	300	2570	260	0.0250	0.0020	0.2930	0.0090		
80.05331	V-5		Bromus tectorum	2600	300	890	90	0.0440		0.1110	0.0120		
80.05332	V-5		Artemesia caruthii	1900	300	3700	370	0.0189	0.0018	0.4540	0.0130		
85.03507	0,0		Melilotus albus									0.7580	1.3000
85.03508	0,0		Grass									-0.2140	0.8550
85.03509	0,20		Grass									0.3970	0.2490
85.03510	0,20		Forb									0.0985	0.1060
85.03511	-20,-20		Grass										
85.03512	-20,-20		Artemesia									2.1100	0.4700
85.03513	-20,0		Poplar Tree									1.3200	1.0900
85.03514	-20,20		Poplar Tree									0.0545	0.9830
85.03515	-20,20		Gumweed									0.2390	0.2380
85.03516	-20,40		Ground Cherry									0.0904	0.1020
85.03517	-40,-40		Shrub Oak									0.3000	0.3210
85.03518	-40,-40		Grass									0.5410	0.2700
85.03519	-40,20		Gumweed									0.5350	0.3520
85.03520	-40,0		Artemesia drac.									0.5990	0.3960
85.03521	-40,0		Russian olive									1.2900	0.3210
85.03522	-40,20		Melilotus									0.1530	0.6420
85.03523	-40,40		Bromus Tectorum									0.3500	0.2010
85.03524	-40,40		Melilotus albus									0.6360	0.5640
85.03525	-60,20		Snakeweed									0.6370	0.5790
85.03526	-60,60		Melilotus albus									0.8540	0.6500
85.03527	-80,20		Cottonwood									0.1110	0.1090
85.03528	-80,20		Grass									0.6870	0.4790

[a]The ± values reported for each radionuclide are analytical laboratory uncertainty.
[b]Upper background levels from the Environmental and Surveillance Group (1987).

TABLE 16.7-IV
SELECTED RADIONUCLIDES CONCENTRATIONS IN SUBSURFACE SOIL AT MDA V IN 1983[a]
(Sample location V-1)

Depth (Meters) BKGD.[b]	Tritium (pCi/L) 7200[b]	Total U (µg/g) 3.4[b]	239/240Pu (pCi/g) 0.025[b]	137Cs (pCi/g) 1.09[b]
0-0.9	11300 ± 1200	4.1 ± 0.2	1.300 ± 0.050	0.20 ± 0.06
0.9-2.4	21000 ± 2000	62.7 ± 4.3	7.700 ± 0.200	0.60 ± 0.12
2.4-4.0	17000 ± 1700	7.3 ± 0.4	[c]	0.16 ± 0.07
4.0-5.5	24000 ± 2000	4.0 ± 0.2	1.420 ± 0.04	<0.1
5.5-7.0	22000 ± 2000	3.7 ± 0.2	0.271 ± 0.013	<0.1
7.0-8.5	19000 ± 2000	4.0 ± 0.2	[c]	0.17 ± 0.07
8.5-10.1	18000 ± 1800	4.0 ± 0.2	2.200 ± 0.70	<0.1
10.1-11.6	15100 ± 1500	3.8 ± 0.2	0.810 ± 0.030	0.10 ± 0.04
11.6-13.1	17700 ± 1800	3.8 ± 0.2	0.375 ± 0.015	<0.1
13.1-14.6	16500 ± 1700	3.9 ± 0.2	0.226 ± 0.009	<0.1
14.6-16.2	20000 ± 2000	3.7 ± 0.2	0.110 ± 0.006	<0.1
16.2-17.7	20000 ± 2000	3.7 ± 0.2	0.076 ± 0.006	<0.1

Detection Limits:	Tritium	Total U	239,240Pu
137Cs	(nCi/l)	(µg/g)	(pCi/g)
(pCi/g)	0.7	0.03	0.002 0.1

[a]Surface soil (0–30cm). Absorption bed materials (30–120cm). Tuff (below 120 cm)
[b]Upper background levels from Purtymun (1987).
[c]Concentration large enough to interfere with analytical results. Data are lacking regarding the concentration at which this occurred.

16.8 SWMU 21-014 Material Disposal Area (MDA) A

16.8.1 Site Description

All of MDA A is included in SWMU 21-014, with no subunits defined (LANL 1990). MDA A covers an area of 5000 m^2 (1.25 acre) (Walker et al. 1981) and contains two underground tanks (the General's Tanks), two pits on the east end of the site, and a large pit in the center (Fig. 16.8-1). There is some discrepancy in the records on the number of pits on the east end of the site. An early engineering drawing (ENG-1266) depicted four pits; however, later drawings (ENG-C2076), along with several reports and memos, referred to the existence of only two pits. A recent geophysical survey of MDA A (Gerety et. al. 1989) suggested that only two pits are present on the east end of the site; therefore, it will be assumed there are two pits, not four.

16.8.1.1 Site History

Table 16.8-I provides a chronological sequence of events and data that pertain to MDA A. The following summary and evaluation of this information provide the basis for identifying information needed to complete characterization and assessment of this site.

MDA A was actively used for waste disposal during two periods, 1945 to 1949 and 1969 to 1977. During the first period, the two pits on the east end of the site and the two underground tanks were used for waste disposal and storage. The second phase commenced in 1969 when the large pit in the center of MDA A was constructed to receive decontamination and decommissioning debris from TA-21 (Purtymun 1969; Meyer 1971; Desilets 1972; Christenson 1973c). This pit was used until late 1977. Remediation of the site cover was conducted in 1985 and 1987 (Mayfield 1985b; Salazar 1987). MDA A was decommissioned in May 1978.

Two Eastern Pits

The two eastern pits were constructed in 1945 and are shown (ENG-1266) as being about 5.5-m wide, 3.8-m long, and 3.8-m deep for a trench volume of about 750 m^3. They received "laboratory equipment, building construction material, paper, rubber gloves, filters from air cleaning systems and contaminated or toxic chemicals" (Meyer 1952). The possibility exists that "plutonium, polonium, uranium, americium, curium, Radium-Lanthanum [sic], actinium, and waste products from the Water Boiler" were present in the waste (Meyer 1952). Polonium and $^{239/240}Pu$ were also thought to be the major contaminants in the waste (Meyer 1952). If this were

the case, only the plutonium would remain at present because of the short half-life of the polonium.

There is also reference to the storage of several hundred 55-gal. drums containing "iodide waste" (Emelity 1978) on the east end of MDA A in the early 1950s. These drums contained a caustic sodium hydroxide (NaOH) solution and stable iodine, which were used to scrub ventilation exhaust air containing plutonium and perhaps uranium (Maraman 1990). Corrosion of the drums resulted in liquid releases to surface soil on MDA A. The volume of liquid and its chemical content are unknown. The drums were removed in 1960, and the storage area was paved to immobilize contaminants leaked to the soil.

General's Tanks

In 1945, two 50,000 gal. (about 190 m^3 3.7 m in diameter by 19.1 m in length) steel tanks (the "General's Tanks") were buried on the west end of MDA A to receive solutions containing $^{239/240}Pu$. The intent was to store these liquids until improved chemical recovery methods could be used to extract the $^{239/240}Pu$. The plutonium was never recovered as planned. However, from 1975 to 1983, the liquids in the tanks were removed and processed at the TA-21-257 waste treatment facility. A sludge remains in the bottom of both tanks; however, the volume of sludge is unknown. A memo (Voelz 1973) suggested that less than 1% of the radioactivity in the tanks was associated with the liquid that was processed. This implies that most of the radioactivity remains in the tanks and associated sludge. Estimates of the total $^{239/240}Pu$ (and ^{241}Pu which has decayed to ^{241}Am) stored in the tanks, based on several sources (Voelz 1973; Christenson 1973) is roughly 200-400 g (12-25 Ci). Evidence of rain water entry into the tanks led to the sealing of openings in the top of the tanks in 1985.

Central Pit

A large pit was constructed in the center of MDA A in 1969 to contain debris from demolition work at TA-21. It was to be excavated to a depth of 9.1 m (30 ft), allowing approximately 5,352 m^3 (7,000 yd^3) to be buried with a cover of 5 ft of earth (Purtymun 1969). As originally constructed, however, the available waste volume was only 3,735 m^3, with a depth of 22 ft (Purtymun 1969). The pit was enlarged (total volume of 14,325 m^3) in 1972, but not deepened, and used until late 1974 to accommodate additional building debris. After the demolition work was completed in 1974, waste of an unspecified nature was placed into the remaining unfilled portion of the large trench (Rogers 1977). The pit was decommissioned in May 1978 when a soil cover was placed over the pit (Environmental Surveillance Group 1985). The contaminants placed into the large pit

included $^{239/240}Pu$, ^{238}Pu, ^{235}U, depleted uranium, and other unspecified radionuclides associated with the waste. Asphalt was also a component of the waste.

16.8.1.2 Existing Information

16.8.1.2.1 Waste Discharge Information

The following information was taken from a variety of sources predating 1980. This information is highly qualitative and is presented here to identify radionuclides and other contaminants present in the waste.

Documentation detailing the quantities of contaminants and types of waste (i.e., specific radionuclides and hazardous chemicals) placed into the two eastern pits is nonexistent. It seems certain, based upon the early technical work conducted at TA-21, that radionuclides were present in the waste.

Most of the existing predecommissioning data on MDA A concern liquids in the General's Tanks. The residue still present in the tanks could contain most of the original radionuclide inventory, estimated to be about 12-25 Ci (200-400 g) of $^{239/240}Pu$. Whether these estimates are strictly for $^{239/240}Pu$ or also include ^{241}Am is unknown. Plutonium-241 is formed along with $^{239/240}Pu$ in the production reactor and is inseparable from the more well known plutonium isotope. Some estimates of the activity in the tanks (Rogers 1977) suggest that about one-third of it is ^{241}Am (ingrowth from ^{241}Pu decay).

The quantities and concentrations of contaminants placed into the large central pit, beginning in 1969, are unknown. However, because this pit contains building debris, Rogers (1977) stated it was contaminated with $^{239/240}Pu$, ^{238}Pu, ^{235}U, and depleted uranium along with other unidentified radioactive isotopes. Whether nonradiological hazardous wastes are present in this or any other pit in MDA A is also unknown.

16.8.1.2.2 Historical Surface Sampling Data

Beginning in 1980, sampling of the cover at MDA A began to better characterize the distribution of radionuclides. Three locations, one outside of MDA A, (Fig. 16.8-1) were selected in 1980 for sampling based on the results of field radiation instrument surveys with the phoswich and high pressure ion chamber (HPIC). Results of the follow-on soil and vegetation sampling are given in Table 16.8-II. The soil samples were taken in three intervals to a 30-cm depth and suggest that

tritium levels in the cover are at background level; uranium in sampling location A-2 soils is elevated to depths of 30 cm; and $^{239/240}Pu$ concentrations are elevated in samples from all three locations and in all three depth intervals with a maximum of 60 nCi/g in the 1- to 10-cm interval. Uranium concentrations in soil at location A-2 decreased with depth while plutonium concentrations were relatively uniform with depth. Location A-3 is outside of MDA A, and the plutonium levels there may be unrelated to MDA A. Vegetation sampling results show that tritium and total uranium concentrations are only elevated in vegetation within MDA A. The one vegetation sample outside MDA A had above-background plutonium.

In 1984, soil and vegetation sampling was conducted on MDA A, including analyses for plutonium, tritium, uranium, and radiation fields as measured with field instruments. The full sampling grid was used for the instrument survey (Fig. 16.8-2), while soil and vegetation samples were taken from the western one-third of the site, with particular emphasis on the General's Tanks area.

The results (Table 16.8-III) of the instrument survey with the phoswich detector analyzer set to respond to low-energy x-rays (16-60 KeV) from plutonium and americium suggest a fairly widespread distribution of these elements across the site. Some counts were two to three times background levels of about 800 counts per 200 seconds. Relative µR/hr as measured with the HPIC were also elevated above the background level rate. The HPIC responds primarily to moderate and high-energy x-ray and gamma ray photons.

Concentrations of selected radionuclides in cover soil profile samples and vegetation are shown by grid location in Tables 16.8-IV and 16.8-V. The 39 grid locations used for the soil and vegetation sampling (Fig. 16.8-2) included several locations outside of the fenced area to the west and two points to the northwest. Soil samples were collected at three depths: 0 --1 cm, 1 - 10 cm, and 10 - 30 cm. Not all locations and depths were assayed for each radionuclide. The most complete data are for the 1 - 10-cm depth.

Generally, tritium concentrations in soil and vegetation were less than background levels in the majority of samples. However, all soil samples contained uranium and plutonium concentrations that were well above maximum background levels, as detailed below. Uranium concentrations were also elevated above background levels in vegetation samples.

All uranium concentrations in soil (except one sample) were above the background level of 3.4 µg/g. Uranium concentrations in 88% of the vegetation samples exceeded the background level of about 1 µg/g by factors of 2 to 6. Because uranium concentrations were elevated in soil,

elevated uranium concentrations in plants may be because of the presence of contaminated dust on vegetation, instead of root uptake.

Plutonium-238 in soil was elevated above the maximum background level of 0.005 pCi/g in all samples, except one. Ninety percent of the values reported were greater than two times the maximum background level. Of 36 samples, the majority have ^{238}Pu concentrations that were more than ten times the maximum background level. Figure 16.8-3 shows the spatial prediction surface generated from kriging data at depth 1 to 10 cm. The contours are for concentration levels above background level. Plutonium-238 is most elevated over the pit that is at the edge of the data.

Concentrations of $^{239/240}Pu$ in soil were more than ten times the maximum background levels in the majority of samples. Plutonium-239 and -240 in soil generally exceeded background levels, ranging between 1 and 20 pCi/g. Figure 16.8-4 shows the spatial prediction surface generated from kriging data at depth 1 to 10 cm. The contours are for concentration levels above background level. Plutonium-239 and -240 are most elevated over the General's Tanks and outside of the fence to the east and to the northwest.

16.8.1.2.3 Historical Subsurface Sampling Data

Four test holes were drilled in MDA A adjacent to the General's Tanks in May 1974 to evaluate whether the tanks had leaked contaminants into the surrounding soil (Wheeler 1976). The holes were augered to a depth of about 10 m (35 ft), and composite samples were collected in 1.5-m (5-ft) intervals. The bottom of the tanks are at a depth of 15 ft. Results, as summarized in an internal memo, indicated that gross alpha and gross beta concentrations were well within regional soil background levels, suggesting that lateral migration of any leakage from the tanks could not be identified as of May 1974.

In 1983, soil profile samples were taken using a power auger at 90-cm (3 ft) intervals to a total depth of 900 cm (30 ft) at six locations around the perimeter of the General's Tanks (Fig. 16.8-5). Analyses for ^{238}Pu and $^{239/240}Pu$ are summarized in Table 16.8-VI. All samples in the 0-90-cm (0-3-ft) depth profile had levels of $^{239/240}Pu$ above background, and three of the six had levels of ^{238}Pu above background. In deeper sampling intervals, only one sample (27-30-ft depth) had a ^{238}Pu concentration elevated above background level. Nine samples at depths deeper than 3 ft exceeded the maximum background level for $^{239/240}Pu$. Generally, holes 1 and 3 have the most elevated levels.

16.8.1.2.4 Summary of Historical Data

Existing data on the spatial distribution of radionuclides in MDA A indicate that elevated levels of the radionuclides exist over most of the General's Tanks area as well as off the fenced area to the west and northwest. No data were taken on the east side of MDA A or off MDA A to the east or north down DP Canyon.

Surface soil concentrations of ^{238}Pu, $^{239/240}Pu$, and uranium were elevated above maximum background levels in both the 1980 and 1984 samples. Note however that these levels may no longer be present today because the cover was remediated in 1985 and 1987.

Limited vegetation data suggest elevated uranium levels. However, it is not known whether they reflect the presence of contaminated dust on the vegetation or root uptake.

Auger samples collected in 1974 and 1983 near the General's Tanks to 30-ft depths found levels of ^{238}Pu, $^{239/240}Pu$, and uranium elevated above maximum background levels in most sampling intervals. No other subsurface data are available from other parts of MDA A.

To date, no analyses for ^{241}Am in soil and vegetation have been performed, although it is likely to be present as a result of ingrowth from ^{241}Pu decay. No information exists on the nonradiactive hazardous waste content of MDA A.

16.8.1.4 Source Term

Two pits at the eastern end of MDA A contain solid waste that is known to be radioactively contaminated, with $^{239/240}Pu$ as the major contaminant. The central pit also contains solid waste that is radioactively contaminated. Source concentrations for these three pits are unknown. Drums stored on the surface prior to 1960, at the east end of MDA A east of the two pits, may have leaked stable iodine in an NaOH solution, with a good probability of plutonium and perhaps uranium contamination. Again, the volume of this possible contamination is unknown. Whether nonradiologic hazardous waste is present in these pits is unknown.

The General's Tanks contain a sludge estimated to have a total of 200 to 400 g (12-25 Ci) of $^{239/240}Pu$ (and ^{241}Am). The chemical composition of this sludge is unknown; however, it may contain metals and solvents used in plutonium processing.

16.8.2 Objectives and Data Needs

The objective of this investigation is to confirm the absence of contaminant migration from MDA A. Specific data required to assess contaminant migration at MDA A include the following:

1. Confirm the absence of contaminant migration by identifying contaminants present in both the surface and subsurface. Plutonium-239/240 and ^{241}Am were disposed of in MDA A, and uranium has been found in previous sampling. However, whether other radionuclides and hazardous wastes may be present is unknown. Because the objective is to confirm absence of contamination, Level III/IV analyses are necessary.

2. Determine the lateral and vertical extent of contaminant migration by surface and subsurface soil sampling and analysis using Level II/III data.

3. Determine the primary migration pathways through the evaluation of sample analysis results. The primary migration pathway is expected to be surface erosion.

16.8.3 Sampling/Investigation Rationale

Surface sampling. Surface sampling within the MDA A fence was conducted in October 1990 on a 10- by 10-m grid, with several additional samples on a 3- by 3-m grid for assessing spatial variability. At this time, analytical results from this sampling are not available. Additional samples will be collected from the MDA A fence to the canyon rim. This sampling will be coordinated with the OU-wide surface characterization (Chapters 12 and 13). These data, along with the detailed drainage sampling (Sec. 16.1.4) will be evaluated to define whether further MDA A surface sampling is necessary either within or beyond the MDA A fence.

These data will be used to determine spatial prediction surfaces, such as kriging surfaces for MDA A and the surrounding area. These surfaces will be used to determine contaminant distributions, to study migration patterns and erosion effects, and to guide both subsequent sampling and analytical needs. Requirements for additional sampling and the numbers and locations of those additional sample units will be dictated by the accuracy requirements for the prediction surfaces. These accuracy requirements reflect the degree of uncertainty that will be acceptable for comparisons to action levels, for the risk assessments, and for migration and erosion modeling.

Subsurface sampling. As discussed in Sec. 16.1.5, because MDA A was a solid waste disposal area (with the exception of the General's Tanks), emphasis will be on how far contaminants have migrated and not on source term definition. Therefore, the focus is on angle drill holes reaching beneath MDA A to identify any migration of contamination. Although the General's Tanks re-

ceived liquid wastes, they are empty, and the initial investigation of this plan emphasizes angle holes beneath them to evaluate migration. Depending on the results of initial sampling, this approach to subsurface contaminant migration characterization may need to be modified or expanded to include a larger area.

Given limited contaminant information, initial sampling will analyze for a broad analytical spectrum of radionuclides, organics, inorganics, and metals. However, in any necessary additional investigations, the analytical suite will be focused as appropriate to specific contaminants identified.

16.8.4 Sampling Plan

Detailed tables have been prepared to identify the sample screening and analysis requirements for each planned investigation at MDA A. However, due to the large number of pages, these tables have been placed in Sec. F.8 of Appendix F, Analytical Tables.

16.8.4.1 Surface Sampling Plan

16.8.4.1.1 1990 Surface Sampling

MDA A was sampled intensively in October 1990 for surface radionuclide contamination. This sampling effort is part of the Environmental Surveillance Group's environmental surveillance of low-level radioactive waste sites. Sample locations are on a 10- by 10-m grid. As shown in Fig. 16.8-6, several areas have additional sample locations based on a 3- by 3-m grid. These replicate sample units allow for characterization of the local variability, increasing precision for the prediction of contaminant concentration distributions. Phoswich and μR counts will be determined for each sample location, and samples taken at these locations will be analyzed in the laboratory for radionuclide contamination.

In 1985, MDA A underwent site stabilization activities of removing surface contamination, adding cover material, recontouring, and reseeding. The data collected in 1990 should help determine the effectiveness of this stabilization activity.

16.8.4.1.2 Initial Investigation

To supplement the October 1990 sampling within the fence (see Sec. 16.8.1.2.2), 40 samples will be taken on a 20- by 20-m grid from the fence to the canyon rim. Five additional samples will also be collected approximately 5 m from selected grid nodes as shown in Fig. 16.8-7 to assess

spatial variability. The 20- by 20-m grid to the canyon rim will be coordinated with the 40- by 40-m grid of the TA-21 OU surface sampling plan described in Chapters 12 and 13. Drainage samples will be collected as described in Section 16.1.4. Radioactive survey instruments will be used within the gridded area to confirm that no areas of elevated radioactivity are present between grid points. Up to 10 additional samples will be taken to further characterize any such areas detected.

The samples will be submitted to an analytical laboratory for radionuclides, metals, and semivolatiles analyses. The screening and analysis requirements are given in Table F.8-I (see Appendix F).

16.8.1.4.3 Subsequent Investigation

For planning purposes, it is assumed that 20 surface samples on a 10- by 10-m grid surrounding MDA A will be required in a subsequent investigation. A reduced analytical suite will be used, if possible, based on results from the initial investigation. However, for planning purposes, it is assumed that a full analytical suite will be used. Table F.8-II (Appendix F) gives the assumed screening and analysis requirements for the subsequent investigation.

16.8.4.2 Subsurface Sampling Plan

16.8.4.2.1 Initial Investigation

The subsurface sampling plan at MDA A is designed to provide information for the data needs described in Sec. 16.8.2. Sampling objectives are discussed in the Introduction (Secs. 16.1.2 and 16.1.5). Subsurface studies at MDA A will emphasize the characterization of potential contaminant infiltration beneath the two underground storage tanks (General's Tanks); two eastern solid waste disposal pits; the central solid waste disposal pit; and the NaOH-iodine drum site. These features have been accurately located with a previous geophysics study (Gerety et al. 1989), which has assisted in hole placement beneath features of interest.

Six holes will be drilled around the perimeter of the site (Fig. 16.8-8). Three of the holes will be inclined 15 to 30° from horizontal, and three of the holes will be vertical (Figs. 16.8-8 and 16.8-9). One inclined drill hole will penetrate beneath the General's Tanks to detect possible leakage of contaminants. One inclined drill hole will penetrate tuff adjacent and below the two eastern solid waste disposal pits, and another inclined hole will be drilled beneath the central solid waste storage pit. Two vertical drill holes are located north of these solid waste pits to detect possible

lateral movement of contaminants towards DP Canyon. An additional vertical hole will be drilled to determine the presence of contamination at the NaOH-iodine drum storage site.

Samples for contaminant characterization, along with samples for moisture determination, will be collected at 5-ft intervals along the length of the drill holes. The nominal length of the drill holes is given in Fig. 16.8-8. The borehole stopping criteria in Sec. 11.5.3 will be applied only to vertical boreholes (angled holes will stop at the defined length), and the field laboratory will be used to make these determinations.

A full suite of analytical laboratory analyses will be conducted on all core samples. The screening and analysis requirements are identified in Table F.8-III (Appendix F).

An objective of this investigation is to evaluate the importance of fractures as potential preferential transport pathways. When fractures are encountered, they will be preferentially sampled. When a fracture is encountered over a 5-ft sampling interval, two samples will be taken from that sampling interval to allow a comparison of analytical results for fracture and nonfracture intervals.

Geochemical parameters and mineralogy (as detailed in Sec. 12.5.1.5) will be characterized systematically at 20-ft intervals in the core and within contaminant zones to define the geochemical parameters associated with particular contaminants. For planning purposes it is assumed that 20% additional sampling within contaminant zones will be needed to define mineralogical and geochemical control on contaminants. Geochemical analysis is summarized by borehole in Table F.8-IV (Appendix F).

16.8.4.2.2 Subsequent Investigation

If the hypothesis is correct that no migration is occurring, then either no subsequent investigation or a minimal subsequent investigation may be required. However, if initial boreholes or modeling results suggest migration is occurring, then additional boreholes may be required. The necessity for additional characterization will be determined after results from the initial drilling are evaluated. Placement of additional drill holes will be based on results from the initial drill holes and modeling results.

It is anticipated that no more than five additional boreholes will be required. In any subsequent sampling, to the extent possible, a reduced analytical suite, determined by analyzing for the full suite of contaminants in the initial investigation, will be used.

For planning purposes, it is assumed that five 75-ft boreholes will be required (see Fig. 16.8-10). The analytical suite specified for the samples may be focused based on initial sample analysis results, but for planning purposes, it is assumed that a full analytical suite will be used. Table F.8-V (see Appendix F) identifies the assumed screening and analysis requirements for the subsequent investigations.

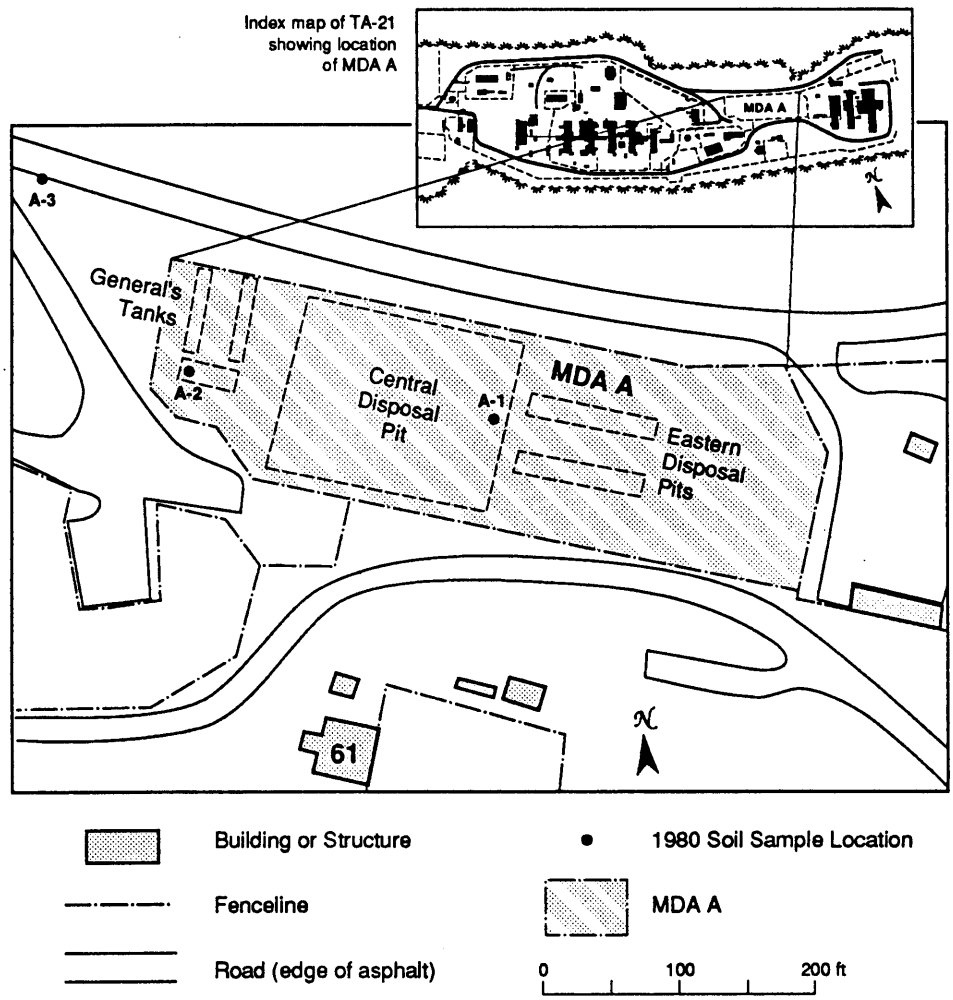


Fig. 16.8-1 General base map of MDA A showing location of 1980 soil samples.

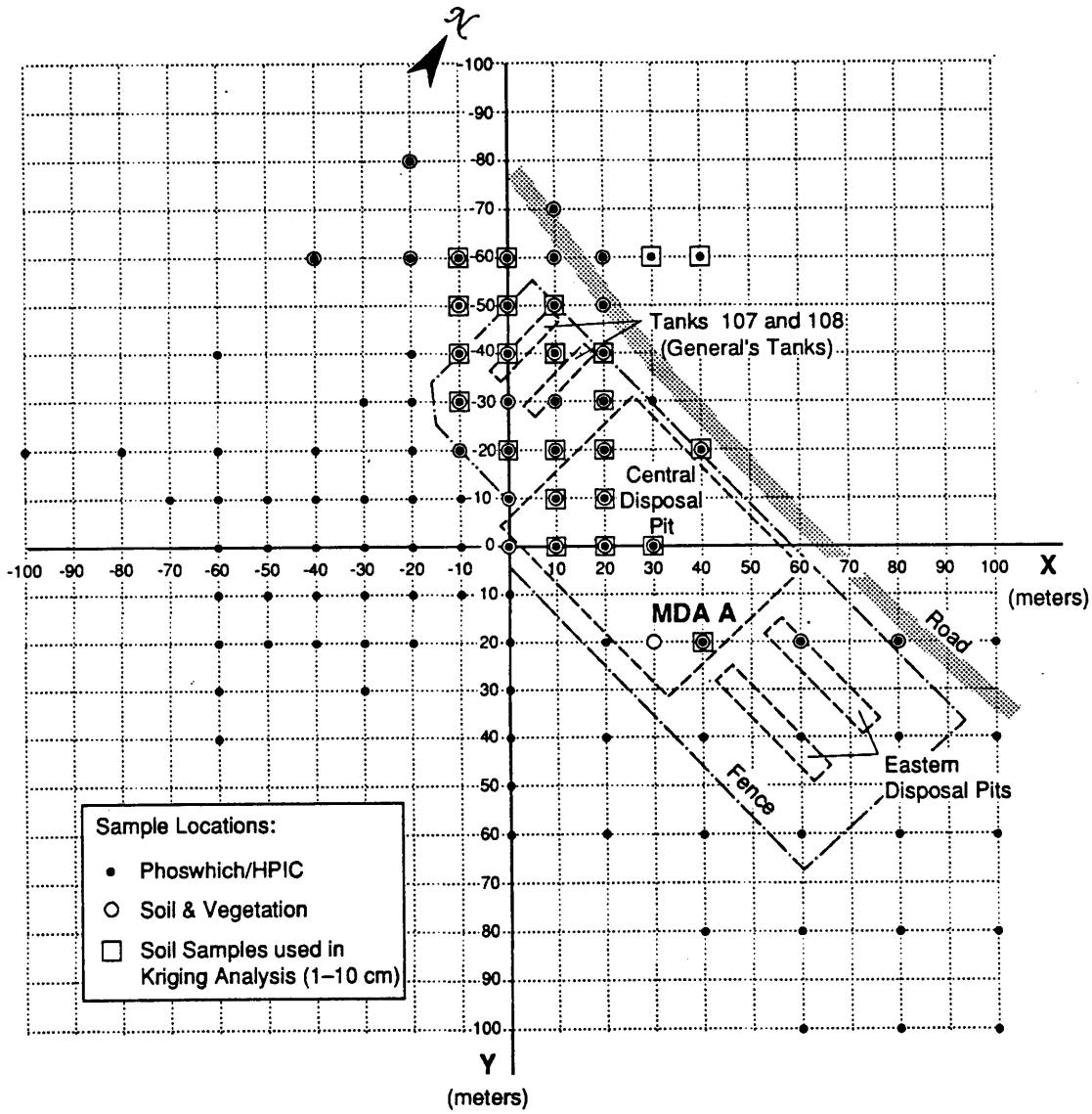


Fig. 16.8-2 Sampling grid used on MDA A in 1984.

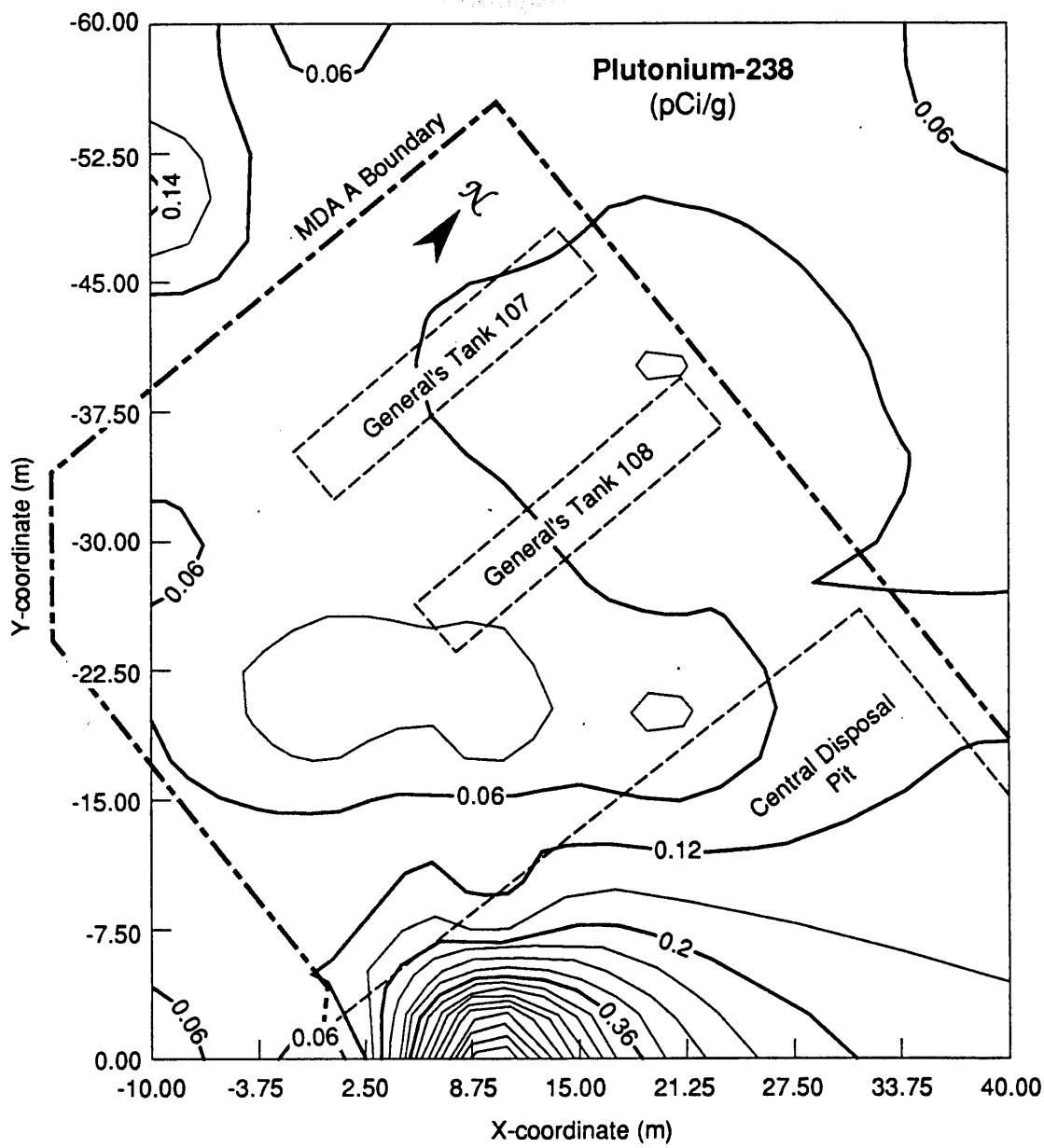


Fig. 16.8-3 Plutonium-238 contours from 1984 surface sampling program.

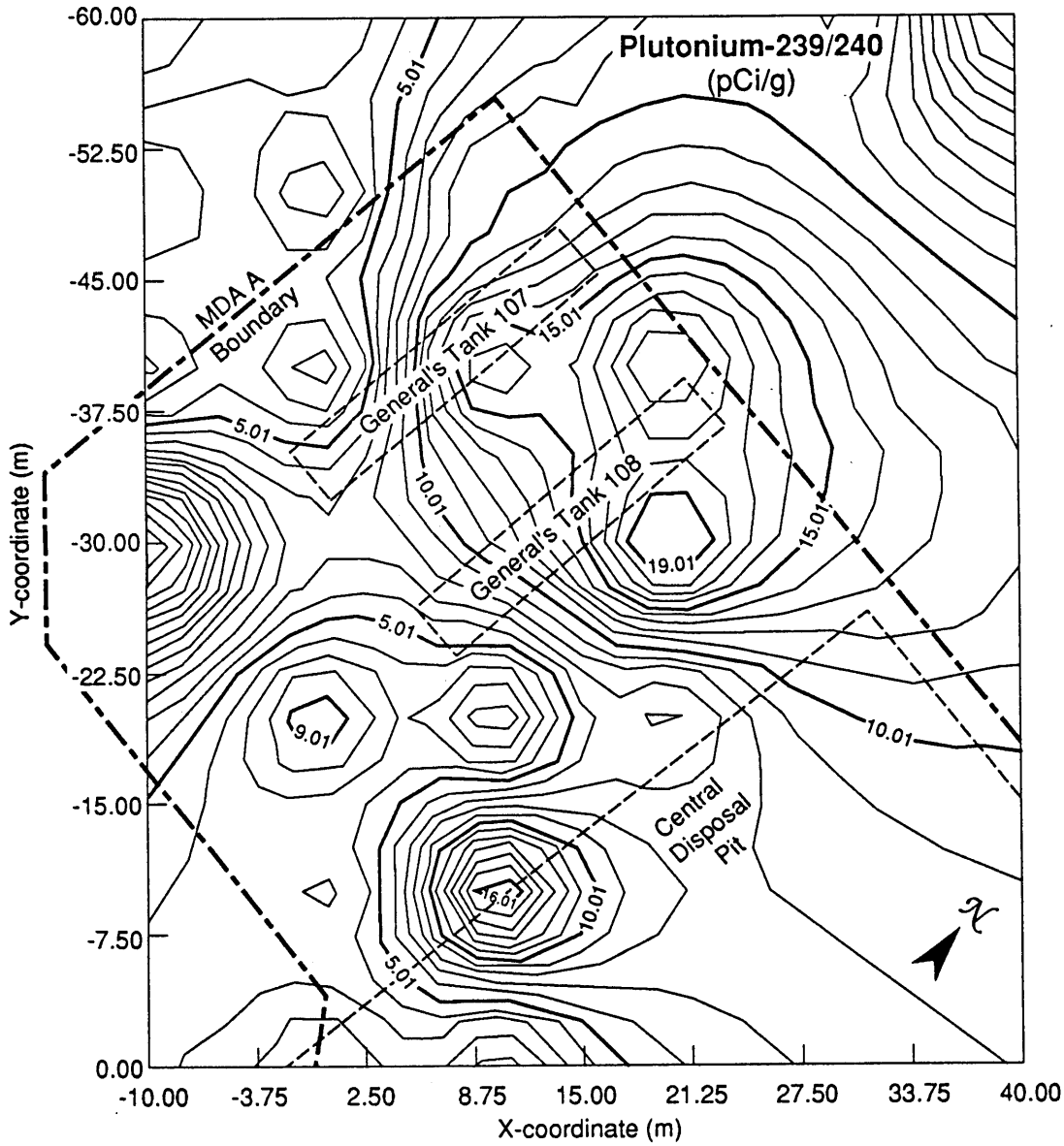


Fig. 16.8-4 Plutonium-239/240 contours from 1984 surface sampling program.

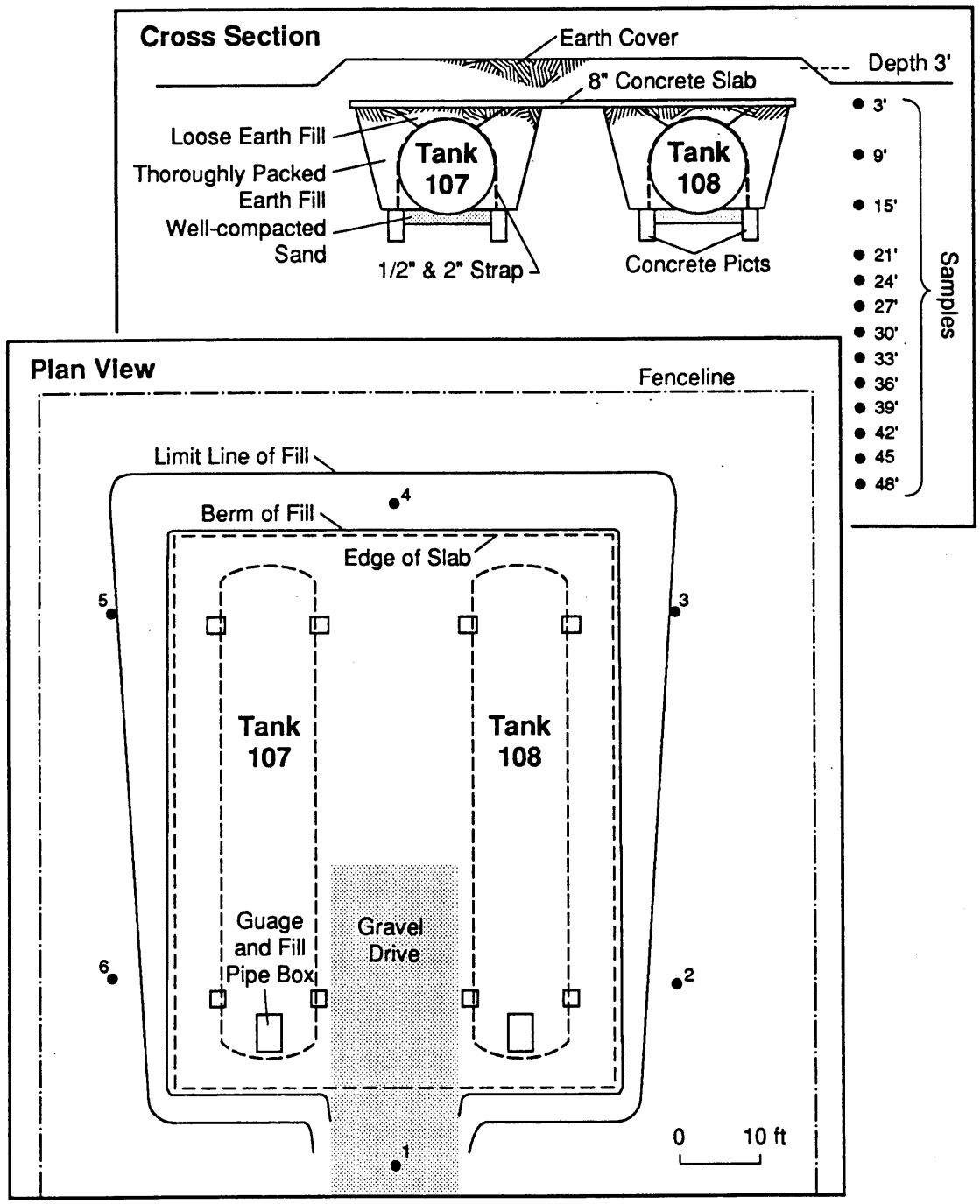


Fig. 16.8-5 1983 subsurface soil samples collected with "minuteman" drill (cross section). Locations perimeter to the "General's Tanks" as marked on map (plan view).

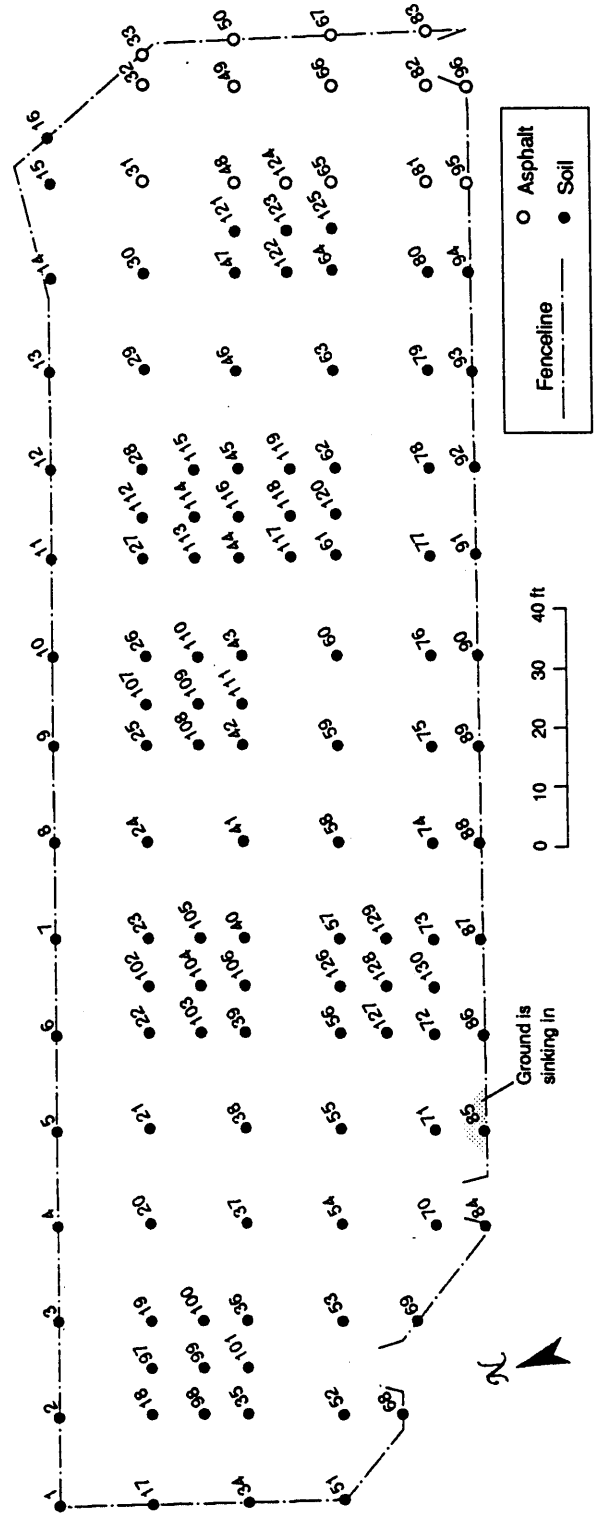


Fig. 16.8-6 Fall 1990 sampling locations for Environmental Surveillance Group's surveillance of low-level radioactive waste.

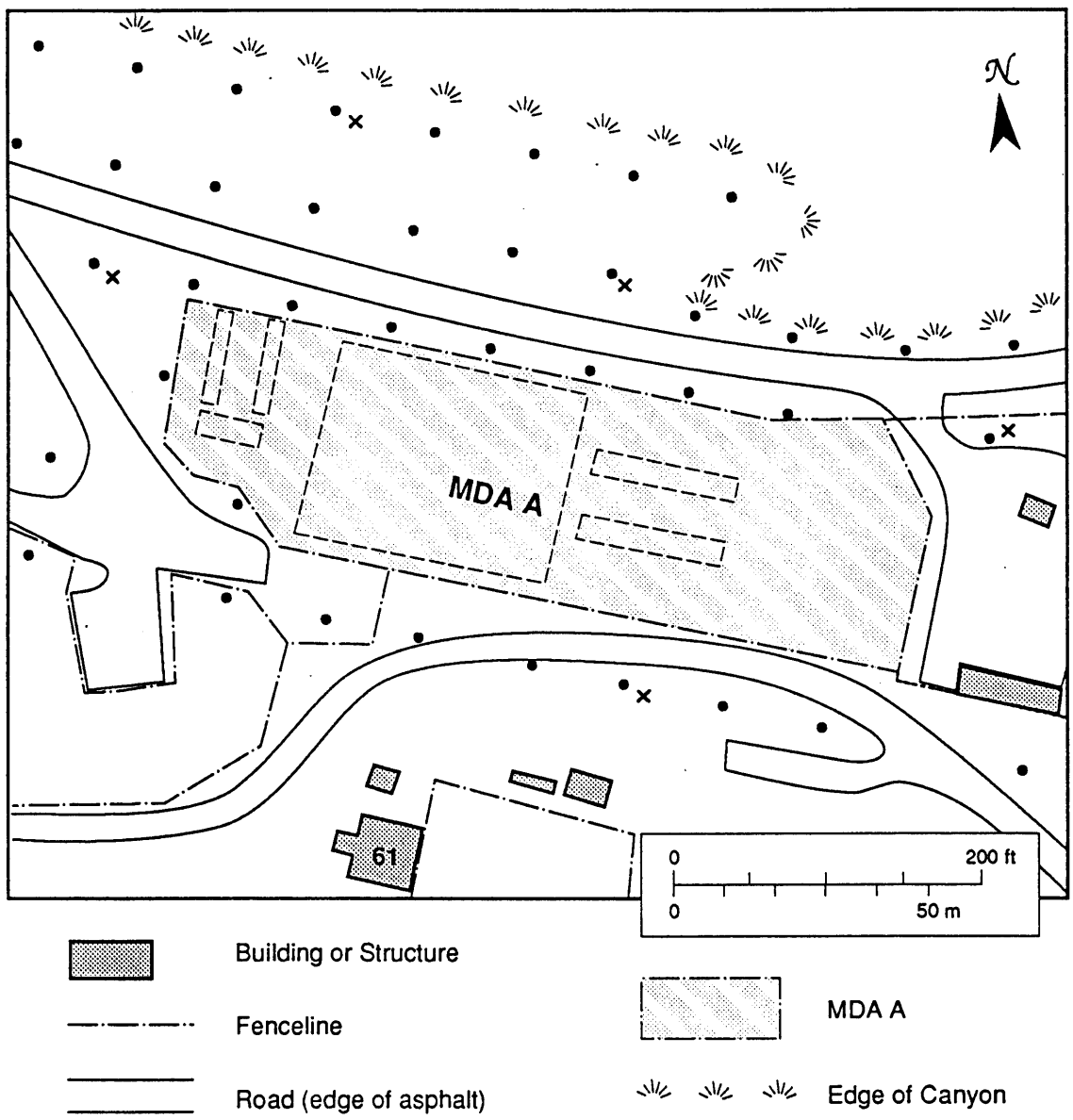


Fig. 16.8-7 Twenty-meter by twenty-meter surface sampling grid for MDA A. The x's indicate possible replicate sample locations.

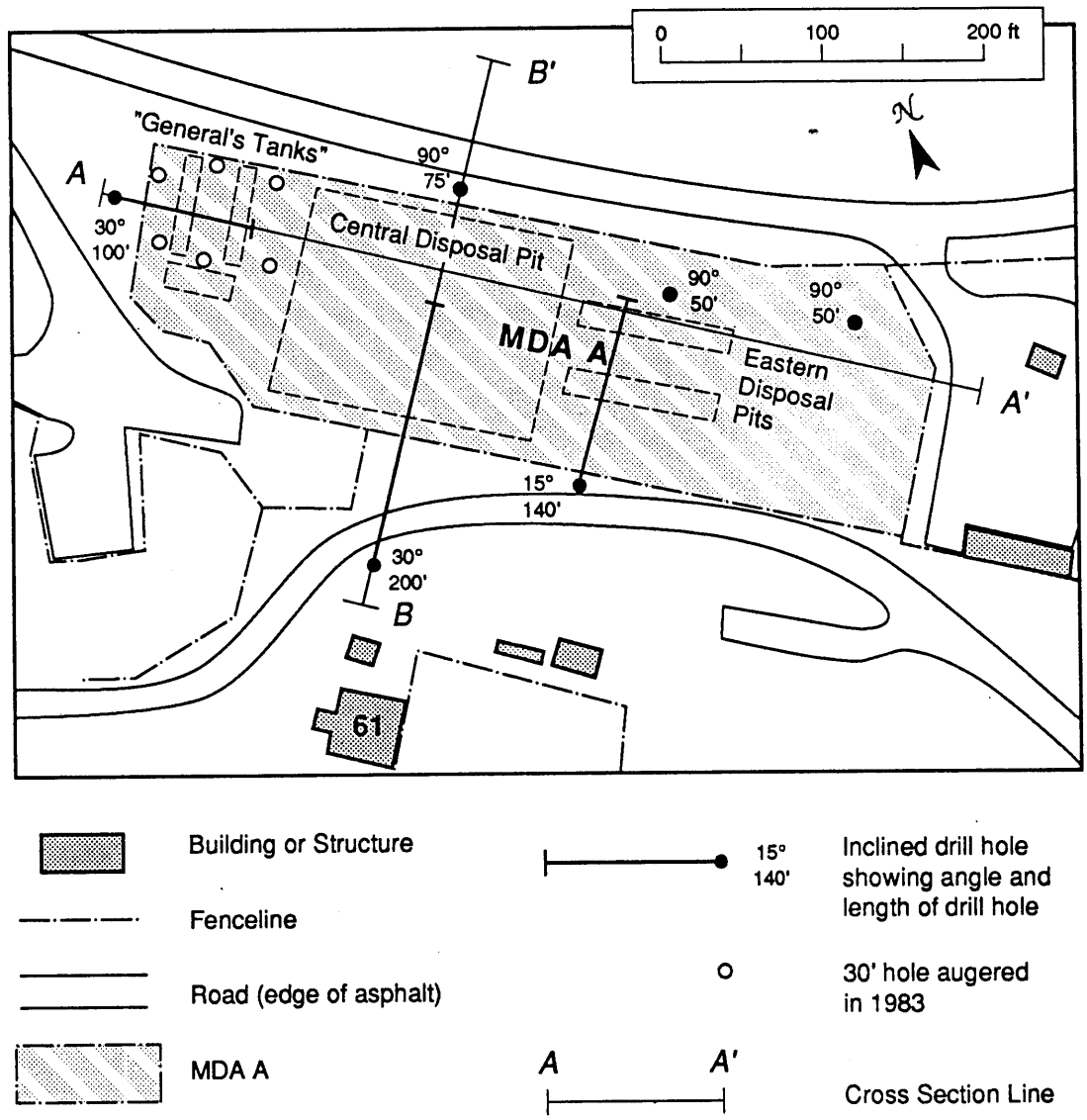


Fig. 16.8-8 Location of initial characterization drill holes at MDA A.

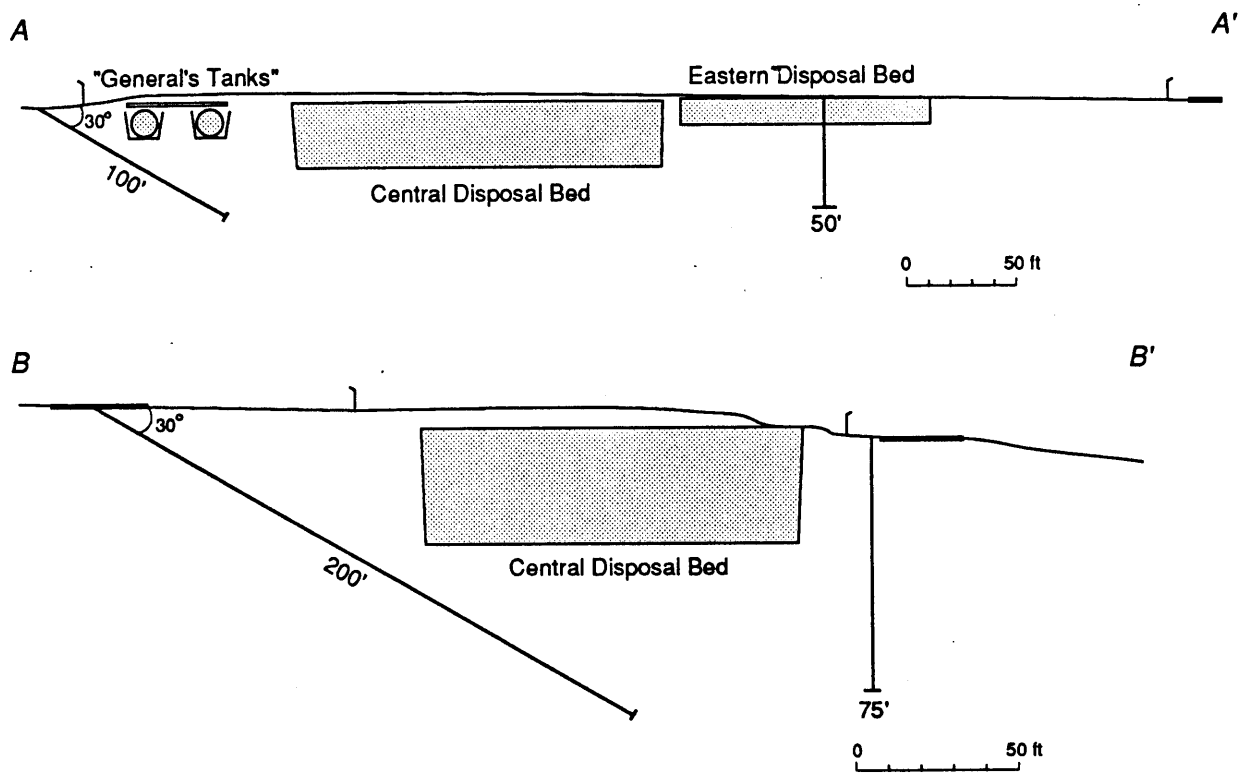


Fig. 16.8-9 Cross sections for MDA A showing layout of the "General's Tanks," disposal beds, and initial characterization drill holes. Drill holes outside the plane of the section are dashed.

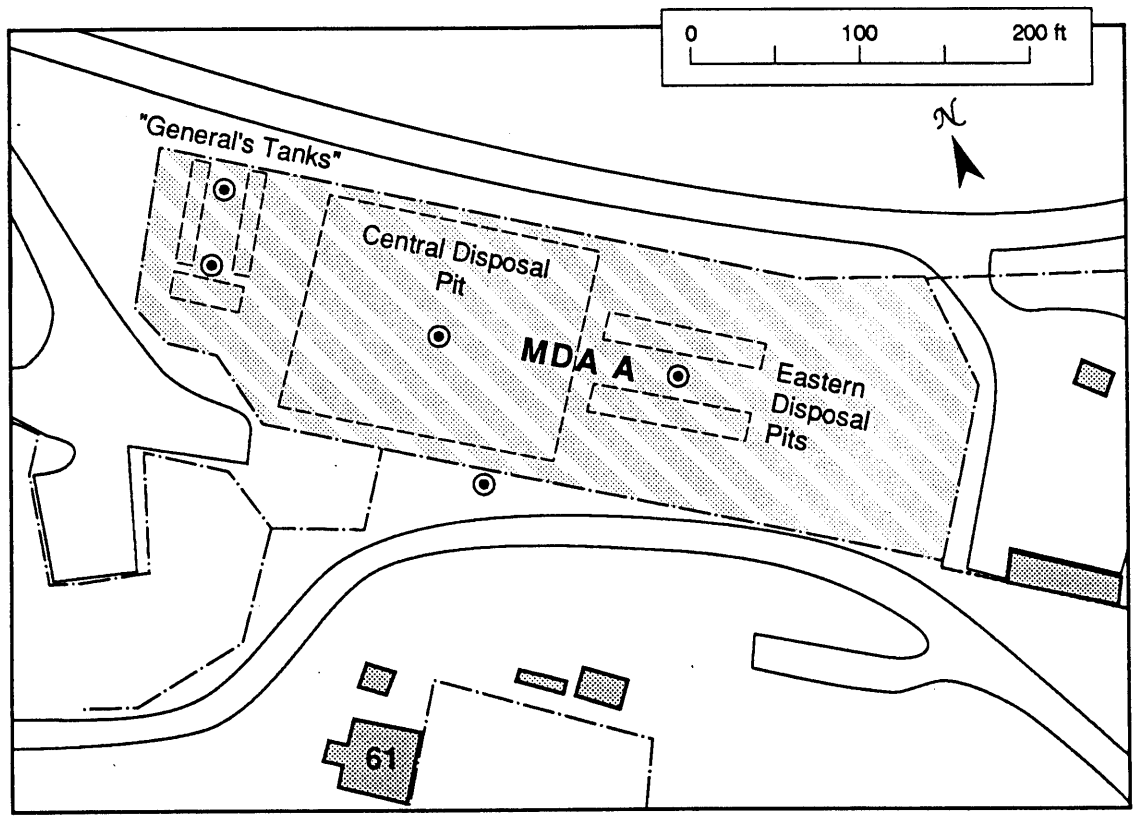


Fig. 16.8-10 Location of subsequent characterization drill holes at MDA A.

TABLE 16.8-I CHRONOLOGICAL EVENTS FOR MDA A

Date	Location	Reference	Event
1945	MDA A	N/A	Construction of four pits on eastern end of MDA A (125 ft x 18 ft x 12 ft deep).
1945	MDA A	N/A	Construction of two storage tanks (General's Tanks: 12 ft in diameter and 62-ft 10-in. long.
1946	MDA A	N/A	4 pits on eastern end of MDA A closed.
1946	MDA A	N/A	Last addition of liquids to General's Tanks.
Early 1950s up to June 1952	General's Tanks liquids at MDA A (designated as site 6-2 SL in report)	Unpublished 1963 USGS Report cited in LA-6848-MS	Gross alpha assays on liquid contents.
1960	MDA A	N/A	Hundreds of drums of radiolodide waste, which were previously stored within MDA A, were removed.
1969-1972	MDA A	N/A	Building debris from demolition work at TA-21 added to large pit in center of MDA A.
1969	MDA A	N/A	Large pit constructed in the center of MDA A (150 ft x 40 ft x 22-ft deep).
1972	MDA A	N/A	Large pit in center of MDA A enlarged to bury building materials from the demolition of building TA-21-12 (172 ft x 134 ft x 22-ft deep).
1972-1978	MDA A	N/A	Waste materials added to large pit in center of MDA A.
1973,1975	General's Tanks liquids at MDA A	Memo No. H7-76-PEM-162	Gross alpha, ^{238}Pu, $^{239/240}Pu$, ^{241}Am, and nitrate assays on grab samples.

TABLE 16.8-I CHRONOLOGICAL EVENTS FOR MATERIAL DISPOSAL MDA A

Date	Location	Reference	Event
May 1974 segment.	Four locations immediately east and west of General's Tanks at MDA A	Los Alamos report LA-6848-MS, 1976 H-8 memo H8-WS-610	4 holes were augered to a depth of 35 feet and one composite sample collected from each 5 foot Gross alpha and beta assays performed.
1975	MDA A	N/A	Liquids in one of General's Tanks removed for processing at TA 21-257.
1978	MDA A	N/A	Large pit in center of MDA A covered over.
1980	31 locations outside of MDA A, 24 locations along MDA A fence, and 10 locations inside of MDA A	A411 Project File	Phoswich and uR meter field surveys
1980	MDA A site visit	A411 Project File	Overall qualitative evaluation of site surface condition.
5/20/80-6/2/80	2 locations within MDA A and 1 outside MDA A	A411 Project File	Soil samples collected for the 0–1-cm, 1–10-cm and 10–30- cm depths at each locations, as well as a total of 6 vegetation samples, and analyzed for tritium, total U, and $^{239/240}Pu$
10/6/82	Site visit of MDA A	A411 Project File	Overall qualitative evaluation of site conditions, µR meter survey. No soil and vegetation samples.
4th quarter 1982	5 locations on perimeter of MDA A	Los Alamos Notebook 23820 notes, 1983 Los Alamos report LA-9762-ENV	TLD data.
1983	MDA A	N/A	Liquids in General's Tanks removed for processing.

TABLE 16.8-I CHRONOLOGICAL EVENTS FOR MATERIAL DISPOSAL MDA A

Date	Location	Reference	Event
1983	2 locations between north fence of MDA A and road	A411 Project File, memo HSE-8-85-271, 3/27/85	Subsurface samples collected in various depth increments to a depth of about 17.6 m and assayed for ^{137}Cs, $^{239/240}Pu$ and total U.
1983	Surface soils from 15 locations within MDA A and 5 locations outside of MDA A.	1984 Los Alamos report LA-10100-ENV	Soil samples from 0-1 cm, 1-10 cm and 10-30 cm depths assayed for tritium, total U, and $^{239/240}Pu$.
1983	6 locations adjacent to and surrounding the General's Tanks at MDA A	A411 Project File	Soil samples collected at 3 foot intervals to a depth of 30 feet in each hole using Purtymun's drill rig (auger samples). Samples assayed for tritium, uranium, ^{238}Pu, $^{239/240}Pu$, and ^{137}Cs
4 quarters 1983	5 locations on perimeter of MDA A	Los Alamos Notebook 23820, 1984 Los Alamos report LA-10100-ENV	TLD date.
1984	15 locations within MDA A and 5 locations outside of MDA A	1985 July A411 monthly report, memo HSE8-85-909	Soil samples collected at 0-1, 1-10 and 10-30 cm sampling depths at each of 20 locations and analyzed for tritium, total U and $^{239/240}Pu$.
May 1984	16 locations outside MDA A fence and 21 locations inside fence	A411 Project File	Phoswich and uR meter surveys.
May-July 1984	33 locations around MDA A	A411 Project File	Vegetation samples assayed for tritium, total U and $^{239/240}Pu$.
July-August 1984	16 locations outside MDA A fence and 21 locations inside fence	A411 Project File	Phoswich and µR meter surveys.

TABLE 16.8-I CHRONOLOGICAL EVENTS FOR MATERIAL DISPOSAL MDA A

Date	Location	Reference	Event
4 quarters 1984	5 locations on perimeter of MDA A	Los Alamos Notebook 23820 notes, 1986 Los Alamos report LA-UR-86990, 1985 Los Alamos report LA-10421-ENV	TLD data.
1985	MDA A	N/A	Site stabilization activities in sealing and covering openings in the General's Tanks, removing surface contamination, adding cover material and recontouring and reseeding MDA A.
1st quarter 1985	7 locations within and outside of MDA A	A411 Project File	Gamma spectrum analysis of soils at 1–10-cm and 1030-cm depths.
6/85	Site visit of MDA A	A411 Project File	Overall qualitative evaluation of site conditions before and after stabilization.
6/12/85	MDA A trench cap	A411 Project File	Annual site inspection of opened trench cap.
4 quarters 1985	5 locations around MDA A perimeter	Los Alamos Notebook 23820 notes	TLD data.
7/86	Surface reconnaissance of MDA A	A411 Project File	Qualitative evaluations of site conditions.
7/18/86	Surface of MDA A	A411 Project file	Surface reconnaissance survey remarking on general conditions of cover.
4 quarters 1986	5 locations around MDA A perimeter	Los Alamos report LA-10992-ENV	TLD data.

TABLE 16.8-II. RADIONUCLIDES IN SOIL AND VEGETATION SAMPLES FROM MDA A IN 1980

Location	Soil Sample Depth (cm)	^{3}H (pCi/L)		Concentrations Total U (µg/g)		$^{239,240}Pu$ (pCi/g)	
		Soil	Veg	Soil	Veg	Soil	Veg
Bkgd.[a,b]		7200[a]	800[b]	3.4[a]	9.6[b]	.025[a]	.00023[b]
A-3	0-1	2700		3.5		1.10	
	1-10	2200	100	3.3	0.1	0.93	0.29
	10-30	1600		3.5		2.00	
A-2	0-1	9100	5200[c]	38.0	1.3[c]	14,000	1700[c]
	1-10	3100	1300	13.0	0.4	60,000	1700
	10-30	3200	3500	6.5	0.1	17,000	80
A-1	0-1	5800	3400[c]	3.6	0.4[c]	11.6	2.16
	1-10	3000	5500	3.9	0.1	15.5	3.10
	10-30	4500		4.4		17.5	

[a]Upper background levels from Purtymun (1987).
[b]Upper background levels from The Environmental Surveillance Group (1987).
[c]Vegetation data are for different species.

TABLE16.8-III. FIELD SURVEY DATA FROM MDA A IN1984.

Grid Location x	Grid Location y	Phoswich counts[a] per 200 sec	HPIC[b] µR/hr
0	0	1028	7.5
0	-10	712	9.0
-10	0	1419	8.5
-10	-10	812	3.0
-20	-20	963	12.5
-30	-20	496	4.0
-40	-20	710	6.5
-50	-10	796	7.5
-60	-10	1273	8.3
-60	0	1179	7.7
-60	-10	906	8.3
-70	-10	726	6.5
-50	-20	931	7.7
-60	20	771	6.5
-60	30	1234	9.0
-60	40	1253	8.3
-30	-10	1161	8.3
-40	10	1040	7.5
-50	0	1475	9.5
-50	10	1455	10.2
-40	20	1422	8.5
-30	20	1552	9.5
-20	10	1413	9.0
-20	0	1428	9.5
-29	0	807	7.5
-40	0	2107	10.5
-40	10	1503	10.2
-30	10	1407	8.5
0	0	1500	7.5
0	10	1819	7.7
0	20	1871	7.5
0	30	1837	8.3
10	-10	1768	8.5
-20	20	1761	7.7
-30	30	1634	6.3
20	20	922	2.1
40	20	728	5.0
60	20	860	4.1
40	40	1070	7.5
60	40	918	6.5
80	40	907	6.0
60	60	799	7.5
80	60	1333	5.7
100	60	1295	4.5

TABLE16.8-III. FIELD SURVEY DATA FROM AREA A IN1984 (continued)

Grid Location x	Grid Location y	Phoswich counts[a] per 200 sec	HPIC[b] µR/hr
80	80	682	4.7
100	80	910	4.7
120	80	1152	6.5
100	100	1034	4.5
20	100	796	4.9
0	80	833	4.9
20	0	1146	9.3
-60	-20	1095	7.7
-80	-20	1057	—
-100	-20	963	5.7
0	40	1618	7.7
-20	40	1373	8.1
0	60	1345	8.5
20	80	1482	8.1
40	100	737	7.3
60	100	969	7.3
40	80	2293	8.0
20	60	1991	18.1
40	60	1501	13.7
20	40	1619	12.5

[a]Counts per 200 seconds, Phoswich window set to16 - 60 KeV, detector height =8 cm. Average background reading x = 872, s =143, n = 7.

[b]HPIC (high pressure ion chamber) readings were taken with the detector one meter above ground, and averaged over a five minute interval. For background, x = 2, s = 0.6, n = 7. The instrument was incorrectly calibrated (readings at Los Alamos should be in the range of 10-15 µR/hr); therefore, only relative and not absolute µR/hr can be compared.

TABLE 16.8-IV RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES TAKEN FROM MDA A IN 1984 FROM THE SAMPLING GRID IN FIG.16.8-2

Sample Location BKGD[a]	Sample Depth (cm)	Tritium Value (pCi/L) 7200[a]	Uranium Value (µg/g) 3.4[a]	^{238}Pu Value (pCi/g) 0.005[a]	$^{239/240}Pu$ Value (pCi/g) 0.025[a]
-20, 10	0-1	3500			
-30, -10		5900			
-20, 0		28000			
-29, 0		9100			
-40, 0		3600			
-50, 0		4200			
-30, 10		4600			
-40, 10		6200			
-50, 10		20000			
-30, 20		5300			
-40, 20		3900			
-40, 10		4300			
-30,-10	1-10	1500	4.03		
-20, 0		3200	4.24	0.0140	0.1380
-29, 0		4700	3.50	6.0000	1000.00
-40, 0		2600	4.22	0.0440	1.2400
-50, 0		3500	4.13	0.0450	1.0700
-40, -10		2900	3.84	0.0370	1.7400
-20, 10		2000	3.91	0.0032	0.0310
-30, -10		2400	5.11	0.0910	19.2000
-40, 10		1700	4.34	0.1040	17.2000
-50, 10		2600	4.24	0.0630	10.0000
-30, 20		2000	4.23	0.1180	21.1000
-40, 20		2100	4.87	0.1250	20.4000
-30, -1-	10-30	2100	4.07	0.1230	16.7000
-40, -10		2300	4.12	0.0480	3.6300
-20, 0		3100	4.15	0.0140	0.1220
-29, 0		5400	3.75	0.0190	3.1000
-40, 0		3700	3.94	1.3300	2.9000
-50, 0		3300	3.83	0.0130	1.4600
-20, 10		3200	4.27	0.0780	12.6000

TABLE 16.8-IV RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES TAKEN FROM MDA A IN 1984 FROM THE SAMPLING GRID IN FIG.16.8-2

Sample Location BKGD[a]	Sample Depth (cm)	Tritium Value (pCi/L) 7200[a]	Uranium Value (µg/g) 3.4[a]	^{238}Pu Value (pCi/g) 0.005[a]	$^{239/240}Pu$ Value (pCi/g) 0.025[a]
-30, 10	10-30	3500	3.93	0.2420	48.8000
-40, 10		2100	3.86	0.0080	0.9700
-50, 10		2600	3.60	0.0110	0.4300
-30, 20		3200	4.03	0.0310	6.1000
-40, 20		1400	3.80	0.0100	1.6400
-60, 40	0-1	6400			
0, 30		4300			
-60, 30		11800			
0, 10		9100			
-10, 10		3700			
-120, 120		3800			
0, 20		8000			
-60, 0		4500			
-10, 0		7000			
0, 0		4800			
-120, -20		5200			
-60, -10		5200			
-50, -10		6600			
-80, -20		2700			
-60, -20		2700			
-160, -40		4200			
-120, -40		4800			
-100, -40		3200			
-60, -40		3300			
-160, -60		5200			
-140, -60		4000			
-120, -60		5300			
-100, -60		3300			
-200, -80		3000			
-200, -80		2500			
-180, -80		6300			

TABLE 16.8-IV RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES TAKEN FROM MDA A IN 1984 FROM THE SAMPLING GRID IN FIG.16.8-2

Sample Location BKGD[a]	Sample Depth (cm)	Tritium Value (pCi/L) 7200[a]	Uranium Value (µg/g) 3.4[a]	^{238}Pu Value (pCi/g) 0.005[a]	$^{239/240}Pu$ Value (pCi/g) 0.025[a]
-160, -80		6400			
-140, -80		8600			
-100, -80		6200			
-80, -80		16600			
-100, -100		4000			
-60, -100		3400	4.12	0.0091	0.1200
-60, 40	1-10	4300	3.82	0.0115	0.2250
-60, 30		3200	4.05	0.0543	10.1000
0, 30		2500	3.87	0.0725	12.0000
-20, 20		4100	3.92	0.0319	5.7700
0, 20		3200	4.08	0.0500	8.6600
-10, 10		5700	3.96	0.1090	17.3000
0, 10		2000	3.96	0.7770	0.4470
-60, 0		5700	3.55	0.0197	2.0700
-10, 0		2800	3.78	0.0924	2.8100
0, 0		2500	3.90	0.0522	0.7820
-60, -10		2800	3.79	0.1020	0.9430
-50, -10		7000	3.53	0.1750	4.4600
-60, 40		2800	3.73		
-60, 30		3200	3.76		
0, 30		3400	3.90		
-20, 20		2700	3.84		
0, 20		3200	3.86		
-10, 10		3400	3.71		
0, 10		4100	3.67		
-60, 0		2400	3.22		
-10, 0		2600	3.66		
0, 0		3000	4.42		
-60, -10		2800	4.03		
-50, -10		2200	3.69		
20, 30	0-1	14100			

TABLE 16.8-IV RADIONUCLIDE CONCENTRATIONS IN SOIL SAMPLES TAKEN FROM MDA A IN 1984 FROM THE SAMPLING GRID IN FIG.16.8-2

Sample Location BKGD[a]	Sample Depth (cm)	Tritium Value (pCi/L) 7200[a]	Uranium Value (µg/g) 3.4[a]	^{238}Pu Value (pCi/g) 0.005[a]	$^{239/240}Pu$ Value (pCi/g) 0.025[a]
20, 60		15000			
20, 40		5300			
-20, 40		6400			
-10, 20		3800			
20, 80	1-10	2800	3.70		
20, 60		3300	3.90		
20, 40		2400	3.89		
-20, 40		2400	4.05		
-10, 20		2000	4.05		
20, 80	10-30	3000	4.71		
20, 60		5800	3.95		
20, 40		3300	3.80		
-20, 40		3400	3.76		
-20, 20		3100	3.96		

[a]Upper background levels from Purtymun (1987).

TABLE 16.8-V. RADIONUCLIDE CONCENTRATIONS IN VEGETATION SAMPLES TAKEN FROM MDAA FROM THE SAMPLING GRID IN FIG. 16.8-2.

Sample Location BKGD[a]	Species	Tritium Value (pCi/L) 800[a]	Uranium Value (µg/g) 9.6[a]
-180, -40	Pinus Ponderosa	3800	9.890
-200, -40	Quercus Gambelii	2700	6.770
-60, -10	Medicago Sativa	2500	0.755
-50, -10	Chrysopsis Foliosa	2200	1.610
-50, -10	Pinus Ponderosa	3100	5.720
-40, -10	Gutierrezia Sarothrae	4000	3.740
-30, -10	Bromus Fectorum	5300	1.000
-30, -10	Artemisia Frigida	3000	4.950
-10, -10	Lactuca Spp.	3000	2.120
-60, 0	Medilolus Offician.	2700	0.930
-50, 0	Artemisia Frigida	3000	4.670
-50, 0	Artemisia Frigida	3400	4.910
-40, 0	Bromus Fectorum	1900	1.310
-29, 0	Artemisia Frigida	4200	6.840
-20, 0	Verbascum Thapsus	19000	4.560
-20, 0	Gutierrezia Sarathrae	17500	1.150
-10, 0	Verbascum Thapsus	2900	3.010
0, 0	Artemisia Frigida	2800	2.690
-40, 10	Artemisia Frigida	3100	2.740
-40, 0	Artemisia Frigida	3300	4.380
-20, 10	Verbascum thapsus	4000	4.090
-10, 10	Compositae	3400	2.320
0, 10	Gutierrezia Sarathrae	6100	1.050
10, 10	Poa Fendleriana	1400	1.260
-40, 20	Bromus Fectorum	3200	0.450
-30, 20	Verbascum Thapsus	3700	4.730
-20, 20	Lactuca Spp.	4300	1.590
-10, 20	Lactuca Spp.	6300	0.980
0, 20	Sitanion Hystrix	3300	2.340
0, 20	Lactuca Spp.	3700	0.880
20, 20	Verbascum Thapsus	6900	2.340

TABLE 16.8-V. RADIONUCLIDE CONCENTRATIONS IN VEGETATION SAMPLES TAKEN FROM MDAA FROM THE SAMPLING GRID IN FIG. 16.8-2.

Sample Location	Species	Tritium Value (pCi/L)	Uranium Value (µg/g)
BKGD[a]		800[a]	9.6[a]
20, 60	Lactuca Spp.	43000	1.090
20, 80		28000	0.550

[a]Upper background levels from the Environmental Surveillance Group (1987).

Table 16.8-VI
Plutonium concentrations in auger samples collected on the perimeter of the General's Tanks in 1983 at MDA A.

Sample Location Bkgd.[a]	Sample Depth (ft)	^{238}Pu (pCi/g) .005[a]	$^{239/240}Pu$ (pCi/g) .025[a]
Hole-1	0-3	0.0100	0.4200
"	6-9	-0.0004	0.0013
"	12-15	0.0003	0.0380
"	15-18	0.0009	0.0050
"	18-21	0.0008	0.1340
Hole-2	0-3	0.0400	6.8000
"	6-9	0.0007	0.0380
"	12-15	0.0003	0.0140
"	18-21	-0.0012	0.0016
"	21-24	0.0003	0.0140
"	24-27	-0.0004	0.0200
"	27-30	0.0011	0.0120
Hole-3	0-3	0.0240	2.5100
"	6-9	0.0008	0.0510
"	12-15	0.0004	0.0270
"	15-18	0.0015	0.0900
"	21-24	0.0008	0.0210
"	24-27	0.0004	0.0450
"	27-30	0.0310	0.0100
Hole-4	0-3	0.0036	5.7000
"	6-9	-0.0006	0.0850
"	12-15	0.0019	0.0007
"	15-18	0.0003	0.0039
"	21-24	-0.0007	0.0021
"	24-27	0.0005	0.0032
"	27-30	0.0025	0.0070
Hole-5	0-3	0.0060	0.4000
"	6-9	0.0009	0.0060
"	12-15	-0.0008	0.0010
"	15-18	-0.0007	0.0007
"	18-21	0.0012	-0.0008
"	21-24	-0.0004	-0.0016
"	24-27	0.0003	0.0062
"	27-30	0.0004	0.0011
Hole-6	0.5-3	-0.0005	0.1720
"	6-9	0.0003	0.0015
"	12-15	0.0002	0.0015
"	15-18	0.0002	0.0044
"	18-21	0.0004	0.0018
"	21-24	0.0007	0.0280
"	24-27	-0.0004	0.0027
"	27-30	0.0015	0.0007

[a]Upper background levels from Purtymun (1987).

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Volume III

TA-21 Operable Unit RFI Work Plan for Environmental Restoration

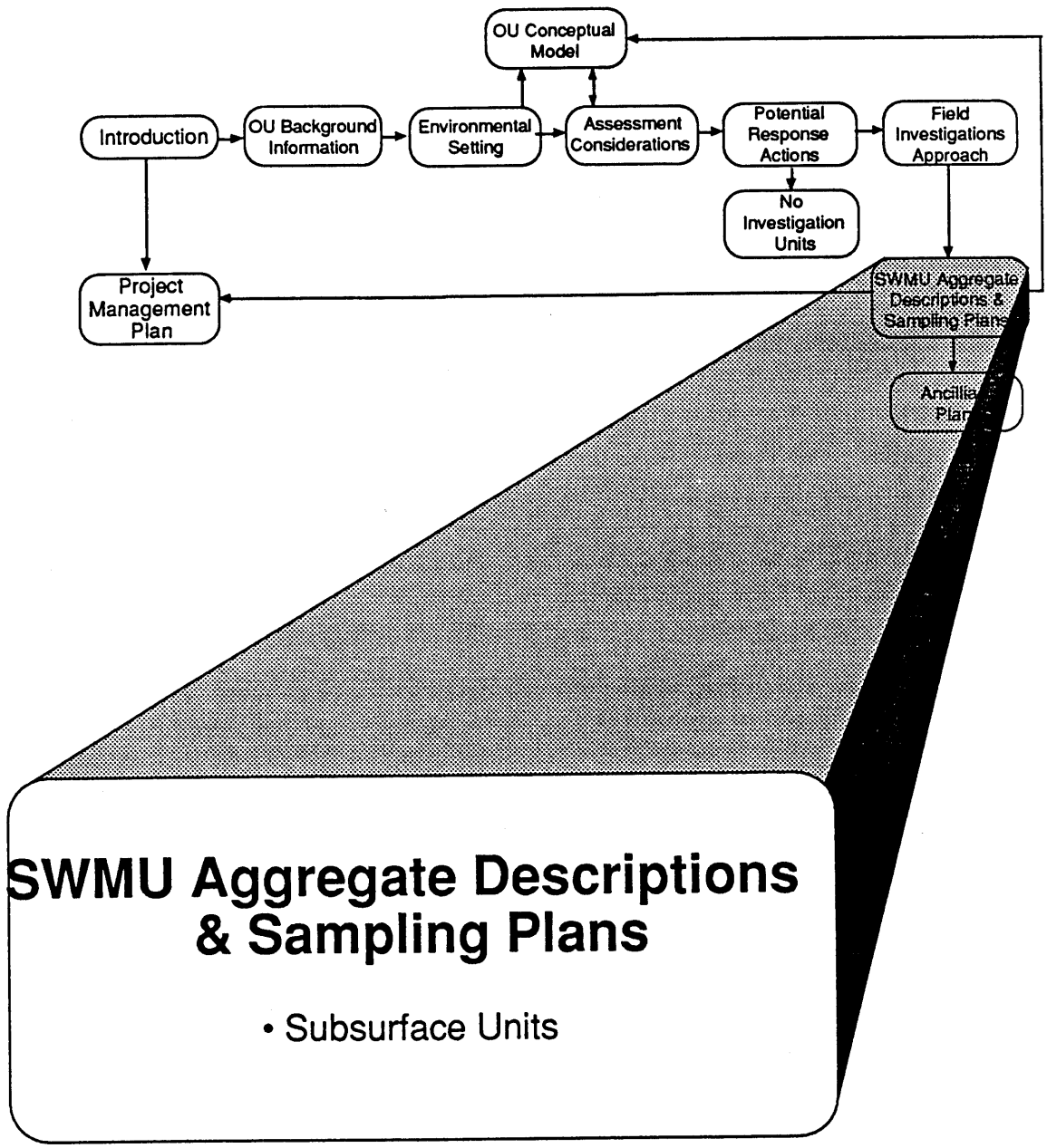
May 1991

A Department of Energy environmental clean-up program

Los Alamos
NATIONAL LABORATORY

LAUR 91-962

CHAPTER 17


OU Conceptual Model
Introduction
OU Background Information
Environmental Setting
Assessment Considerations
Potential Response Actions
Field Investigations Approach
No Investigation Units
Project Management Plan
SWMU Aggregate Descriptions & Sampling Plans
Ancillia
Plan
SWMU Aggregate Descriptions & Sampling Plans
• Subsurface Units

The following paragraphs present a brief description of the SWMUS in this chapter and the proposed field investigations. For all SWMUs in this chapter, the field measurements and laboratory analyses for initial investigations are summarized by section in Tables 17.1-I and 17.1-II. The same information for subsequent investigations is presented in Tables 17.1-III and 17.1-IV. The strategy for field and laboratory analyses is presented for each SWMU in flow charts in Figs. 17.1-1 through 17.1-5.

Underground Seepage Pit, SWMU 21-006(b). The underground seepage pit (TA-21-118) may have been installed as early as 1945. The land surface above the inactive seepage pit was regraded after 1980, and the location of the pit is not accurately known. The pit design is 16-ft wide by 70-ft long, with a depth of 6 ft. No data exist regarding contamination in the area of the underground seepage pit. Assays for radionuclides and nonradionuclides were performed on soil at the outlet line from the seepage pit into the canyon. Toluene, aluminum, iron, lead, ^{137}Cs, $^{239/240}Pu$, and tritium were present at levels higher than background. The analytical results are an indication that the soil around the seepage pit structure and the tuff beneath it may be contaminated with organic, inorganic, and radiological constituents and that these contaminants may have migrated.

The strategy for the field investigation at the seepage pit is presented in Fig. 17.1-1. The initial investigation includes a field survey with geophysical instruments to locate three boreholes into the seepage pit. If contaminants are identified in the subsurface soil samples, a subsequent field investigation will include additional vertical boreholes to characterize the lateral and vertical extent of contamination. Tables 17.1-I through 17.1-IV summarize measurements and analyses for subsurface soil samples to be taken during the field investigation.

Waste Treatment Laboratory, SWMU 21-009. The waste treatment laboratory was constructed in 1948. The building, removed in 1965, was originally built on concrete pillars and measured 16-ft wide by 40-ft long. There is no physical evidence at the present time to mark the former location of the laboratory. During operations, the building was contaminated with plutonium dust. Perchloric acid is an additional likely contaminant.

In addition to the former location of the laboratory, this SWMU includes an inactive buried waste line that carried waste from the laboratory building to a septic tank and ultimately to

17. SUBSURFACE UNITS DESCRIPTION AND SAMPLING PLAN

17.1 Introduction

This chapter provides site descriptions, the objectives of the investigation, and field sampling plans for several SWMUs that have the potential for liquid releases that occurred in the past but were confined primarily to subsurface soils. The list below identifies the SWMUs addressed in this chapter and the section in which each is addressed.

- Section 17.2

  SWMU 21-006(b), Underground Seepage Pits

- Section 17.3

  SWMU 21-009, Waste Treatment Laboratory

- Section 17.4

  SWMU 21-012, Dry Wells

- Section 17.5

  SWMU 21-022 (a and f), Acid Waste Lines and Sumps

- Section 17.6

  SWMU 21-005, Acid Pit

For all of the SWMUs in this chapter, data are needed on the presence or absence of contaminants in subsurface soil. Identified potential contaminant migration pathways for all of the SWMUs include infiltration and vapor phase movement (see Chapter 5). Exposure routes and potential receptors for each environmental transport pathway are identified in Chapter 6.

The criteria for preliminary identification of potential response actions at TA-21 SWMUs are presented in Chapter 10. The no-action alternative is identified as a potential appropriate remedial alternative for all of the SWMUs in this chapter. The field investigations at three of the SWMUs (21-005, 21-009, and 21-012) may determine that none of these is a release site, in which case, SWMUs that are not release sites will be proposed for no further investigation. Other preliminary remedial alternatives that are identified for two SWMUs [21-006(b), 21-022(a) and (f)] in this chapter include institutional controls, treatment, removal and disposal, and removal and treatment (see Table 10-I).

SWMU 21-022(f), Sump TA-21-173, is located off the northeast corner of TA-21-152. It is 5.5 ft in diameter and 6-ft deep. No previous sampling has been performed. The sump is located in the eastern portion of TA-21, where ^{210}Po and ^{227}Ac are associated with the waste from DP East. In addition to radionuclides, hazardous constituents may be present. It is not known whether environmental contamination is present.

The objective of the field investigation at SWMUs 21-022(a) and (f) is to confirm the presence or absence of contamination and to determine the lateral and vertical extent of contamination. The strategy for the investigation is presented in Fig. 17.1-4. Tables 17.1-I through 17.1-IV summarize the field measurements and laboratory analyses that are part of the initial and subsequent investigations.

Acid Pit, SWMU 21-005. The acid pit was installed in 1946 to use nitric acid to dispose of classified correspondence. The pit, removed in 1967, was a 3-ft^2 by 4-ft deep reinforced concrete structure covered with sheet iron. No data exist regarding contamination in the area of the former acid pit. No releases from the acid pit to the environment were documented.

The objective of the field investigation at SWMU 21-005 is to confirm the presence of contaminants in subsurface soils beneath the former location of the acid pit. The strategy for the field investigation at the acid pit is presented in Fig. 17.1-5. Field measurements and laboratory analyses for the initial investigation are summarized in Tables 17.1-I and 17.1-II.

an outfall near the canyon rim. The septic tank was removed during demolition of the laboratory, but whether the buried waste line still exists is not known.

The objective of the field investigation at SWMU 21-009 is to confirm the absence or presence of contamination in subsurface soils. The strategy for the field investigation at SWMU 21-009 is presented in Fig. 17.1-2. The initial investigation includes trenching to evaluate contamination associated with the drain line, land surveys to stake the location of the former laboratory, and three vertical boreholes within the footprint of the building to determine whether contaminants are present in subsurface soil samples. If contaminants are found, then a subsequent investigation includes additional vertical boreholes to characterize the lateral and vertical extent of contamination. Tables 17.1-I through 17.1-IV present a summary of measurements and analyses for subsurface soil samples to be taken during the initial and subsequent field investigations.

Dry Wells, SWMU 21-012. The dry wells investigation includes four inactive structures that received boiler blowdown (pressurized discharge of gaseous steam) from the former steam plant. The structure includes two concrete blowdown pits, a seepage pit, and a 54-ft-deep dry well. The old steam plant was constructed in 1945 and removed in 1985. The area was regraded, and there is presently no visible evidence of the locations of the structures that received boiler blowdown. There is no documentation that the structures were removed.

The objective of the field investigation at SWMU 21-012 is to confirm the absence of contamination in the subsurface beneath the inactive structures. The strategy for the investigation is presented in Fig. 17.1-3. Tables 17.1-I and 17.1-II summarize the field measurements and analytical laboratory analyses that are part of the initial investigation.

Acid Waste Lines and Sumps, SWMU 21-022 (a) and (f). There are 10 subunits identified in SWMU 21-022. Eight of these subunits, which are now inaccessible, are discussed in Chapter 18, Units for Coordination with Building D&D. The two subunits that are included for characterization in this chapter are two sumps that are accessible. The sumps are no longer being used.

SWMU 21-022(a), Sump TA-21-74, is located north of Building TA-21-21. The sump was constructed of brick in 1946 and is of unknown depth. No previous sampling has been performed. However, the sump is believed to be contaminated with plutonium and uranium.

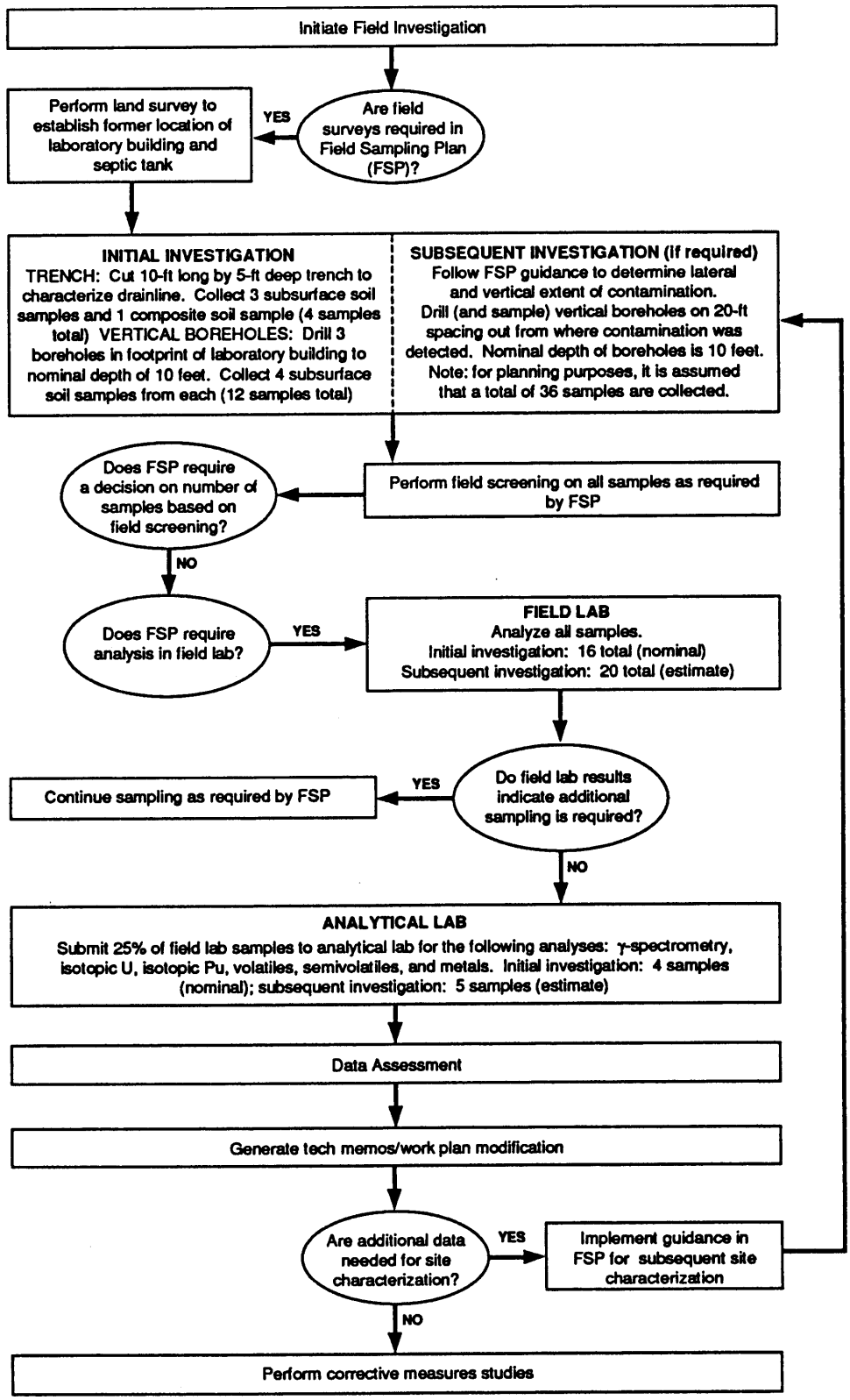


Fig. 17.1-2 Logic flow for the field investigation at SWMU 21-009 Waste Treatment Laboratory.

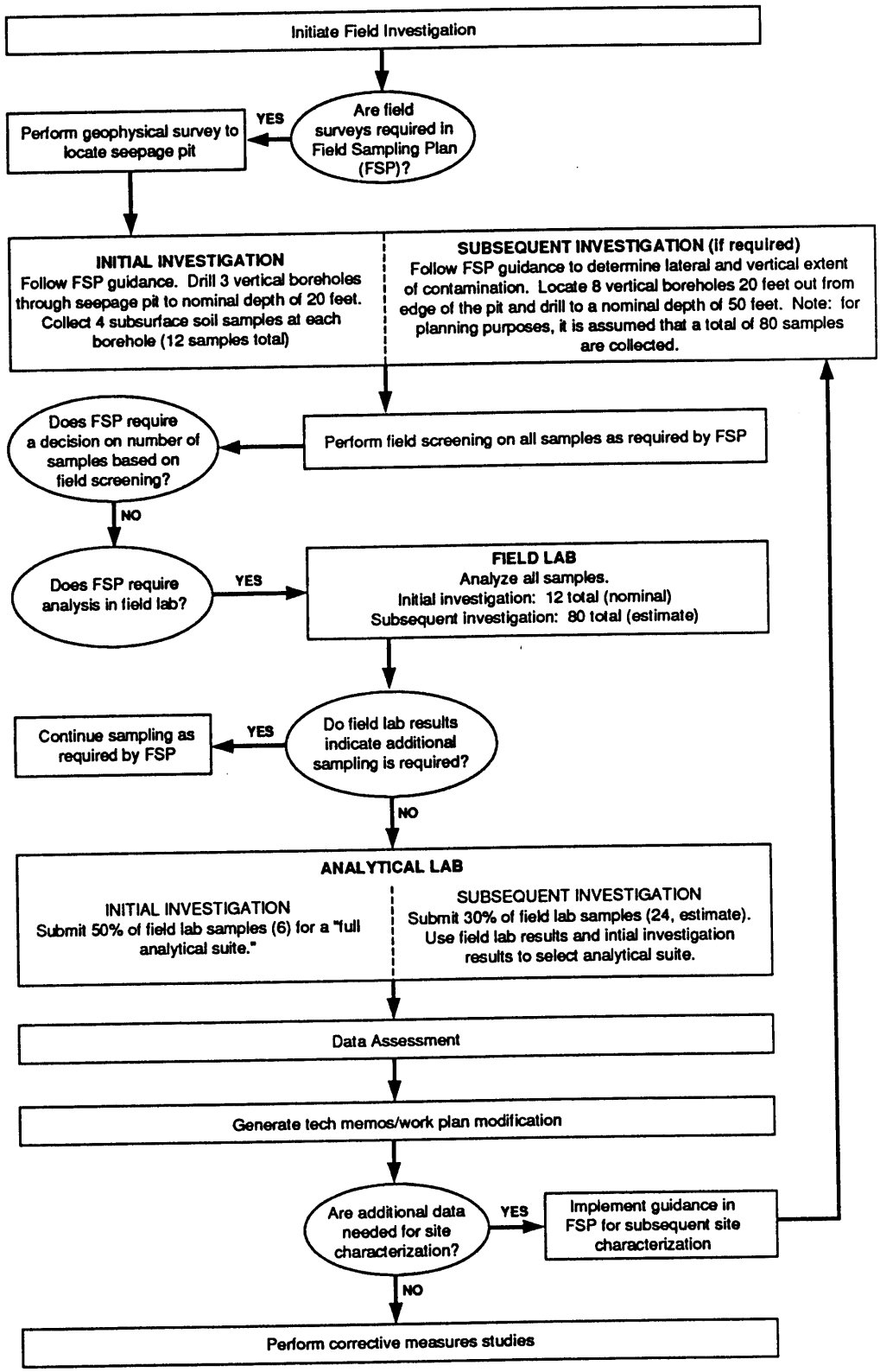


Fig. 17.1-1 Logic flow for the field investigation at SWMU 21-006(b) underground seepage pit.

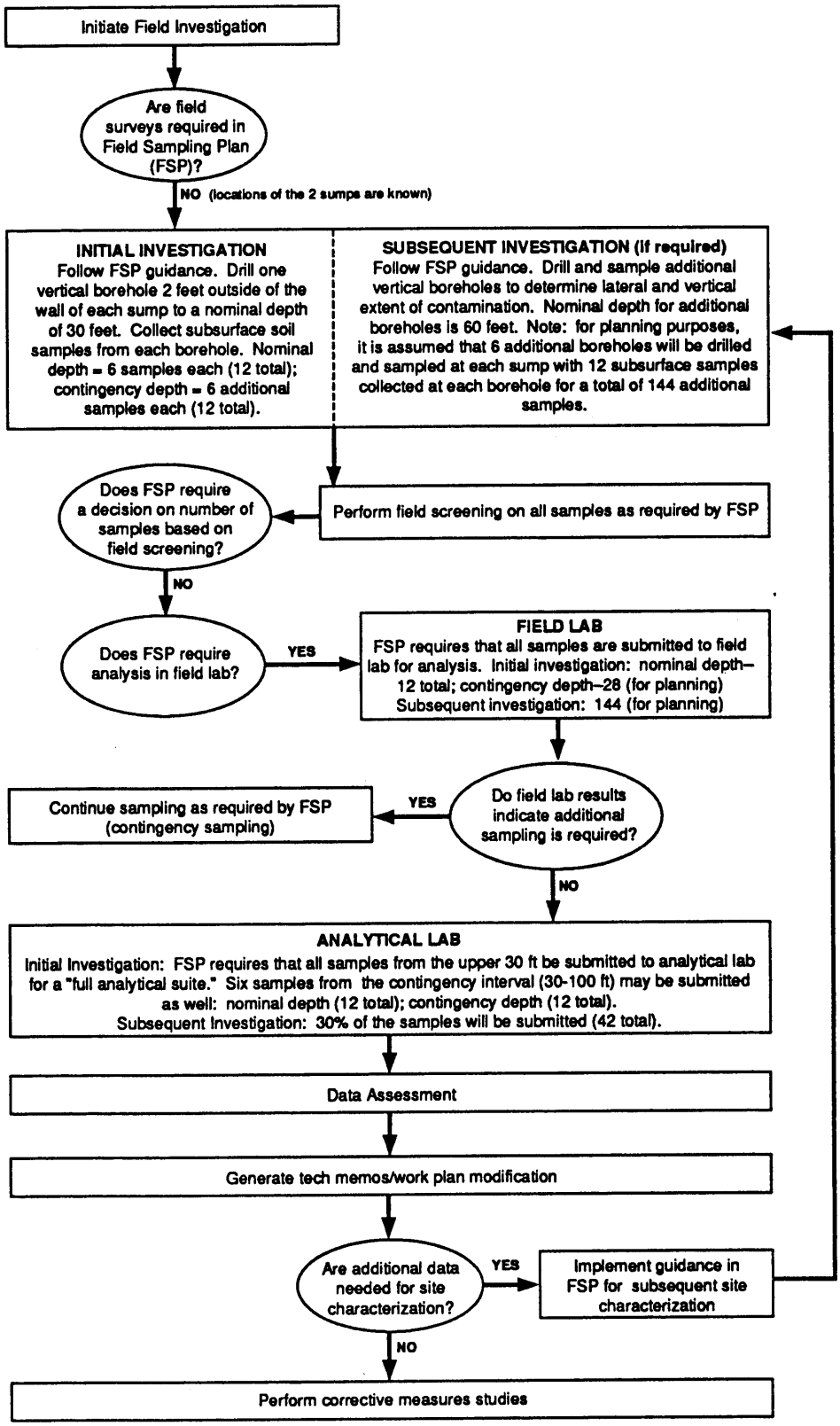


Fig. 17.1-4 Logic flow for the field investigation at SWMU 21-022(a), (f) sumps.

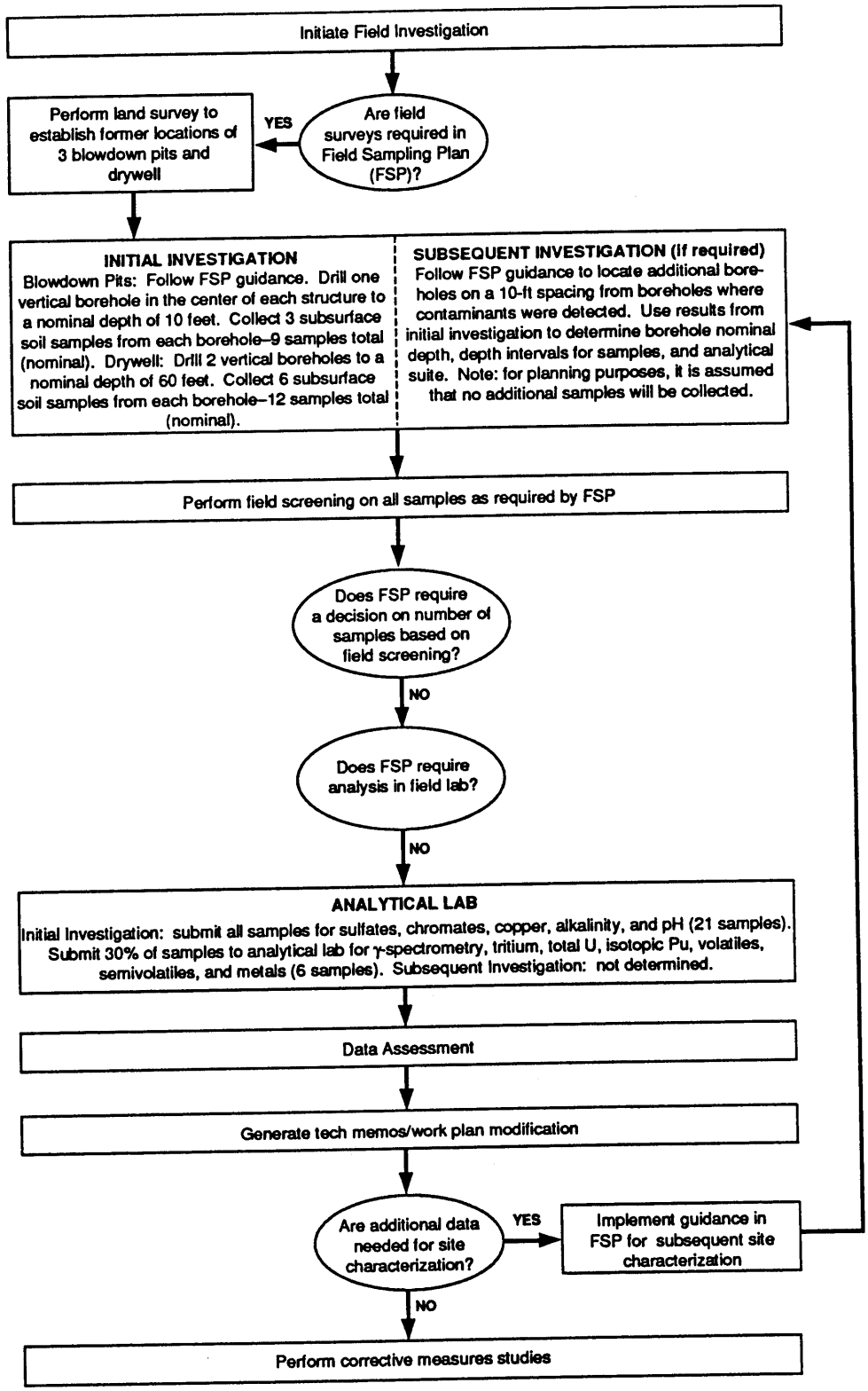


Fig. 17.1-3 Logic flow for the field investigation at SWMU 21-012 dry wells.

17.1-1 SUMMARY OF INITIAL INVESTIGATIONS BY SECTION FOR CHAPTER 17.

Section	Description	Survey Areas				Trench		Boreholes										QA
		Land	Radiological	Geophysical	No. of Locations	No. of Samples	Shallow			Vertical			Angled					
							Number	Total Footage	No. of Samples	Number	Total Footage	No. of Samples	Number	Total Footage	No. of Samples			
17.2	Underground Seepage Pit	1		1	1	4				3	45	12						4
17.3	Waste Treatment Laboratory						3	30	12	2	120	20						7
17.4	Dry Wells	5					3	30	12	2	200	40						10
17.5	Acid Lines and Sumps												1	10	4			4
17.6	Acid Pit	1																
Total		7		1	1	4	6	60	24	7	365	72	1	10	4			25

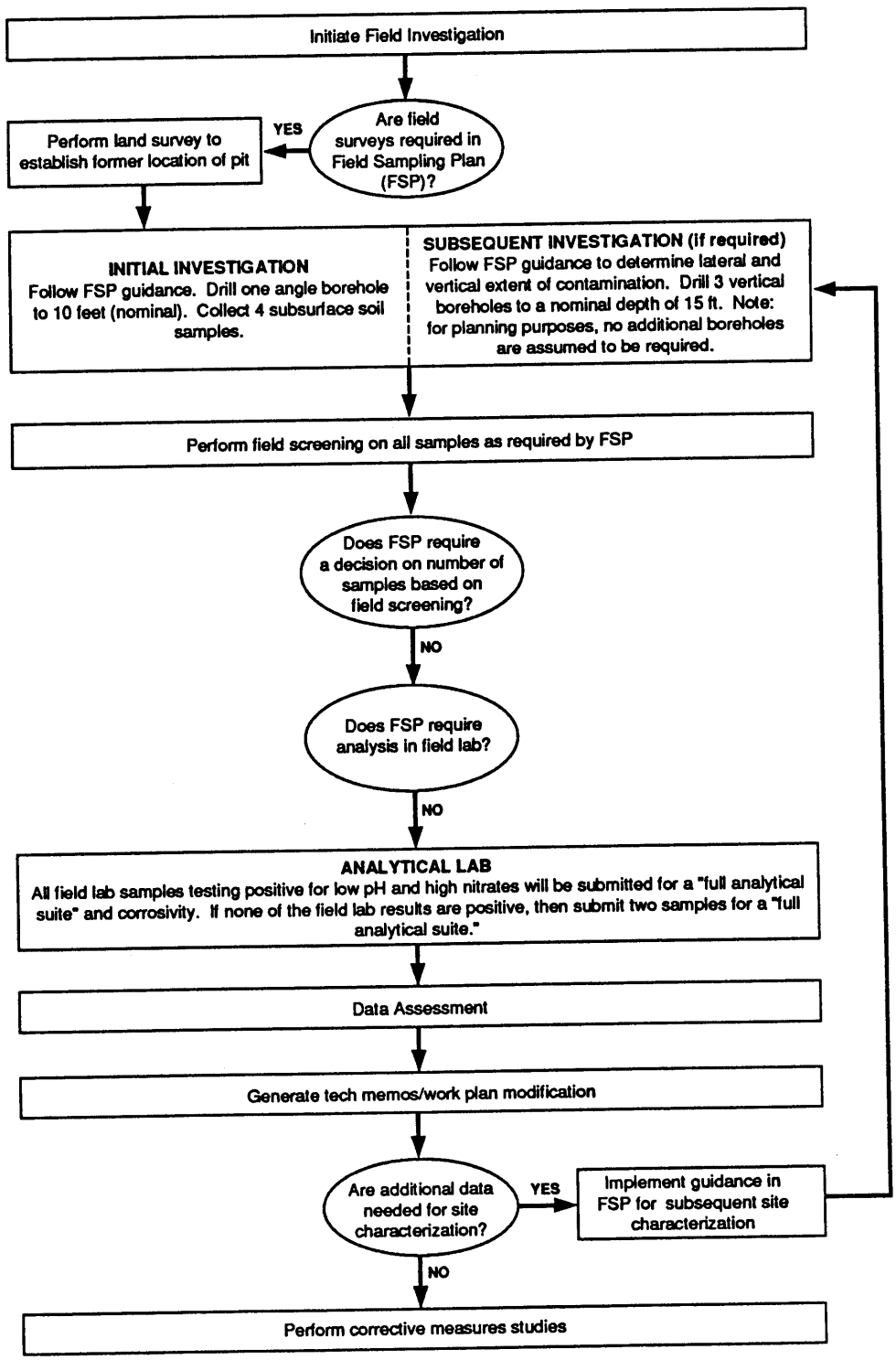


Fig. 17.1-5 Logic flow for the field investigation at the acid pit.

17.1-III SUMMARY OF SUBSEQUENT INVESTIGATIONS BY SECTION FOR CHAPTER 17.

Section	Description	Boreholes						Q A
		Shallow			Vertical			
		Number	Total Footage	No. of Samples	Number	Total Footage	No. of Samples	
17.2	Underground Seepage Pit							18
17.3	Waste Treatment Laboratori	5	50	20	8	400	80	4
17.4	Dry Wells							
17.5	Acid Lines and Sumps				12	720	144	32
17.6	Acid Pit							
Total		5	50	20	20	1120	224	54

17.1-II SUMMARY OF SAMPLE AND ANALYSIS FOR INITIAL INVESTIGATIONS BY SECTION FOR CHAPTER 17.

	17.2	17.3	17.4	17.5	17.6					Total
Field Sample Screening										
Gross Gamma	12	16	32	40	4					104
Gross Alpha	12	16	32	40	4					104
Organic Vapor	12	16	32	40	4					104
Combustible Gas/Oxygen	12	16			4					32
Lithological Logging	12	16	32	40	4					104
Field Laboratory Measurements										
Gross Alpha	12	16		40						68
Gamma Spectrometry	12	16		40						68
Tritium	12	16		40						68
Volatile Organics	12	16		40						68
PCB										
Soil Moisture										
Laboratory Analysis										
Gamma Spectrometry	8	9	9	30	4					60
Tritium	8	9	9	30	4					60
Total Uranium	8	9	9	30	4					60
Isotopic Plutonium	8	9	9	30	4					60
Isotopic Thorium				30						30
Strontium 90	8	9		30						47
VOA (SW 8240)	10	11	13	34	6					74
Semivolatiles (SW 8270)	9	10	11	32	5					67
Metals (SW 6010)	9	10	11	32	5					67
PCB (SW 8080)										
Sulfates/Chromates/Copper Salts			26							26
Alkalinity, pH			11							11
Nitrates, pH					4					4

17.1-IV SUMMARY OF SAMPLE AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS BY SECTION FOR CH-17.

	17.2	17.3		17.5						Total
Field Sample Screening										
Gross Gamma	43	20		144						207
Gross Alpha	80	20		144						244
Organic Vapor	80	20		144						244
Combustible Gas/Oxygen	80	20								100
Lithological Logging	80	20		144						244
Field Laboratory Measurements										
Gross Alpha	80	20		144						244
Gamma Spectrometry	80	20		144						244
Tritium	80	20		144						244
Volatile Organics	80	20		144						244
PCB										
Soil Moisture										
Laboratory Analysis										
Gamma Spectrometry	42	7		54						103
Tritium	42	7		54						103
Total Uranium	42	7		54						103
Isotopic Plutonium	42	7		54						103
Isotopic Thorium				54						54
Strontium 90	42			54						96
VOA (SW 8240)	54	9		74						137
Semivolatiles (SW 8270)	46	8		62						116
Metals (SW 6010)	46	8		62						116
PCB (SW 8080)										
Sulfates/Chromates/Copper Salts										
Alkalinity, pH										
Nitrates, pH										

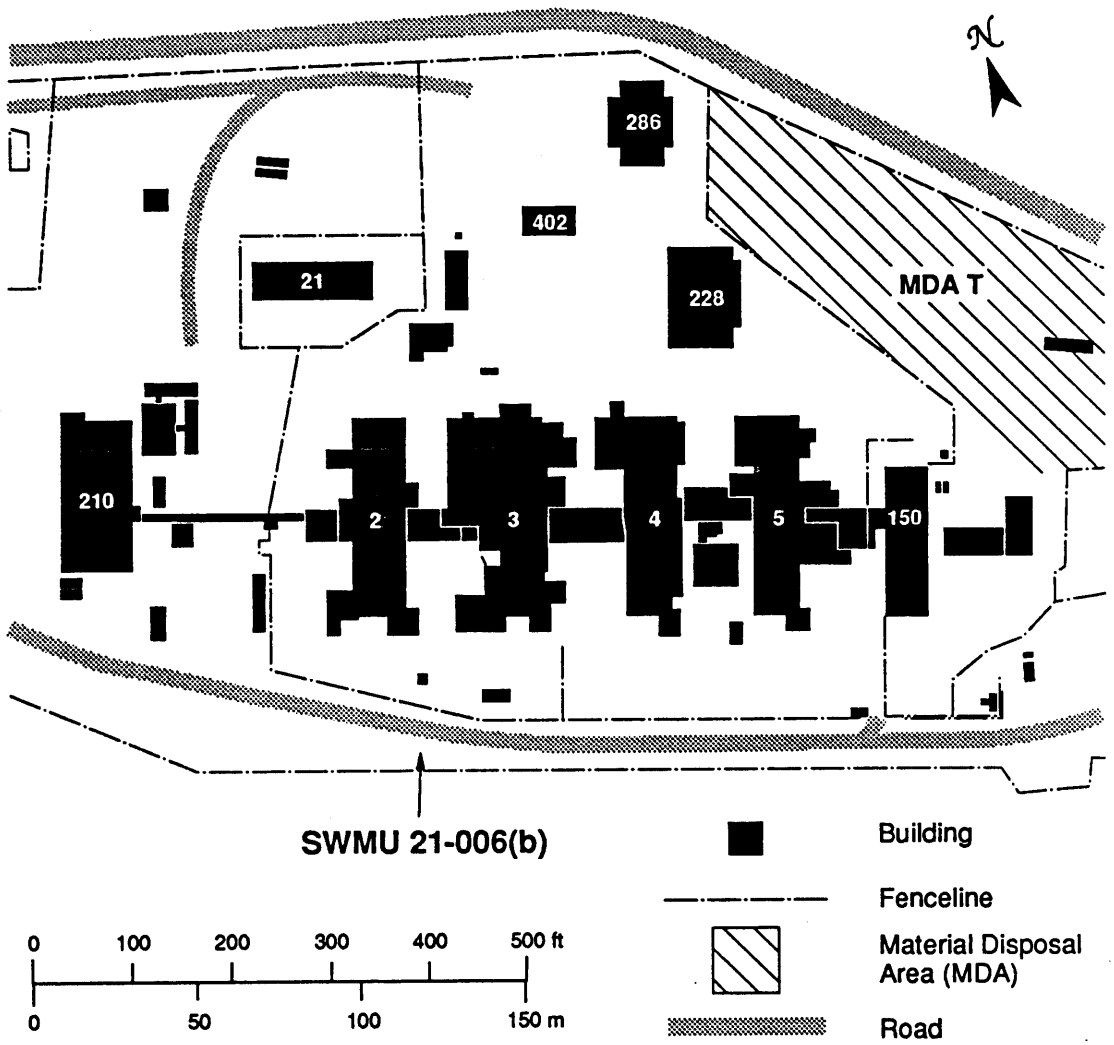


Fig. 17.2-1 General location of SWMU 21-006(b) at TA-21. (LANL 1990)

17.2 SWMU 21-006(b) Underground Seepage Pits

17.2.1 Site Description

This section describes the field activities for one underground seepage pit [SWMU 21-006(b)] located at TA-21 (Fig. 17.2-1). SWMUs 21-006(a) and (c)–(f) are discussed in Chapter 18, SWMUs for coordination with Building Decontamination and Decommissioning. SWMU 21-006(b) addresses a site that was used to dispose "ether waste" originating from Building TA-21-2 where a plutonium purification process used a double ether extraction (Merrill 1990). This process and system are no longer active. No releases from the underground seepage pit to the environment are documented.

17.2.1.1 Site History

The underground seepage pit (TA-21-118) may have been installed in 1945 as a part of new plutonium extraction facilities at TA-21-2 (Christensen and Maraman 1969) (Fig. 17.2-2). The inlet line, TA-21-134, originated from the east side of Building TA-21-2 and ran south to the pit. From the pit, the outlet line, TA-21-135, ran south and ended at an outfall above Los Alamos Canyon (LASL 1976a; LASL 1976b). This outfall [SWMU 21-006(b)] is addressed in Sec. 15.9.

The underground seepage pit consisted of a brick manhole placed within a trench. The manhole was approximately 5 ft by 12 ft, with a depth of 6 ft. The trench was 16 ft by 70 ft, with a depth of 6 ft. Although this seepage pit structure had a raised outlet line within the manhole, the brickwork of the manhole allowed liquid to flow readily into the surrounding pit. The pit was backfilled with 3 ft of boulders topped with 12 in. of gravel. This total design may have been used to facilitate evaporation and seepage of the majority of the waste and minimize discharges into the canyon. A photograph of the manhole taken in 1980 shows brickwork exposed at the ground surface (LANL 1980). Since this photograph was taken, the manhole and pit may have been paved over.

Inlet line TA-21-134 consists of a 200-ft length of 3-in.-diameter, jennite-coated cast iron pipe. Outlet line TA-21-135 consists of 90 ft of 2 in.-diameter, jennite-coated cast iron pipe, of which approximately 30 ft extend over the rim of Los Alamos Canyon (Fig. 17.2-2) (LASL 1976a; LASL 1976b). These lines are still in place (LANL 1987).

The operation producing the ether waste was the third of three processes that were used to purify plutonium. Improved processes and an increase in the purity of the incoming material eventually

allowed the chemist to eliminate the double ethyl ether extraction as well as some others (Merrill 1990). The ether extraction process was discontinued in September 1945 (Christensen 1969).

17.2.1.2 Existing Information

No data exist regarding contamination in the area of the underground seepage pits, TA-21-118. It is suspected that given the size of the seepage pit, and even though the inlet pipe was only 3 in. in diameter, the volume of ether waste fed into the seepage pit was quite large (LANL 1990).

A soil sample was collected below the outfall of line TA-21-135 on October 31, 1988. It was analyzed according to U.S. EPA Contract Laboratory Program (CLP) Statement of Work Organic protocols for Target Compound List volatile organic constituents, semivolatile organic constituents, pesticides/PCBs, and Target Analyte List metals. It was also analyzed for explosives, ^{241}Am, ^{137}Cs, ^{238}Pu, $^{239/240}Pu$, ^{226}Ra, ^{90}Sr, ^{232}Th, and isotopic uranium (DOE 1989).

Toluene was the only volatile organic compound detected in the surface soil. Toluene was present at 9.9 µg/kg. The detection limit of this analysis was 6.0 µg/kg. No semivolatile, pesticide/PCBs, or explosive compounds were present above the method detection or method reporting limits.

Table 17.2-I presents a summary of the results of metals analyses. Only lead was higher than the reported background level , at 191 mg/kg. The upper limit of background level is 54 mg/kg (Sec. 4.2.4). All other metals were within their respective background ranges.

Table 17.2-II presents a summary of the results of radionuclide analyses. The concentrations of ^{137}Cs, $^{239/240}Pu$, ^{234}U, and tritium were 1.5 pCi/g, 1.3 pCi/g, 1.8 pCi/g (in soil), and 31 pCi/ml (in soil moisture), respectively. For comparison, the upper limt background levels for ^{137}Cs, $^{239/240}Pu$, ^{234}U, and tritium of 0.44 pCi/g, 0.025 pCi/g, 1.7 pCi/g, and 0.0072 pCi/ml, respectively (Sec. 4.2.4). All other radionuclides were within their respective background ranges.

17.2.1.3 Source Term

No data exist regarding contamination in and around the underground seepage pit TA-21-118. The ether extraction process at TA-21-2 was designed for the separation and purification of plutonium. The specific composition of ether waste is unknown; it may have been contaminated with plutonium. Ether extraction at TA-21-2 was discontinued; however, material from oxalate extraction, material from cation-exchange processes, and material from other experimental

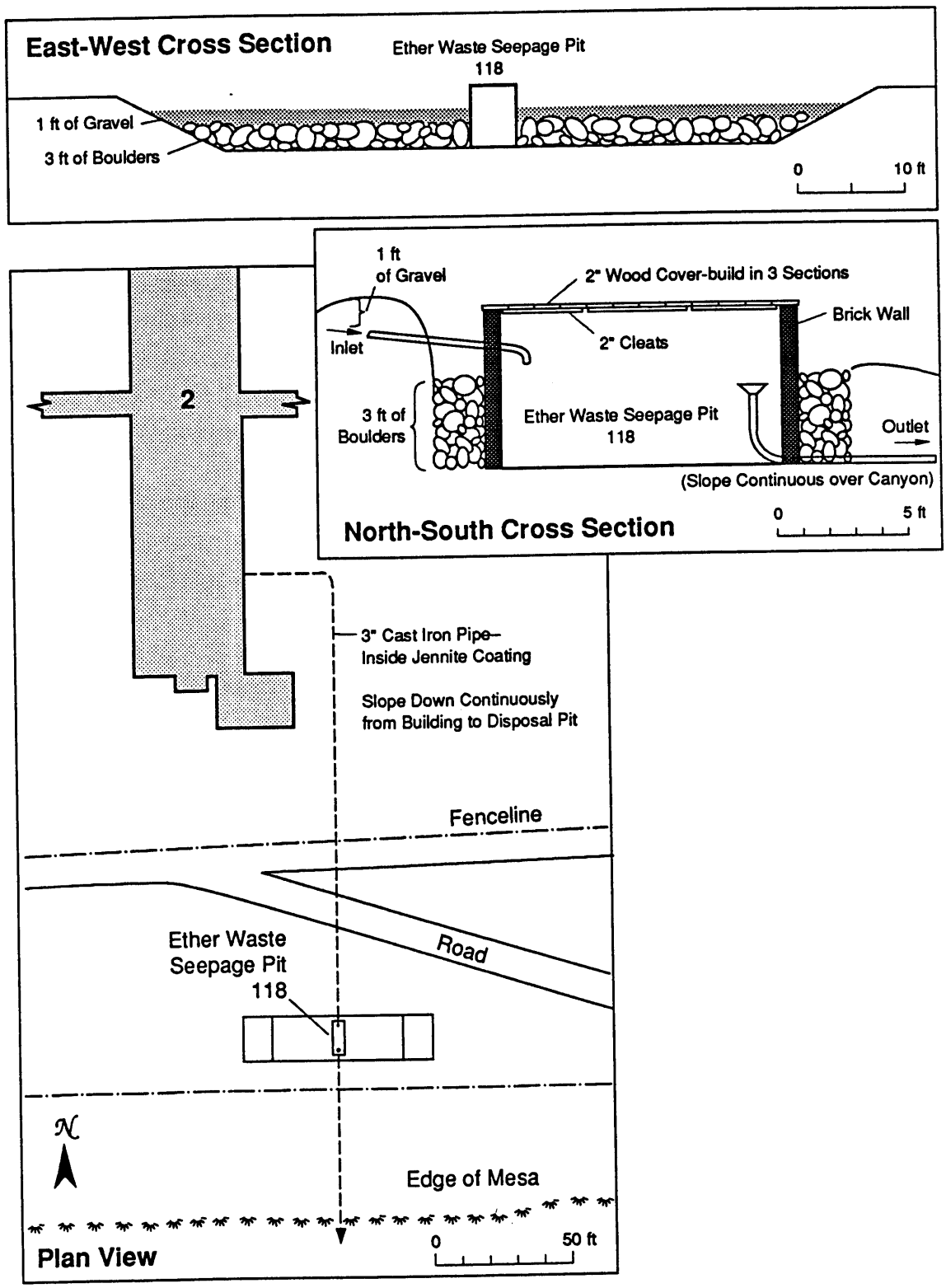


Fig. 17.2-2 Design specifications for TA-21 seepage pit SWMU 21-006(b). (LASL 1945)

TABLE 17.2-II
RADIONUCLIDE RESULTS FROM SWMU 21-006(b) OUTFALL SOIL SAMPLES COMPARED TO BACKGROUND SOIL CONCENTRATIONS (MEAN) FROM NORTHERN NEW MEXICO[a]

Metals	Value (mg/kg)	Detection Limit (mg/kg)	Mean $\bar{x}$	Standard Deviation (s)	Upper Limit[b] of Background $\bar{x} \pm 2s$ (pCi/g)
AMERICIUM-241	0.1	0.1	—	—	not reported
CESIUM-137	1.5	0.2	0.18	0.13	0.44
PLUTONIUM-238	0.0	0.1	0.001	0.002	0.005
PLUTONIUM-239	1.3	0.3	0.007	0.009	0.025
RADIUM-226	1.2	0.2	1.5	0.5	2.5
STRONTIUM-90	0.0	0.2	0.34	0.27	0.88
THORIUM-232	1.0	0.2	1.0	0.4	1.8
TRITIUM	31 (pCi/ml)	3.0 (pCi/ml)	0.0026	0.0023	0.0072 (pCi/ml)
URANIUM-234	1.8	0.3	1.1	0.5	1.7
URANIUM-235	0.1	0.2	—	—	not reported
URANIUM-238	1.0	0.2	1.1	0.5	1.7

[a]Purtymun et al. 1987.
[b]The upper limit of background was defined by Purtymun et al. (1987) as $\bar{x} \pm 2s$, as used in Table 4.2-XIII. For a consistent basis of comparison, the upper limit of background given here for metals is $\bar{x} \pm 2s$ as calculated from the data given in Table 4.2-XV.

TABLE 17.2-I
METALS FROM SWMU 21-006(b) OUTFALL SOIL SAMPLES COMPARED TO BACKGROUND SOIL CONCENTRATIONS (AVERAGES) AT THE LOS ALAMOS SIGMA MESA SITE[a]

Metals	Value (mg/kg)	Detection Limit (mg/kg)	Mean $\bar{x}$	Standard Deviation (s)	Upper Limit[b] of Background $\bar{x} \pm 2s$ (mg/kg)
ALUMINUM, TOTAL	3990	37.0	58,000	3,500	65,000
BARIUM, TOTAL	48.8	37.0	410	220	850
CALCIUM, TOTAL	1340	932.0	—	—	—
CHROMIUM, TOTAL	6.2	2.0	27	24	75
COPPER, TOTAL	7.1	6.0	10	4.5	19
IRON, TOTAL	3560	19.0	17,000	4,800	26,600
LEAD, TOTAL	191	93.0	24	15	54
MANGANESE, TOTAL	137	4.0	510	130	770
NICKEL, TOTAL	9.1	8.0	8.9	4.8	18.5
ZINC, TOTAL	48.8	4.0	54	12	78

[a]Ferenbaugh et al. 1990.
[b]The upper limit of background was defined by Purtymun et al. (1987) as $\bar{x} \pm 2s$, as used in Table 4.2-XIII. For a consistent basis of comparison, the upper limit of background given here for metals is $\bar{x} \pm 2s$ as calculated from the data given in Table 4.2-XV.

17.2.4 Sampling Plan

17.2.4.1 Initial Investigations

A land survey to locate the seepage pit TA-21-118 will be conducted, using engineering drawings (LASL 1976a; LASL 1976b) as a guide (for method see Sec. 11.3.2). To confirm the location of the manhole and pit, a geophysical survey will also be employed on an area approximately 100 by 200 ft (Fig. 17.2-3). The geophysical survey will qualitatively identify the cast iron lines TA-21-124 and TA-21-125 (for method see Sec. 11.4.2.1). Identification of the location of the lines will confirm the surveyed position of the manhole and pit.

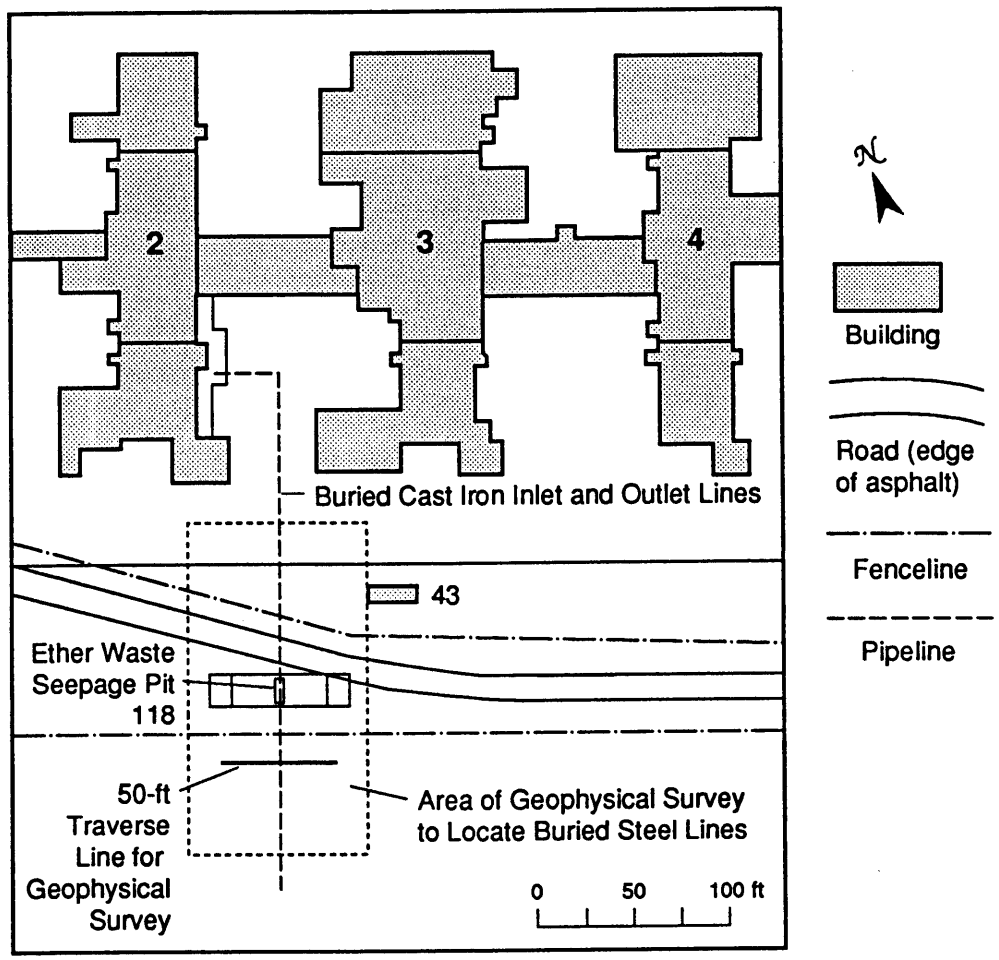


Fig. 17.2-3 Design of surface geophysical survey to locate ether waste seepage pit TA-21-118.

processes may have been routed to the pit. These materials may have been contaminated with radionuclides, organic compounds, and inorganic compounds.

Assays for radionuclides and nonradionuclides were performed on soil at the outlet line into the canyon. These assays showed the presence of lead, ^{137}Cs, $^{239/240}Pu$, ^{234}U, and tritium at levels higher than background level. Because the outfall originates from the underground seepage pit, it may be assumed that this seepage pit structure, the soil around it, and the tuff beneath it may be contaminated with organic, inorganic, and radiological constituents, and these contaminants may have migrated.

17.2.2 Sample Objectives and Data Needs

The objective of this investigation is to confirm the presence and determine the extent of contamination at SWMU 21-006(b). Specific data required to assess contamination at SWMU 21-006(b) include the following:

1. Determine the location of the underground seepage pit (TA-21-118). The location of the pit may have been paved over. By determining the location of the influent line and the effluent line using a geophysical survey, the position of the underground seepage pit can be confirmed.

2. Identify the contaminants present using Level II and III data. The outfall from the pit showed the presence of organic and inorganic constituents as well as radionuclides.

3. If contaminants are identified in the underground seepage pits, determine the lateral and vertical extent of contaminant migration by subsurface sampling and Level III/IV analyses.

17.2.3 Sampling/Investigation Rationale

Two phases of investigation are expected for SWMU 21-006(b). The initial investigation will begin by identifying and marking the structures. In addition, contamination of the subsurface will be investigated by drilling three boreholes within and beneath the manhole and pit.

Additional investigation will be needed if contaminants are identified in borehole samples beneath the manhole and pit. Subsequent investigations may include additional boreholes and subsurface sampling over a wider area. The analytical suite may be focused more closely to specific analytes in these subsequent investigation phases, based on results from initial samples.

Table 17.2-III

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-006(B), UNDERGROUND SEEPAGE PIT.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Thorium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Sulfates/Chromates/Copper Salts	Alkalinity, pH	Nitrates, pH
TA-21-118																																		
Geophysical Survey						X	X																											
Vertical Borehole	1	0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		5.0 - 10.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		10.0 - 15.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		15.0 - 20.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E	E	E	E	E				
Vertical Borehole	2	0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E	E	E	E	E				
Field Duplicate																						X	X	X	X	X	X	X	X	X				
		5.0 - 10.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		10.0 - 15.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		15.0 - 20.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E	E	E	E	E				
Vertical Borehole	3	0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		5.0 - 10.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		10.0 - 15.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		15.0 - 20.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E	E	E	E	E	E				
Rinsate Blank																						X	X	X				X	X	X				
Field Blank																												X	X	X				
Trip Blank																														X				

Three vertical boreholes will be drilled: one through the center of the pit and one each through the pit at 25 ft east and west of the initial borehole (Fig. 17.2-4) (for method see Sec. 11.5.3.2). The nominal depth for these boreholes is 20 ft. The screening and analysis requirements are shown in Table 17.2-III.

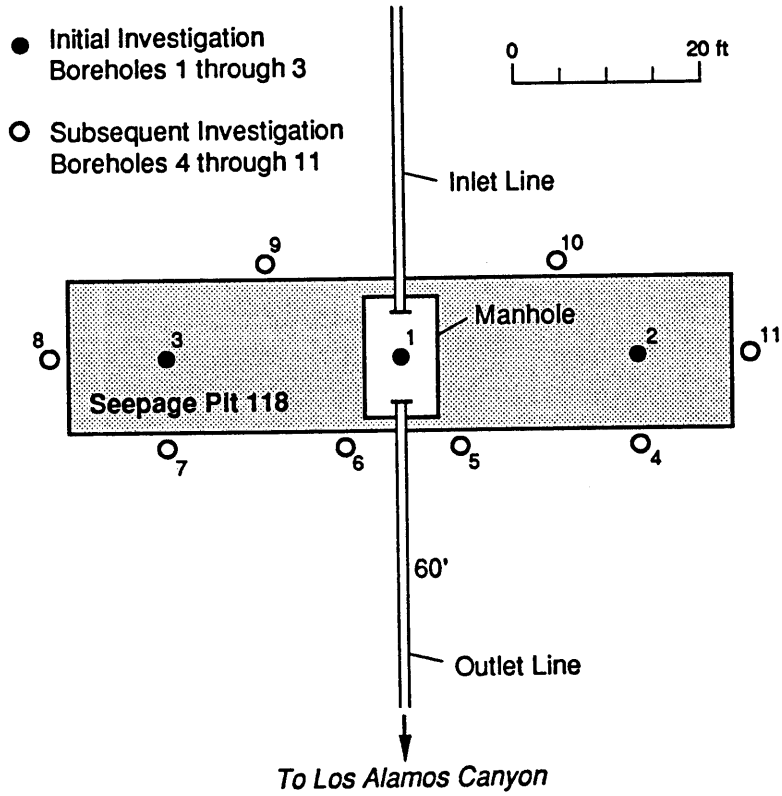


Fig. 17.2-4 Borehole locations to investigate seepage pit TA-21-118, SWMU 21-006(b).

All samples will be analyzed in the field laboratory. These analyses will be used to define whether the nominal borehole depth has reached the edge of the contaminant plume or whether each borehole needs to be deeper. Because this investigation presupposes the ether pit is contaminated, the purpose of samples sent to the analytical laboratory is twofold: first, to define the source term, and second, to define the edges of the contaminant plume. Therefore, samples sent to the analytical laboratory for confirmatory analysis will include "hot" samples for source term definition and samples from the edges of the plume to confirm absence of contamination. For planning purposes, it is assumed 12 samples will be analyzed in the field laboratory and six will be submitted to the analytical laboratory.

If no contamination is identified, no further action will be taken at SWMU 21-006(b).

Table 17.2-IV

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-006(B), UNDERGROUND SEEPAGE PIT.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Thorium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Sulfates/Chromates/Copper Salts	Alkalinity, pH	Nitrates, pH
TA-21-118																																		
Vertical Borehole	1	0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 10.0 ft						X	X		X	X	X	X	X	X	X																	
		10.0 - 15.0 ft						X	X		X	X	X	X	X	X	X					X	X	X	X		X	X	X	X				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
		15.0 - 20.0 ft						X	X		X	X	X	X	X	X	X					X	X	X	X		X	X	X	X				
		20.0 - 25.0 ft						X	X		X	X	X	X	X	X	X																	
		25.0 - 30.0 ft						X	X		X	X	X	X	X	X	X					X	X	X	X		X	X	X	X				
		30.0 - 35.0 ft						X	X		X	X	X	X	X	X	X																	
		35.0 - 40.0 ft						X	X		X	X	X	X	X	X	X					X	X	X	X		X	X	X	X				
		40.0 - 45.0 ft						X	X		X	X	X	X	X	X	X																	
		45.0 - 50.0 ft						X	X		X	X	X	X	X	X	X					X	X	X	X		X	X	X	X				
Trip Blank																												X						
Vertical Borehole	2	0.0 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 10.0 ft						X	X		X	X	X	X	X	X	X																	
		10.0 - 15.0 ft						X	X		X	X	X	X	X	X	X					X	X	X	X		X	X	X	X				
		15.0 - 20.0 ft						X	X		X	X	X	X	X	X	X																	
		20.0 - 25.0 ft						X	X		X	X	X	X	X	X	X					X	X	X	X		X	X	X	X				
		25.0 - 30.0 ft						X	X		X	X	X	X	X	X	X																	
		30.0 - 35.0 ft						X	X		X	X	X	X	X	X	X					X	X	X	X		X	X	X	X				
		35.0 - 40.0 ft						X	X		X	X	X	X	X	X	X																	
		40.0 - 45.0 ft						X	X		X	X	X	X	X	X	X					X	X	X	X		X	X	X	X				
		45.0 - 50.0 ft						X	X		X	X	X	X	X	X	X																	
Trip Blank																												X						

17.2.4.2 Subsequent Investigations

If contaminants are identified in or beneath the underground seepage pits, it will be necessary to determine the lateral and vertical extent of contamination by additional subsurface sampling and Level III/IV analyses.

It is anticipated that no more than eight additional boreholes will be needed. These will be placed 20 ft out from the edges of the pit to define the lateral and vertical extent of contamination. Example locations are shown in Fig. 17.2-4. Four boreholes will be placed immediately south (downgradient), of the pit, one at each end, and two to the north. The nominal depth is assumed to be 50 ft but will be based on analysis of results from the initial investigation. For planning purposes, it is assumed that 80 additional samples from the 8 boreholes will be required. It is assumed that 30% of these will be submitted to the analytical laboratory. The screening and analysis requirements are shown in Table 17.2-IV. The analysis may be directed toward the contaminants identified in the initial investigation.

Table 17.2-IV

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-006(B), UNDERGROUND SEEPAGE PIT.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Thorium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Sulfates/Chromates/Copper Salts	Alkalinity, pH	Nitrates, pH
		5.0 – 10.0 ft		X	X			X	X		X	X	X	X	X	X	X					X	X	X			X	X	X				
		10.0 – 15.0 ft		X	X			X	X		X	X	X	X	X	X	X					X	X	X			X	X	X				
Rinsate Blank																																	
Field Blank											X	X	X	X	X	X	X					X	X	X			X	X	X				
		15.0 – 20.0 ft									X	X	X	X	X	X	X					X	X	X			X	X	X				
		20.0 – 25.0 ft									X	X	X	X	X	X	X					X	X	X			X	X	X				
		25.0 – 30.0 ft									X	X	X	X	X	X	X					X	X	X			X	X	X				
		30.0 – 35.0 ft									X	X	X	X	X	X	X					X	X	X			X	X	X				
		35.0 – 40.0 ft									X	X	X	X	X	X	X					X	X	X			X	X	X				
		40.0 – 45.0 ft									X	X	X	X	X	X	X					X	X	X			X	X	X				
		45.0 – 50.0 ft									X	X	X	X	X	X	X					X	X	X			X	X	X				
Trip Blank																																	
Vertical Borehole	6	0.0 – 5.0 ft						X	X		X	X	X	X	X	X	X					X	X	X			X	X	X				
		5.0 – 10.0 ft						X	X		X	X	X	X	X	X	X					X	X	X			X	X	X				
		10.0 – 15.0 ft						X	X		X	X	X	X	X	X	X					X	X	X			X	X	X				
		15.0 – 20.0 ft						X	X		X	X	X	X	X	X	X					X	X	X			X	X	X				
		20.0 – 25.0 ft						X	X		X	X	X	X	X	X	X					X	X	X			X	X	X				
		25.0 – 30.0 ft						X	X		X	X	X	X	X	X	X					X	X	X			X	X	X				
		30.0 – 35.0 ft						X	X		X	X	X	X	X	X	X					X	X	X			X	X	X				
		35.0 – 40.0 ft						X	X		X	X	X	X	X	X	X					X	X	X			X	X	X				
		40.0 – 45.0 ft						X	X		X	X	X	X	X	X	X					X	X	X			X	X	X				
		45.0 – 50.0 ft						X	X		X	X	X	X	X	X	X					X	X	X			X	X	X				
Trip Blank																																	
Vertical Borehole	7	0.0 – 5.0 ft						X	X		X	X	X	X	X	X	X					X	X	X			X	X	X				
		5.0 – 10.0 ft						X	X		X	X	X	X	X	X	X					X	X	X			X	X	X				
		10.0 – 15.0 ft						X	X		X	X	X	X	X	X	X					X	X	X			X	X	X				

Table 17.2-IV

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-006(B), UNDERGROUND SEEPAGE PIT.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Thorium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Sulfates/Chromates/Copper Salts	Alkalinity, pH	Nitrates, pH
Vertical Borehole	3	0.0 - 5.0 R						X	X	X				X	X	X	X			X	X	X	X		X		X	X			
		5.0 - 10.0 R						X	X	X				X	X	X	X			X	X	X	X		X		X	X			
		10.0 - 15.0 R						X	X	X				X	X	X	X			X	X	X	X		X		X	X			
Rinsate Blank																															
Field Blank		15.0 - 20.0 R						X	X	X	X	X	X	X	X	X	X			X	X	X	X		X		X	X			
		20.0 - 25.0 R						X	X	X	X	X	X	X	X	X	X			X	X	X	X		X		X	X			
		25.0 - 30.0 R						X	X	X	X	X	X	X	X	X	X			X	X	X	X		X		X	X			
		30.0 - 35.0 R						X	X	X	X	X	X	X	X	X	X			X	X	X	X		X		X	X			
		35.0 - 40.0 R						X	X	X	X	X	X	X	X	X	X			X	X	X	X		X		X	X			
Field Duplicate		40.0 - 45.0 R						X	X	X	X	X	X	X	X	X	X			X	X	X	X		X		X	X			
		45.0 - 50.0 R						X	X	X	X	X	X	X	X	X	X			X	X	X	X		X		X	X			
Trip Blank																															
Vertical Borehole	4	0.0 - 5.0 R						X	X	X	X	X	X	X	X	X	X			X	X	X	X		X		X	X			
		5.0 - 10.0 R						X	X	X	X	X	X	X	X	X	X			X	X	X	X		X		X	X			
		10.0 - 15.0 R						X	X	X	X	X	X	X	X	X	X			X	X	X	X		X		X	X			
		15.0 - 20.0 R						X	X	X	X	X	X	X	X	X	X			X	X	X	X		X		X	X			
		20.0 - 25.0 R						X	X	X	X	X	X	X	X	X	X			X	X	X	X		X		X	X			
		25.0 - 30.0 R						X	X	X	X	X	X	X	X	X	X			X	X	X	X		X		X	X			
		30.0 - 35.0 R						X	X	X	X	X	X	X	X	X	X			X	X	X	X		X		X	X			
		35.0 - 40.0 R						X	X	X	X	X	X	X	X	X	X			X	X	X	X		X		X	X			
		40.0 - 45.0 R						X	X	X	X	X	X	X	X	X	X			X	X	X	X		X		X	X			
		45.0 - 50.0 R						X	X	X	X	X	X	X	X	X	X			X	X	X	X		X		X	X			
Trip Blank																															
Vertical Borehole	5	0.0 - 5.0 R						X	X	X	X	X	X	X	X	X	X			X	X	X	X		X		X	X			

Table 17.2-IV

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-006(B), UNDERGROUND SEEPAGE PIT.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture				Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Thorium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Sulfates/Chromates/Copper Salts	Alkalinity, pH	Nitrates, pH
Rinsate Blank																																		
Field Blank																																		
		15.0 - 20.0 ft						X						X	X	X	X					X	X	X		X	X	X	X	X				
		20.0 - 25.0 ft						X						X	X	X	X					X	X	X		X	X	X	X	X				
		25.0 - 30.0 ft						X						X	X	X	X					X	X	X		X	X	X	X	X				
		30.0 - 35.0 ft						X						X	X	X	X					X	X	X		X	X	X	X	X				
		35.0 - 40.0 ft						X						X	X	X	X					X	X	X		X	X	X	X	X				
Field Duplicate		40.0 - 45.0 ft							X	X	X	X	X	X	X	X	X					X	X	X		X	X	X	X	X				
		45.0 - 50.0 ft							X	X	X	X	X	X	X	X	X					X	X	X		X	X	X	X	X				
Trip Blank																																		
Vertical Borehole	6	0.0 - 5.0 ft						X		X	X	X	X																					
		5.0 - 10.0 ft						X		X	X	X	X																					
		10.0 - 15.0 ft						X		X	X	X	X																					
		15.0 - 20.0 ft						X		X	X	X	X																					
		20.0 - 25.0 ft						X		X	X	X	X																					
		25.0 - 30.0 ft						X		X	X	X	X																					
		30.0 - 35.0 ft						X		X	X	X	X																					
		35.0 - 40.0 ft						X		X	X	X	X																					
		40.0 - 45.0 ft						X		X	X	X	X																					
		45.0 - 50.0 ft						X		X	X	X	X																					
Trip Blank																																		

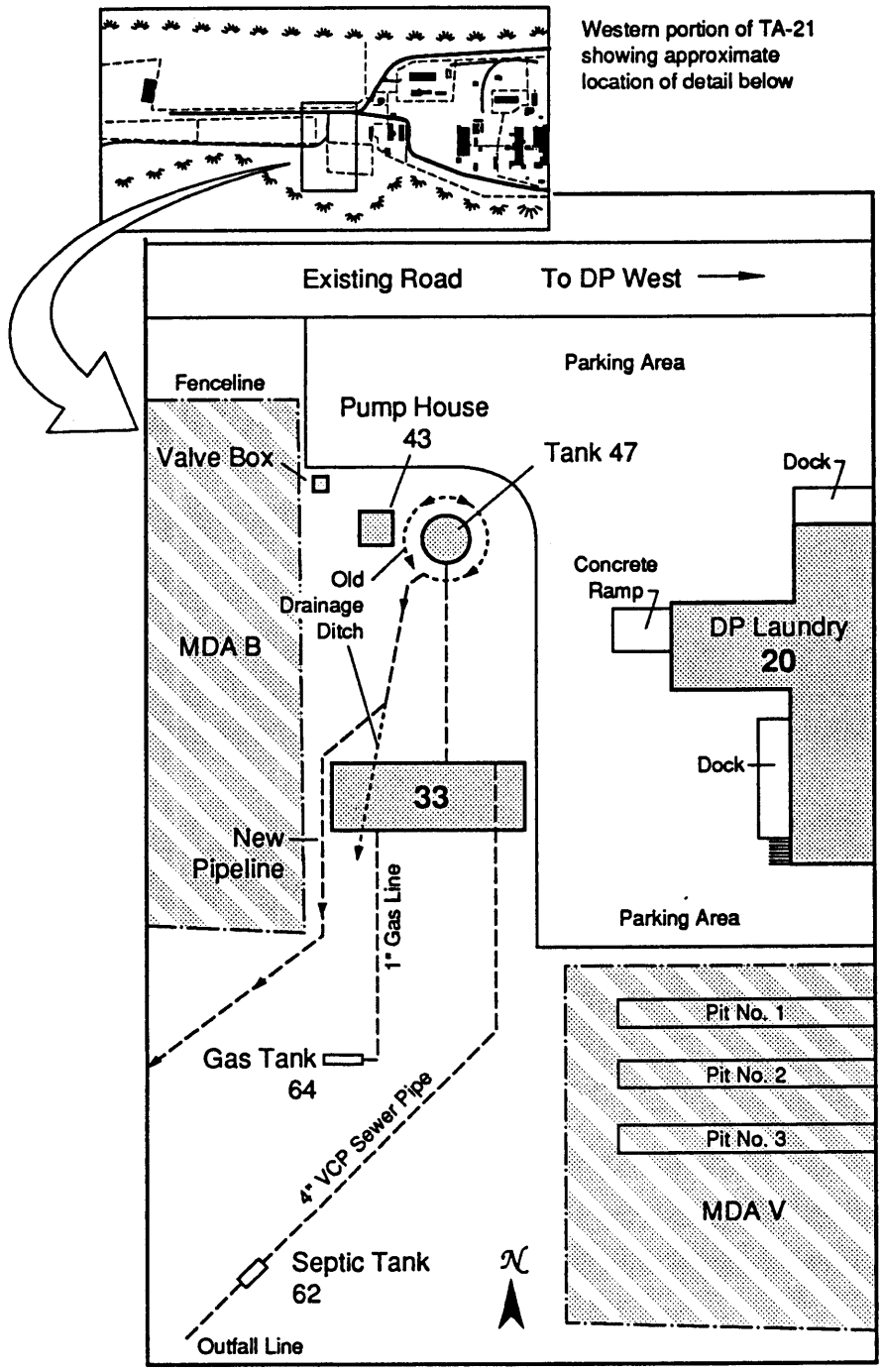


Fig. 17.3-1 Location of Building 33 at TA-21 in 1948. (LASL 1948)

17.3 SWMU 21-009 Waste Treatment Laboratory

17.3.1 Site Description

This section describes the field activities for the location of the former waste treatment laboratory (SWMU 21-009) located at TA-21 (Fig. 17.3-1). This SWMU addresses a site on which a plutonium-contaminated building stood. The former waste treatment laboratory was decontaminated and decommissioned, but contaminated drain lines may still be present. No releases from the former waste treatment laboratory to the environment are documented.

17.3.1.1 Site History

The waste treatment laboratory, TA-21-33, was constructed in August 1948. Building TA-21-33 was a wood frame structure with a wooden floor built on concrete pillars and measuring 16 ft by 48 ft, with a 12-ft ceiling. During the course of operations between September 1948 and January 1965, the floor, work benches, hoods, shelves, drains, and exhaust ducts were contaminated with plutonium dust (Romero 1963). Perchloric acid was also used and may have contaminated the hoods (Romero 1965).

The building was decontaminated and decommissioned between January 29, 1965, and April 21, 1965. It was cut in two sections and was removed to MDA G where it was burned (LASL 1965). The concrete foundation of TA-21-33 was bulldozed from its original site into Los Alamos Canyon (LASL 1965). This bulldozed waste disposal area is considered in Sec. 14.7 as a surface disposal area, SWMU 21-013(b). No physical evidence of the waste treatment laboratory remains at its former location, which appears to have been back-filled.

Two waste lines were present beneath the laboratory. It is not known how deep these lines were buried. One line carried waste from TA-21-33 to septic tank TA-21-62 and ultimately to an outfall near the canyon rim. Tank TA-21-62 was removed during demolition, although it is not clear whether the waste line from TA-21-33 to septic tank TA-21-62 was removed. The outfall and tank associated with this drain lines is addressed as SWMU 21-023(c) in Sec. 15.2.

The second waste line ran from TA-21-47 along the west side of the laboratory to an outfall near the canyon rim. The second drain lines was decontaminated and decommissioned in March 1965 along with the associated oil tank, TA-21-47 (LANL no date). The outfall is SWMU 21-027(d) in Sec. 15.2.

17.3.3. Field Sampling/Investigation Rationale

Two phases of investigations are planned for SWMU 21-009. The initial investigation consists of locating the buried waste line by digging a trench perpendicular to the course of the line between the former location of tank TA-21-62 and the waste treatment laboratory, TA-21-33, and subsurface soil sampling to determine the presence of contaminant types and concentrations within this area.

Building TA-21-33 was contaminated with plutonium dust; therefore, shallow boreholes will be drilled and subsurface soil samples will be collected at the building's former location. These samples will address the potential for residual contamination remaining after decontamination and decommissioning.

The samples obtained from the initial investigation will be assessed in the field laboratory and 25% will be subjected to a full analytical suite to determine the types and concentrations of contaminants present.

Additional surface and subsurface soil sampling will constitute a subsequent investigation to define the lateral and vertical extent of contamination. These samples will be submitted for laboratory analysis for a full suite of analyses unless sampling results from the first phase allow specification of a more focused analytical suite.

17.3.4 Sampling Plan

17.3.4.1. Initial Investigation

The former location of the waste treatment laboratory and septic tank TA-21-62 will be surveyed from old drawings (LASL ~~1954~~ 1946) (for method see Sec. 11.3.2) and marked.

An exploratory trench will be dug between the former locations of septic tank TA-21-62 and the waste treatment laboratory, TA-21-33 (modified from method, Sec. 11.5.4). The long axis of the trench will be dug approximately east-west (perpendicular to the drain lines). The trench will initially be 10-ft long by 5-ft deep, unless the drain lines or backfill that implicates their former presence are identified. If the drain lines are located, a sample will be taken from beneath the joints in the drain lines. If the drain lines are not present, but the former location is identified, soil samples will be taken from beneath the former location. The trench will be extended 5 ft on both ends if no evidence of the former drain lines is discovered during the initial trenching. If the drain

17.3.1.2 Existing Information

No data exist regarding contamination of either buried waste lines. No releases from buried waste lines or the former waste treatment laboratory to the environment were documented (LANL 1990). However, plutonium contamination of the building was identified.

Plutonium dust on surfaces within the waste treatment laboratory measured between 1000 cpm and 20,000 cpm alpha (Romero 1963). Hoods may have been contaminated with perchloric acid as well (Romero 1963).

17.3.1.3 Source Term

The contaminant source term represented by drain lines beneath the former waste treatment laboratory, TA-21-33, is not known. Releases to surface and subsurface soil may have occurred from the drain lines.

The contaminant source term represented by the former waste treatment laboratory, TA-21-33, is not known except that plutonium dust and possibly perchloric acid are possible (Romero 1963). Releases to surface soil may have occurred via exhaust ducts. Releases to surface and subsurface soil may have occurred from the floor, drains, or waste lines.

17.3.2 Objectives and Data Needs

The objective of this investigation is to confirm the absence of contamination at SWMU 21-009.

Specific data required to assess contamination at SWMU 21-009 include the following:

1. Determine the location of the former waste treatment laboratory, TA-21-33, and associated buried waste lines by surveying from old drawings, and using an exploratory trench. This building was decontaminated and decommissioned, but contaminated drain lines may have been left in place.

2. Identify if contaminants are present using Level II and III data. Radionuclides may have been present in buried drain lines or at the former location of the waste treatment laboratory.

3. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by surface and subsurface soil sampling and Level III/IV analyses.

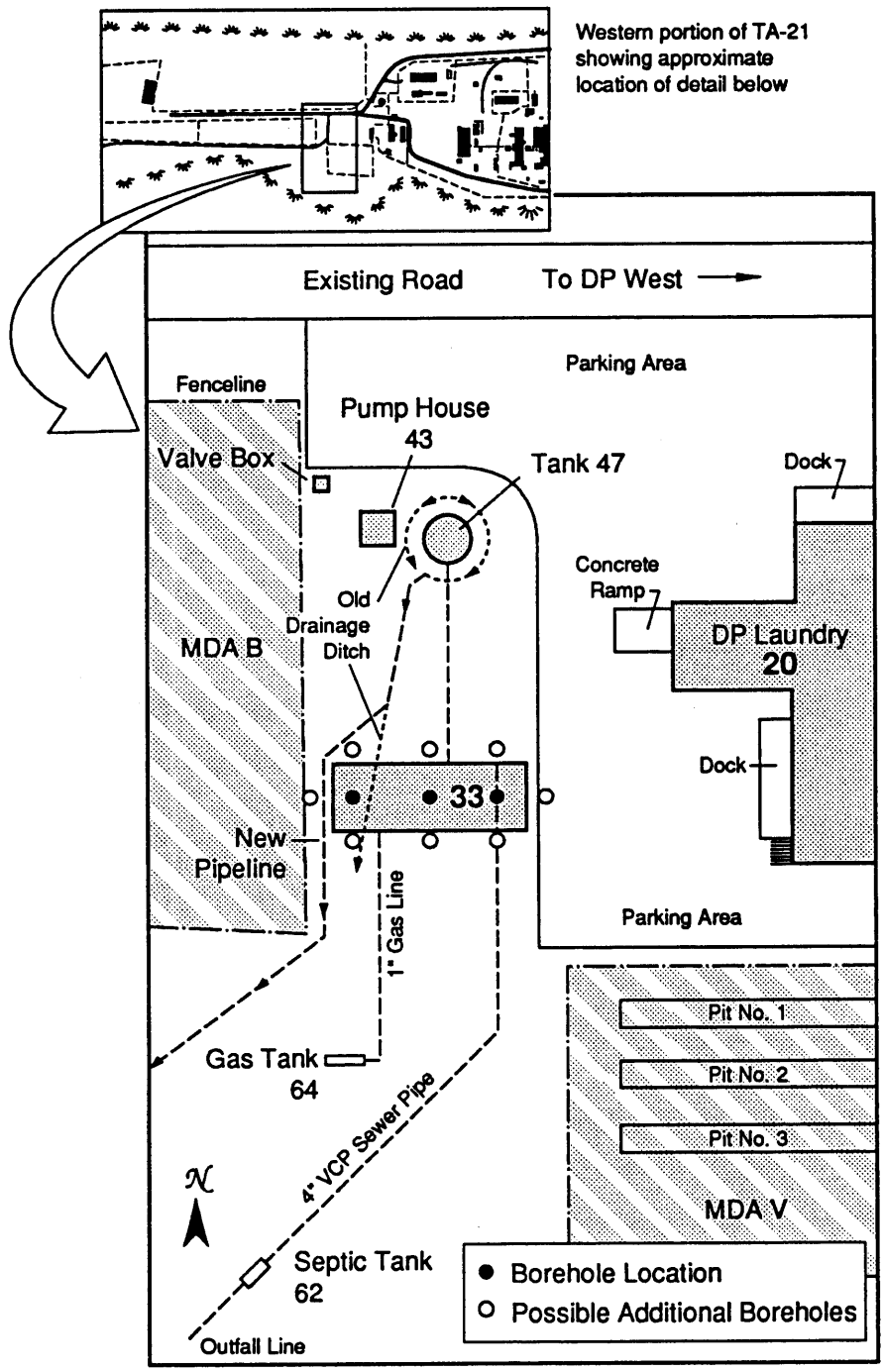


Fig. 17.3-2 Location of borehole sitings around Building 33 (now removed).

lines or their former locations are not identified, three soil samples will be taken from the bottom of the trench at equal distances along the trench. In addition, one composite sample will be taken from the excavated soil. Field screening will be performed continuously, and field laboratory analyses for radionuclides and other contaminants will be performed on all samples taken. Trenching will stop at the 5-ft depth unless there is clear indication that the former drain line trench is deeper.

Three shallow boreholes will be drilled in the footprint of the former location of Building TA-21-33 (for method see Sec. 11.5.3.1) to determine whether any past releases from the building occurred. The boreholes will be drilled on the center line of the long axis of the building, at equal distances from one another. The boreholes will be drilled to a nominal 10-ft depth at locations shown in Fig. 17.3-2.

For planning purposes, it is assumed that three trench samples and one composite sample will be collected and three boreholes with four samples each will be placed. This totals 16 samples collected, to be processed in the field laboratory. Twenty-five percent of the total number of samples collected will be sent to the analytical laboratory. Because the objective of this investigation is to document absence of contamination, all samples with "hits" in the field laboratory plus samples with no contaminants identified in the field laboratory, will be sent to the analytical laboratory for confirmation. The screening and sample analysis requirements for the initial phase of investigation are shown in Table 17.3-I. If no contamination is identified, no further action will be taken at SWMU 21-009.

17.3.4.2. Subsequent Investigations

If contaminants are identified, it will be necessary to determine the lateral and vertical extent of contamination by additional shallow borehole sampling and Level III/IV sample analyses. Shallow boreholes will be drilled (for method see Sec. 11.5.3.1) at 20-ft spacings outward from sampling points at which contamination is identified. For planning purposes, it is anticipated that no more than five additional boreholes to a 10-ft nominal depth will be required (Fig. 17.3-2). This will result in a total of 20 samples to be analyzed in the field laboratory. Twenty-five percent of those samples will be submitted to an analytical laboratory for confirmatory and additional analyses. The screening and sample analysis requirements for subsequent investigations are shown in Table 17.3-II.

Table 17.3-II

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-009, WASTE TREATMENT LABORATORY.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture				Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Thorium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Sulfates/Chromates/Copper Salts	Alkalinity, pH	Nitrates, pH
SWMU 21-009																																		
Shallow Borehole	1	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E			E	E	E				
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E			E	E	E				
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																	
	2	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E			E	E	E				
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																	
	3	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E			E	E	E				
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																	
	4	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E			E	E	E				
Field Duplicate		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E			E	E	E				
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																	
	5	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E			E	E	E				
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																	
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																	
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																	
Rinsate Blank																						X	X	X	X			X	X	X				
Field Blank																						X	X	X	X			X	X	X				
Trip Blank																						X	X	X	X			X	X	X				

Table 17.3-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-009, WASTE TREATMENT LABORATORY.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis															
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Thorium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Sulfates/Chromates/Copper Salts	Alkalinity, pH	Nitrates, pH		
Trench from TA-21-62 to TA-21-33																																				
Trench Soil Sample	1						X	X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E						
	2							X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E						
	3							X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E						
Composite Soil Sample								X	X		X	X	X	X	X	X	X																			
TA-21-33																																				
Shallow Borehole	1	0.0 - 2.5 ft					X	X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E						
Field Duplicate																						E	E	E	E		E	E	E	E						
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																			
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																			
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																			
	2	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E						
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																			
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																			
Rinsate Blank																						X	X	X	X		X	X	X	X						
Field Blank																												X	X	X						
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X																			
	3	0.0 - 2.5 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E						
		2.5 - 5.0 ft						X	X		X	X	X	X	X	X	X																			
		5.0 - 7.5 ft						X	X		X	X	X	X	X	X	X																			
		7.5 - 10.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E						
Trip Blank																											X									

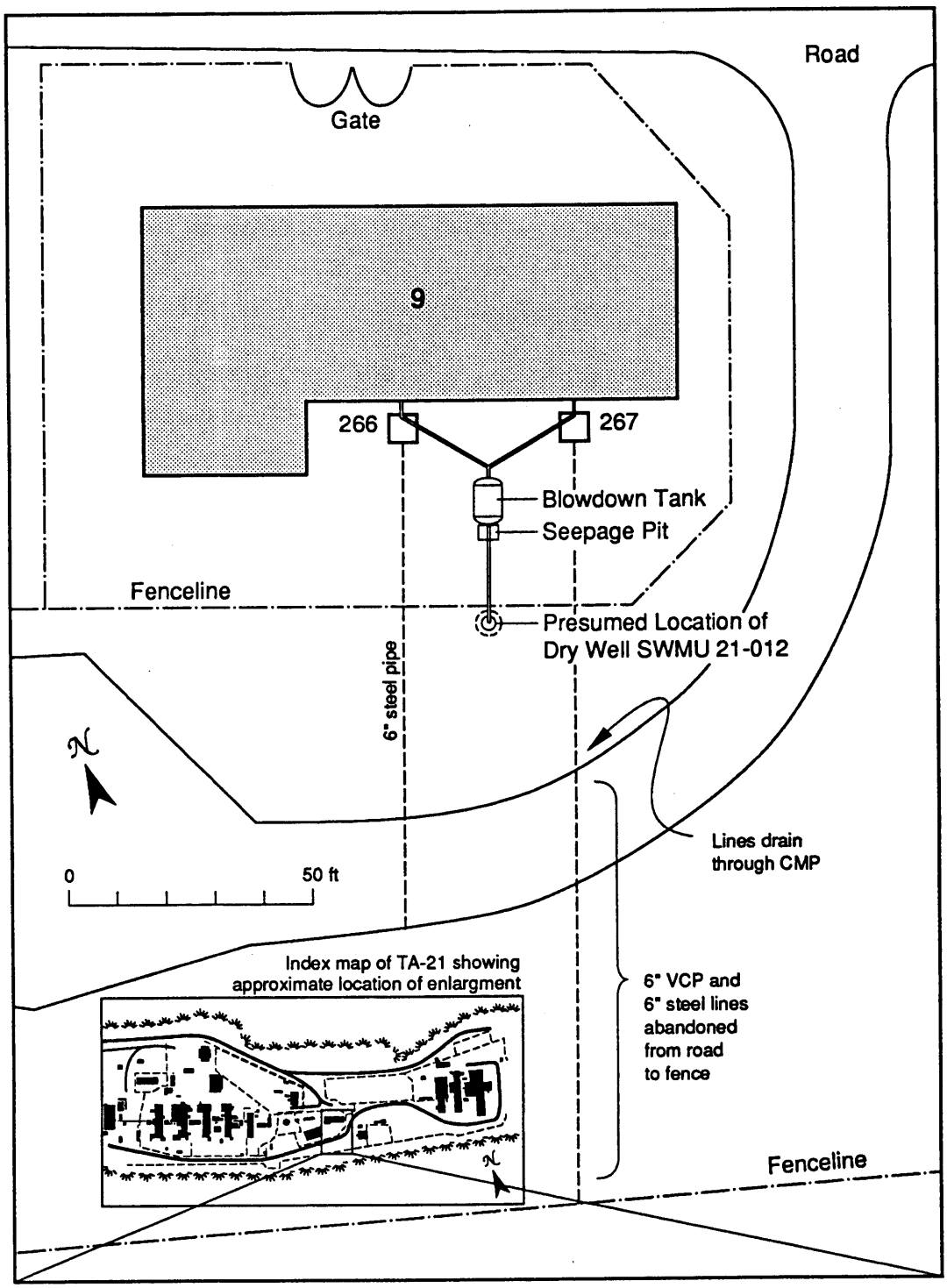


Fig. 17.4-1 Building TA-21-9 and blowdown discharge pipes, 1958. (LASL 1958, 1971, 1979)

17.4 SWMU 21-012 Dry Wells

17.4.1 Site Description

This section describes the field activities for the dry wells (SWMU 21-012) and related structures associated with steam plants at TA-21. One dry well associated with the new steam plant, Building TA-21-357, which was designated SWMU 21-012(a) (LANL 1990), does not exist (Roy T. Weston 1990a). SWMU 21-012(a) is described in Chapter 20, No-Investigation Units.

A second dry well was associated with the former steam plant, Building TA-21-9, designated SWMU 21-012(b). The former steam plant and related aboveground structures were removed, but subsurface structures and piping may remain. No contaminant releases from the dry well and related structures have been documented.

17.4.1.1 Site History

The former steam plant was constructed between May 1, 1945, and September 1, 1945 (LASL no date). For several years, boiler blowdown (pressurized discharge of gaseous steam from the boiler) was discharged from the building into two concrete steam blowdown pits adjacent to the south side of the steam plant (TA-21-266 and TA-21-267). A separate 6-in.-diameter, steel drain line drained each pit toward the southern edge of DP Mesa (Fig. 17.4-1) (LASL 1958). Based upon an engineering drawing (LASL 1958), the two lines are approximately 30 ft apart. Sections of two exposed underground steel lines, which may be from the two concrete blowdown pits, have been observed between the security fence and the road (Roy T. Weston 1990b). It cannot be determined from the site reconnaissance or available LANL engineering drawings if the liquid discharged to the ground surface or to an outfall on the edge of Los Alamos Canyon.

In 1971, boiler blowdown was routed to a 2500-gal. blowdown tank. The tank released overflow liquid into a 6-ft square by 2-ft deep seepage pit filled with river stones (Fig. 17.4-2) (LASL 1979).

In May 1980, a dry well was installed south of the blowdown tank to replace the seepage pit (Fig. 17.4-2) (LASL 1979). Underground piping connected the two structures. The dry well was 4-ft square by 54-ft deep. A 3-in.-diameter, perforated pipe hung vertically in the well to a 49-ft depth. The space surrounding the perforated pipe was filled with large gravel.

Engineering drawings (LASL 1958; LASL 1971; LASL 1979), show the blowdown tank seepage pit and the dry well were centrally located between the two steel drain lines.

The old steam plant was removed in 1985 and was replaced by the new steam plant, TA-21-357 (LANL no date). The area was regraded, and no visible evidence of the former steam plant or the concrete manhole cover for the dry well can be seen. It is not clear whether underground piping from the 2500-gal. tank was removed during demolition. The dry well may remain as well, as evidenced by an area of pavement that remains frost- and ice-free, except after heavy snows or very cold temperatures (Roy T. Weston 1990a).

17.4.1.2 Existing Information

No data exist regarding contamination in the area of the former steam plant dry well and related structures.

17.4.1.3 Source Term

The contaminant source term represented by steam plant blowdown is unknown. Common constituents in boiler blowdown include sulfite and copper salts to control dissolved oxygen and to catalyze the oxidation of manganese, and chromates as scale inhibitors, respectively (APHA 1989).

17.4.2. Objectives and Data Needs

The objective of this investigation is to confirm the absence of contamination at SWMU 21-012.

Specific data required to assess contamination at SWMU 21-012 include the following:

1. Determine the location of Building TA-21-9, structures TA-21-266 and TA-21-267, the pit beneath the blowdown tank, and the dry well. Some of these structures may have been removed, and the dry well may have been paved over.

2. Identify the contaminants present using Level II and III data. Contaminants are not documented, but common constituents in boiler blowdown include sulfite, copper salts, and chromates.

3. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by subsurface soil sampling and Level III/IV analyses.

17.4.3. Sampling/Investigation Rationale

There are two objectives of the initial investigation. The first objective will be to accurately locate the former structures at this SWMU, and the second will be to identify any blowdown-related constituents within them.

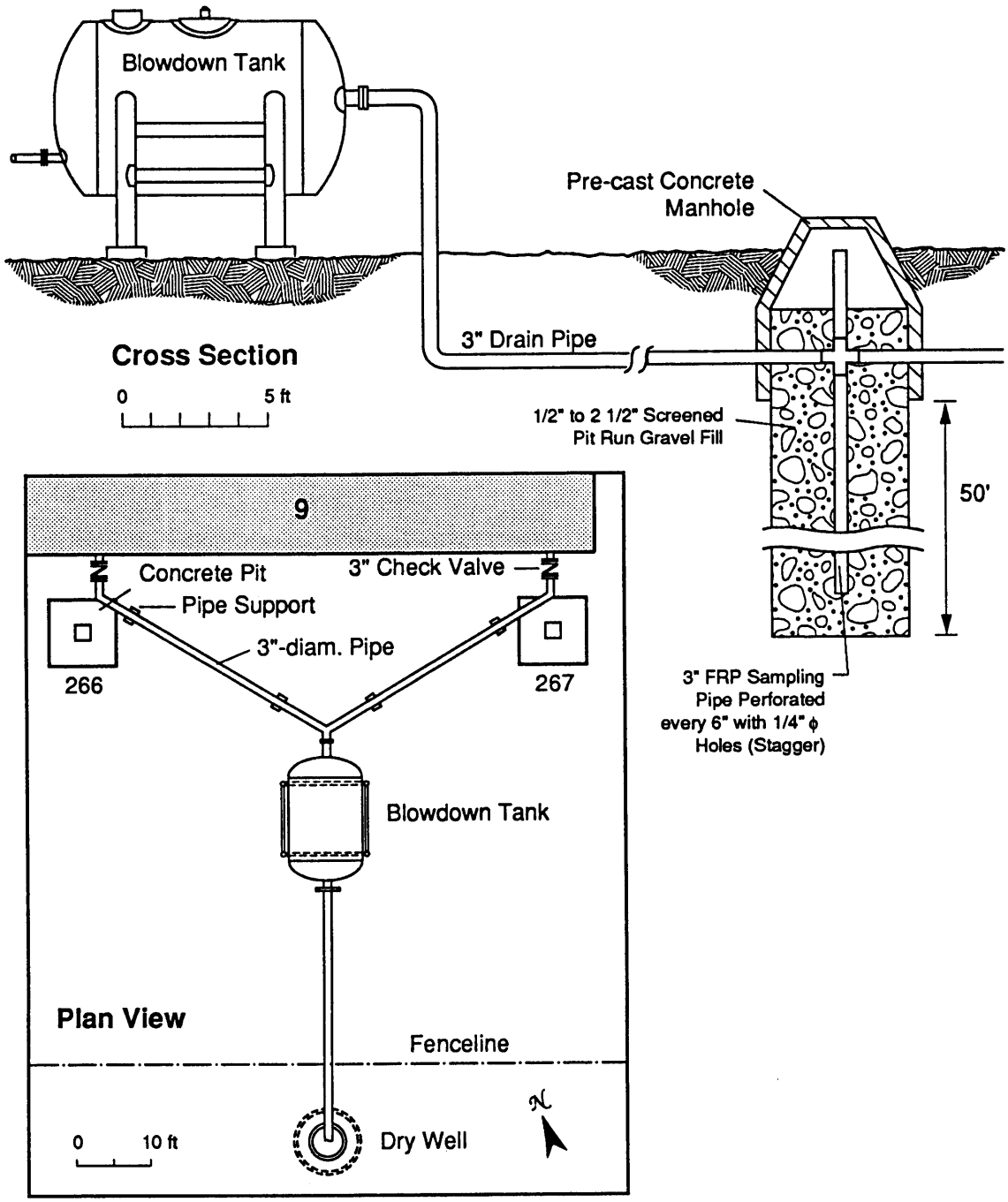


Fig. 17.4-2 Cross section and plan view of the blowdown tank and dry well on the south side of Building TA-21-9 in 1979. (LASL 1979)

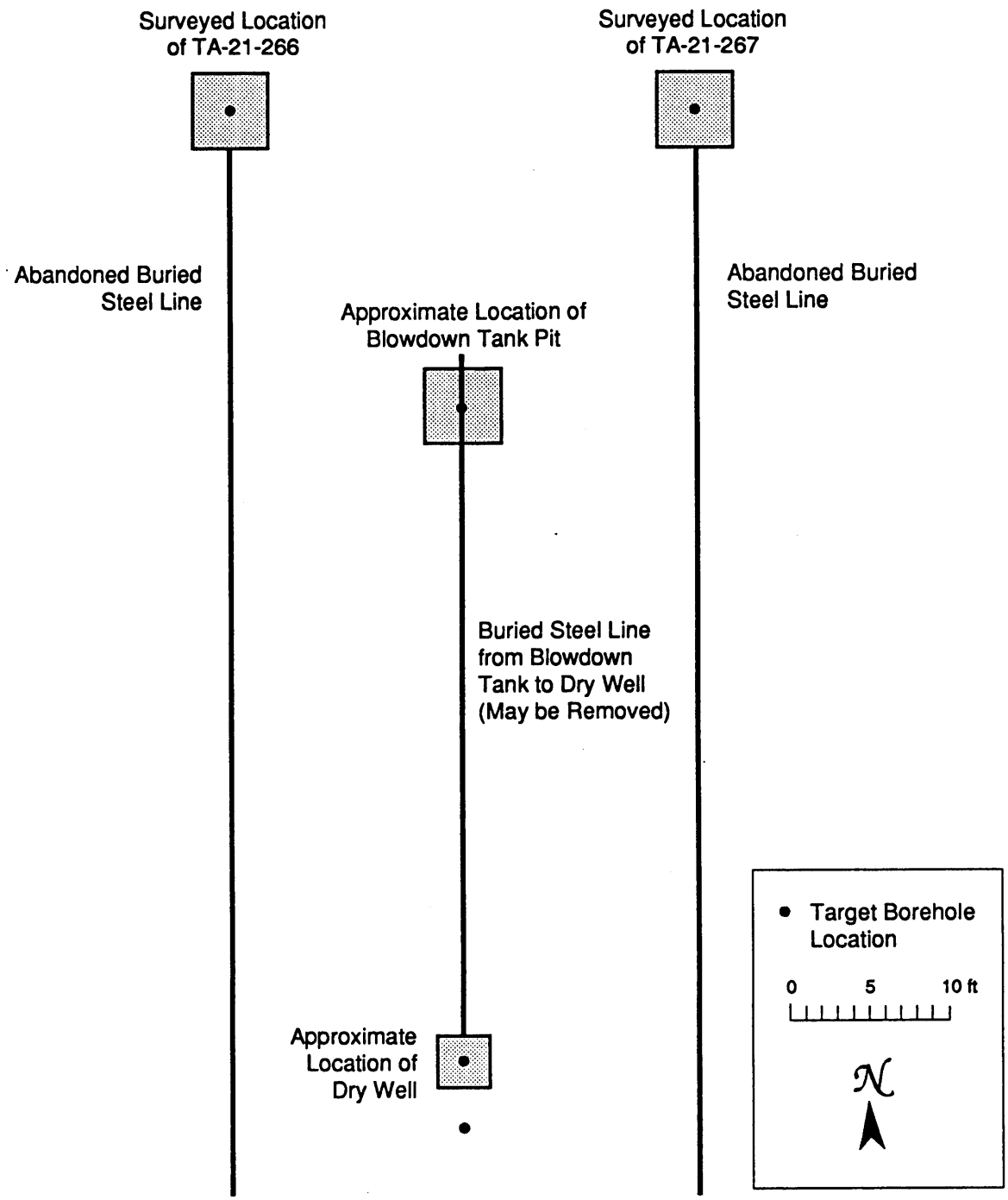


Fig. 17.4-3 Field investigation at SWMU 21-012. (LASL 1958)

Engineering drawings will be used to locate the boiler blowdown structures within this SWMU. Subsurface soil sampling at the three pit locations and at the dry well will be used to assess the presence of contaminants.

Laboratory analyses for the initial investigation target those constituents resulting from boiler blowdown. A full analytical suite will also be used for 30% of the samples to provide a high degree of certainty that other contaminants are not present.

A subsequent investigation may be necessary if unexpected hazardous substances are identified. The objective would be to determine the lateral and vertical extent of contamination, which would be accomplished with additional subsurface sampling. Based upon analytical results from the initial investigation, the analytical suite may be more focused in a subsequent investigation.

17.4.4. Sampling Plan

17.4.4.1. Initial Investigation

Identify Structure Locations. The former locations of Building TA-21-9 and structures TA-21-266 and TA-21-267 will be determined based on an engineering drawing (LANL 1983) and will be surveyed and marked in the field (for method see Sec. 11.4.3.). The two abandoned steel lines exposed at the ground surface south of the road will be visually identified. These lines can be traced in a straight line to the area of structures TA-21-266 and TA-21-267.

Plan details on other engineering drawings (LASL 1971; LASL 1979) will be used to determine the approximate locations of the former pit beneath the blowdown tank and the dry well. The approximate locations will be staked. Accuracy of the location will be based on visual inspection of core samples to determine the presence of gravel or river stones. A comparison of analytical data from these locations with established background levels for the common constituents in boiler blowdown (sulfite, copper salts, and chromate), as well as alkalinity and pH, may also provide an indication the locations have been identified.

Figure 17.4-3 identifies sampling locations for the dry well and related structures.

Structures TA-21-266, TA-21-267, and Blowdown Tank Pit. One shallow borehole will be drilled at the center of these structures (for method see Sec. 11.5.3.1). The presence of fill soil, gravel, or river rock in the soil core may constitute evidence of a positive location for these structures. However, it is not known with certainty if they were filled with gravel or river rock or whether they had a concrete bottom. Nominal borehole depth will be 10 ft. Subsurface soil

Table 17.4-1

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-012, DRY WELLS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Thorium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Sulfates/Chromates/Copper Salts	Alkalinity, pH	Nitrates, pH
TA-21-266																																	
Shallow Borehole	1	0.0 - 2.5 ft					X	X	X		X	X	X									X	X	X	X		X	X	X	X	X	X	X
		2.5 - 5.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X	X	X	X
		5.0 - 7.5 ft						X	X		X	X	X									X	X	X	X		X	X	X	X	X	X	X
		7.5 - 10.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X	X	X	X
TA-21-267																																	
Shallow Borehole	1	0.0 - 2.5 ft					X	X	X		X	X	X									X	X	X	X		X	X	X	X	X	X	X
		2.5 - 5.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X	X	X	X
		5.0 - 7.5 ft						X	X		X	X	X									X	X	X	X		X	X	X	X	X	X	X
		7.5 - 10.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X	X	X	X
Blowdown Tank Pit																																	
Shallow Borehole	1	0.0 - 2.5 ft					X	X	X		X	X	X									X	X	X	X		X	X	X	X	X	X	X
		2.5 - 5.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X	X	X	X
Rinsate Blank																																	
Field Blank																																	
		5.0 - 7.5 ft						X	X		X	X	X									X	X	X	X		X	X	X	X	X	X	X
		7.5 - 10.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X	X	X	X
Field Duplicate																																	
Dry Well							X																										
Vertical Borehole	1	0.0 - 5.0 ft					X	X	X		X	X	X									X	X	X	X		X	X	X	X	X	X	X
		5.0 - 10.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X	X	X	X
		15.0 - 20.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X	X	X	X
		20.0 - 25.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X	X	X	X
		25.0 - 30.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X	X	X	X
		30.0 - 35.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X	X	X	X

samples at these three locations will be collected at the following intervals: 2.5–5 ft, 5–7.5 ft, and 7.5–10 ft, for three samples at each location.

The field screening, field laboratory, and sample analysis requirements for these structures are shown in Table 17.4-I. All samples will be submitted to an analytical laboratory for analysis of common blowdown constituents (sulfates, chromates, and copper salts). In addition, a full analytical suite will be done on 30% of the samples. If no contaminants are identified, no further action will be taken at structures TA-21-266, TA-21-267, and the blowdown tank pit.

Dry Well. Two vertical boreholes will be drilled to investigate the dry well (for method see Sec. 11.5.3.2). The first borehole will be drilled through the approximate center of the dry well. The presence of gravels in the soil core would constitute evidence of a positive location for the dry well. The second borehole will be located 5 ft south of the first borehole. Nominal borehole depth for both boreholes will be 60 ft.

Core samples at the two locations will be collected only at the following intervals: 5–10 ft, 20–25 ft, 35–40 ft, 45–50 ft, 50–55 ft, and 55–60 ft. This sampling interval will result in the collection of six samples at each location and is intended to address the most probable area of contamination at the bottom of the dry well. All of these samples will be analyzed for blowdown constituents, and 30% will be subjected to the full suite of analyses to confirm the absence of any other contaminants. The field screening, field laboratory and sample analysis requirements for the dry well are shown in Table 17.4-I. If no contaminants are identified, no further action will be taken at the dry well.

17.4.4.2. Subsequent Investigation

Although not anticipated, a subsequent investigation may be necessary if unexpected hazardous substances are identified during the initial investigation. If RCRA metals are detected in the initial investigation, then the TCLP will be part of the analytical suite in the subsequent investigations to determine if samples contain a RCRA hazardous waste. Additional borehole locations will be established at 10-ft spacings. Depth intervals and an appropriate analytical suite will be based on analytical results from the initial investigation.

Table 17.4-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-012, DRY WELLS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening							Field Laboratory Measurements									Laboratory Analysis										
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture				Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Thorium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Sulfates/Chromates/Copper Salts	Alkalinity, pH	Nitrates, pH
		35.0 – 40.0 ft						X	X		X		X	X									X	X	X						X	X	X
		45.0 – 50.0 ft						X	X		X		X	X									X	X	X						X	X	X
		50.0 – 55.0 ft						X	X		X		X	X									X	X	X						X	X	X
		55.0 – 60.0 ft						X	X		X		X	X									X	X	X						X	X	X
Trip Blank																																		
Vertical Borehole	2	0.0 – 5.0 ft					X	X	X		X		X	X																				
		5.0 – 10.0 ft						X	X		X		X	X																				
		20.0 – 25.0 ft						X	X		X		X	X									X	X	X						X	X	X
		20.0 – 25.0 ft						X	X		X		X	X																				
		25.0 – 30.0 ft						X	X		X		X	X																				
		30.0 – 35.0 ft						X	X		X		X	X																				
		35.0 – 40.0 ft						X	X		X		X	X									X	X	X						X	X	X
		45.0 – 50.0 ft						X	X		X		X	X									X	X	X						X	X	X
		50.0 – 55.0 ft						X	X		X		X	X																				
		55.0 – 60.0 ft						X	X		X		X	X									X	X	X						X	X	X
Rinsate Blank																																		
Field Blank																																		
Trip Blank																																		

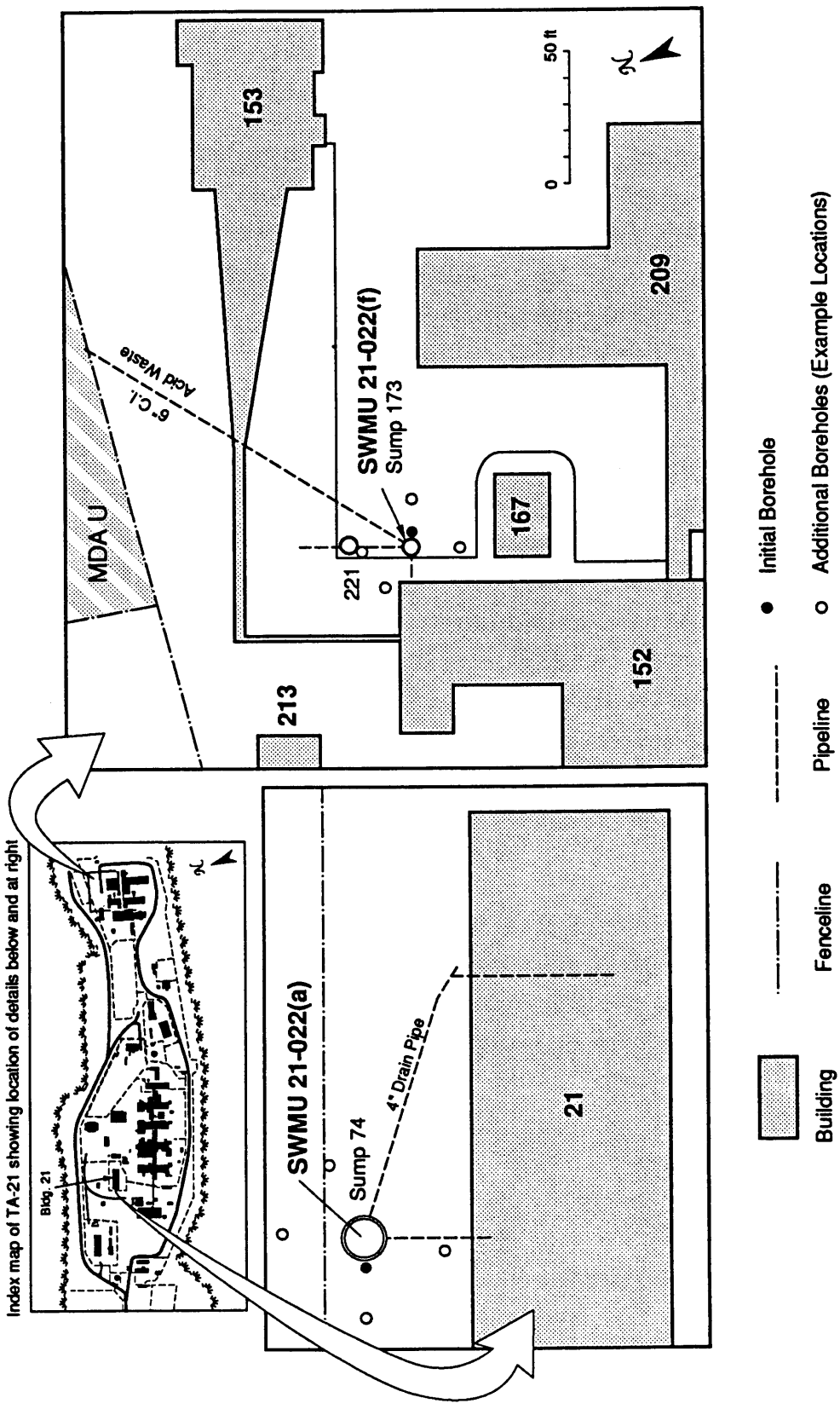


Fig. 17.5-1 Location of SWMUs 21-022(a) (f). (LASL 1960, 1964)

17.5. Acid Waste Lines and Sumps

17.5.1. Site Description

There are 10 subunits identified in SWMU 21-022, Acid Waste Lines and Sumps. Because the presence of existing buildings and other structures preclude characterization investigations, eight of these subunits are discussed in Chapter 18, Units for Coordination with Building D&D. The two subunits discussed in this section, SWMUs 21-022(a) and (f), are accessible, and neither characterization nor remediation should be precluded by the presence of structures.

17.5.1.1. History

SWMU 21-022(a), sump TA-21-74, is located north of Building TA-21-21 (Fig. 17.5-1). The sump was constructed of brick about July 1946, is of unknown depth, and is 5 ft in diameter with a wood cover (LANL no date). TA-21-21 was a vault used for storage of plutonium and uranium, although it is no longer used for storage of nuclear materials. A detailed drawing (LASL 1960) shows the sump as a cylindrical structure with one inlet line from the old portion of the vault and another to be constructed for the new addition to the building (these are shown in Fig. 17.5-1). No outlets are shown. In 1973, a tank (TA-21-335) was constructed to receive releases from TA-21-21. The tank may have replaced sump TA-21-74, although this is not entirely clear. No drawings showing the connections to the tank have been found. The lid of the sump is visible north of TA-21-21, and a sign on the fence just north of the sump identifies it as DP-74 (LANL 1988).

SWMU 21-022(f), sump TA-21-173, is located off the northeast corner of TA-21-152 (Fig. 17.5-1). It is 5.5 ft in diameter and 6-ft deep (LANL no date). A 6-in. drain line leads from the sump to MDA U (SWMU 21-017) to the northeast. The round lid of the sump is visible about 10 ft to 15 ft off the northeast corner of TA-21-152 (LANL 1988). The sump and its drain line are not believed to be in use.

17.5.1.2. Existing Information

SWMU 21-022(a). There is no quantitative contaminant information available for this subunit. No previous sampling has been performed.

SWMU 21-022(f). There is no quantitative contaminant information available for this subunit. No previous sampling has been performed.

17.5-1). The nominal depth of each borehole is 30 ft, resulting in six samples per borehole.

Because comparable sumps in other locations at TA-21 have leaked, a contingency for sampling each borehole to greater depths is considered necessary. The contingency allows for an additional 70 ft for each borehole to be sampled, with an additional six samples per borehole submitted for laboratory analysis.

The major purpose of the field laboratory for the first 30 ft of investigation is to define whether the nominal depth has reached the edge of the contaminant plume or whether each borehole needs to be deeper. Because it is unknown whether these sumps are contaminated, an additional purpose of the field laboratory is to identify the presence of contamination. All samples from the upper 30 ft will be submitted to the analytical laboratory.

Should the boreholes be extended beyond 70 ft, samples to be submitted to the analytical laboratory will include both samples with "hits" in the field laboratory to document the kinds of contaminants present at depth (i.e., contaminant source term definition) and samples without contaminants to document the edges of the plume and confirm absence of contamination.

Table 17.5-I lists the screening and analysis to be performed on samples gathered in the investigation of each sump. If no contamination is identified, then no further action will be taken at SWMU 21-022(a) and (f).

17.5.4.2. Subsequent Investigation

SWMU 21-022(a) and (f). If contamination is detected in the initial borehole, additional information on the lateral extent of contamination may be required. The need for this information will be met by locating boreholes in the four quadrants north, south, west, and east of the center of the sump. The first four of these secondary boreholes will be located 20 ft from the center of the sump (Fig. 17.5-1). Samples from these boreholes will serve to determine if lateral migration of contaminants has occurred. If the direction of lateral movement can be determined from this first set of secondary boreholes, then any additional boreholes may be placed only in the direction of migration. It is expected that no more than six additional boreholes per sump will be required to characterize the extent of contaminant migration.

All subsequent investigation boreholes will be vertical boreholes drilled by the same method used for the initial boreholes (see Sec. 11.5.3.2). The nominal depth for each borehole is assumed to be 60 ft, although this may be adjusted depending on results from the initial investigation. All 12 samples from each borehole will be subjected to field laboratory measurements, but a maximum

17.5.1.3. Source Term

SWMU 21-022(a) is expected to be contaminated with plutonium and uranium because TA-21-21 was used to store these materials. It is not known if hazardous constituents are associated with these radionuclides. It is also not known whether environmental contamination is present.

SWMU 21-022(f) is in the eastern portion of TA-21 where ^{210}Po and ^{227}Ac are associated with the waste from DP East (LANL 1990). Other radionuclides and hazardous constituents may also be present. It is not known if environmental contamination is present.

17.5.2 Objectives and Data Needs

The objective of this investigation is to confirm the presence or absence of contamination and determine the extent of contamination at SWMUs 21-022(a) and (f).

Specific data requirements to assess contamination at SMWU 21-022(a) and (f) include the following:

1. Identify the contaminants present using Level II and III data. Plutonium and uranium contamination may be associated with SWMU 21-022(a), and polonium and actinium may be associated with SWMU 21-022(f). Collect Level III data from boreholes beside the acid sumps, TA-21-74 and TA-21-173.

2. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by subsurface soil sampling and Level III/IV analyses.

17.5.3. Sampling/Investigation Rationale

Boreholes will be drilled in the immediate vicinity of SWMUs 21-022(a) and (f) to determine the nature and extent of contamination. Initial boreholes will determine the presence and depth of contamination. Subsequent investigations may be needed to determine the extent of contamination, if any is present.

17.5.4. Sampling Plan

17.5.4.1. Initial Investigations

SWMU 21-022(a) and (f). For both sumps, sampling will be performed by drilling a vertical borehole approximately 2 ft west of the wall of the sump (for method see Sec. 11.5.3.2) (Fig.

Table 17.5-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-022(A) AND 21-022(F), ACID WASTE LINE AND SUMPS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis													
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Thorium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Sulfates/Chromates/Copper Salts	Alkalinity, pH	Nitrates, pH	
Trip Blank																											X							
TA-21-173																																		
Vertical Borehole	1	0.0 - 5.0 ft						X	X		X		X	X	X	X	X					X	X	X	X	X	X	X	X	X					
		5.0 - 10.0 ft						X	X		X		X	X	X	X	X					X	X	X	X	X	X	X	X	X					
		10.0 - 15.0 ft						X	X		X		X	X	X	X	X					X	X	X	X	X	X	X	X	X					
		15.0 - 20.0 ft						X	X		X		X	X	X	X	X					X	X	X	X	X	X	X	X	X					
		20.0 - 25.0 ft						X	X		X		X	X	X	X	X					X	X	X	X	X	X	X	X	X					
		25.0 - 30.0 ft						X	X		X		X	X	X	X	X					X	X	X	X	X	X	X	X	X					
Field Duplicate																						X	X	X	X	X	X	X	X					
Contingency		30.0 - 35.0 ft						C	C		C		C	C	C	C	C					C	C	C	C	C	C	C	C	C					
		35.0 - 40.0 ft						C	C		C		C	C	C	C	C																		
		40.0 - 45.0 ft						C	C		C		C	C	C	C	C					C	C	C	C	C	C	C	C	C					
		45.0 - 50.0 ft						C	C		C		C	C	C	C	C																		
		50.0 - 55.0 ft						C	C		C		C	C	C	C	C																		
		55.0 - 60.0 ft						C	C		C		C	C	C	C	C					C	C	C	C	C	C	C	C	C					
		60.0 - 65.0 ft						C	C		C		C	C	C	C	C																		
		65.0 - 70.0 ft						C	C		C		C	C	C	C	C					C	C	C	C	C	C	C	C	C					
		70.0 - 75.0 ft						C	C		C		C	C	C	C	C																		
		75.0 - 80.0 ft						C	C		C		C	C	C	C	C																		
		80.0 - 85.0 ft						C	C		C		C	C	C	C	C																		
		85.0 - 90.0 ft						C	C		C		C	C	C	C	C					C	C	C	C	C	C	C	C	C					
		90.0 - 95.0 ft						C	C		C		C	C	C	C	C																		
		95.0 - 100.0 ft						C	C		C		C	C	C	C	C					C	C	C	C	C	C	C	C	C					
Rinsate Blank																						X	X	X	X	X	X	X	X					
Field Blank																											X	X	X					
Field Duplicate																						C	C	C	C	C	C	C	C					

Table 17.5-1

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-022(A) AND 21-022(F), ACID WASTE LINE AND SUMPS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Thorium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Sulfates/Chromates/Copper Salts	Alkalinity, pH	Nitrates, pH
TA-21-74																																	
Vertical Borehole	1	0.0 - 5.0 ft						X	X		X		X	X	X	X	X					X	X	X	X	X	X	X	X	X			
		5.0 - 10.0 ft						X	X		X		X	X	X	X	X					X	X	X	X	X	X	X	X	X			
		10.0 - 15.0 ft						X	X		X		X	X	X	X	X					X	X	X	X	X	X	X	X	X			
		15.0 - 20.0 ft						X	X		X		X	X	X	X	X					X	X	X	X	X	X	X	X	X			
		20.0 - 25.0 ft						X	X		X		X	X	X	X	X					X	X	X	X	X	X	X	X	X			
		25.0 - 30.0 ft						X	X		X		X	X	X	X	X					X	X	X	X	X	X	X	X	X			
Field Duplicate																																	
Contingency		30.0 - 35.0 ft						C	C		C		C	C	C	C	C					C	C	C	C	C	C	C	C	C			
		35.0 - 40.0 ft						C	C		C		C	C	C	C	C					C	C	C	C	C	C	C	C	C			
		40.0 - 45.0 ft						C	C		C		C	C	C	C	C					C	C	C	C	C	C	C	C	C			
		45.0 - 50.0 ft						C	C		C		C	C	C	C	C					C	C	C	C	C	C	C	C	C			
		50.0 - 55.0 ft						C	C		C		C	C	C	C	C					C	C	C	C	C	C	C	C	C			
		55.0 - 60.0 ft						C	C		C		C	C	C	C	C					C	C	C	C	C	C	C	C	C			
		60.0 - 65.0 ft						C	C		C		C	C	C	C	C					C	C	C	C	C	C	C	C	C			
		65.0 - 70.0 ft						C	C		C		C	C	C	C	C					C	C	C	C	C	C	C	C	C			
		70.0 - 75.0 ft						C	C		C		C	C	C	C	C					C	C	C	C	C	C	C	C	C			
		75.0 - 80.0 ft						C	C		C		C	C	C	C	C					C	C	C	C	C	C	C	C	C			
		80.0 - 85.0 ft						C	C		C		C	C	C	C	C					C	C	C	C	C	C	C	C	C			
		85.0 - 90.0 ft						C	C		C		C	C	C	C	C					C	C	C	C	C	C	C	C	C			
		90.0 - 95.0 ft						C	C		C		C	C	C	C	C					C	C	C	C	C	C	C	C	C			
		95.0 - 100.0 ft						C	C		C		C	C	C	C	C					C	C	C	C	C	C	C	C	C			
Rinsate Blank																							X	X	X	X	X	X	X	X			
Field Blank																							X	X	X	X	X	X	X	X			
Field Duplicate																							C	C	C	C	C	C	C	C			

of four per borehole is assumed to be submitted for analytical laboratory measurements.

For each of the two sumps the assumed subsequent investigations will total 72 samples, of which 30% (21 samples) will be sent for laboratory analysis. The analytical suite specified for the samples may be focused based on initial sample analysis results, but for planning purposes, it is assumed that a full analytical suite will be used. Table 17.5-II identifies the assumed screening and analysis requirements for the subsequent investigations.

Table 17.5-1

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-022(A) AND 21-022(F), ACID WASTE LINE AND SUMPS.

	Sample Identification	Interval	Sampling Location	Sample Type
Field Surveys	Gross Gamma			
	Low-Energy Gamma			
	Electromagnetic			
	Land Survey			
Field Screening	Gross Gamma			
	Gross Alpha			
	Organic Vapor			
	Combustible Gas/Oxygen			
	Lithological Logging			
Field Laboratory Measurements	Gross Alpha			
	Gamma Spectrometry			
	Tritium			
	Volatile Organics			
	PCB			
	Soil Moisture			
Laboratory Analysis	Gamma Spectrometry			
	Tritium			
	Total Uranium			
	Isotopic Plutonium			
	Isotopic Thorium			
	Strontium 90			
	VOA (SW 8240)			X
	Semivolatiles (SW 8270)			
	Metals (SW 6010)			
	PCB (SW 8080)			
	Sulfates/Chromates/Copper Salts			
	Alkalinity, pH			
	Nitrates, pH			
				Trip Blank

Table 17.5-II

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-022(A) AND 21-022(F), ACID WASTE LINES AND SUMPS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis													
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Total Uranium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Thorium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Sulfates/Chromates/Copper Salts	Alkalinity, pH	Nitrates, pH	
		45.0 – 50.0 ft						X	X		X		X	X	X	X	X	X																	
		50.0 – 55.0 ft						X	X		X		X	X	X	X	X	X																	
		55.0 – 60.0 ft						X	X		X		X	X	X	X	X	X																	
Trip Blank																												X							
Vertical Borehole	3	0.0 – 5.0 ft						X	X		X		X	X	X	X	X	X				E	E	E	E	E	E	E	E	E					
		5.0 – 10.0 ft						X	X		X		X	X	X	X	X	X																	
Rinsate Blank																						X	X	X	X	X	X	X	X	X					
Field Blank																												X	X	X					
		10.0 – 15.0 ft						X	X		X		X	X	X	X	X	X																	
		15.0 – 20.0 ft						X	X		X		X	X	X	X	X	X																	
		20.0 – 25.0 ft						X	X		X		X	X	X	X	X	X				E	E	E	E	E	E	E	E	E					
		25.0 – 30.0 ft						X	X		X		X	X	X	X	X	X																	
		30.0 – 35.0 ft						X	X		X		X	X	X	X	X	X																	
		35.0 – 40.0 ft						X	X		X		X	X	X	X	X	X				E	E	E	E	E	E	E	E	E					
		40.0 – 45.0 ft						X	X		X		X	X	X	X	X	X																	
		45.0 – 50.0 ft						X	X		X		X	X	X	X	X	X																	
		50.0 – 55.0 ft						X	X		X		X	X	X	X	X	X																	
		55.0 – 60.0 ft						X	X		X		X	X	X	X	X	X				E	E	E	E	E	E	E	E	E					
Trip Blank																												X							
Vertical Borehole	4	0.0 – 5.0 ft						X	X		X		X	X	X	X	X	X				E	E	E	E	E	E	E	E	E					
		5.0 – 10.0 ft						X	X		X		X	X	X	X	X	X																	
		10.0 – 15.0 ft						X	X		X		X	X	X	X	X	X																	
		15.0 – 20.0 ft						X	X		X		X	X	X	X	X	X																	
		20.0 – 25.0 ft						X	X		X		X	X	X	X	X	X				E	E	E	E	E	E	E	E	E					
		25.0 – 30.0 ft						X	X		X		X	X	X	X	X	X																	
		30.0 – 35.0 ft						X	X		X		X	X	X	X	X	X																	

Table 17.5-II

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-022(A) AND 21-022(F), ACID WASTE LINES AND SUMPS.

					Field Surveys				Field Screening			Laboratory Measurements								Laboratory Analysis										
	Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture				Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Thorium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Sulfates/Chromates/Copper Salts	Alkalinity, pH	Nitrates, pH
TA-21-74																																			
	Vertical Borehole	1	0.0 - 5.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				
			5.0 - 10.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				
			10.0 - 15.0 ft						X	X		X		X	X	X	X	X																	
			15.0 - 20.0 ft						X	X		X		X	X	X	X	X																	
			20.0 - 25.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				
			25.0 - 30.0 ft						X	X		X		X	X	X	X	X																	
	Rinsate Blank																						X												
	Field Blank		30.0 - 35.0 ft						X	X		X		X	X	X	X	X					X	X	X	X	X	X	X	X	X				
			35.0 - 40.0 ft						X	X		X		X	X	X	X	X																	
			40.0 - 45.0 ft						X	X		X		X	X	X	X	X																	
			45.0 - 50.0 ft						X	X		X		X	X	X	X	X																	
			50.0 - 55.0 ft						X	X		X		X	X	X	X	X																	
			55.0 - 60.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				
	Trip Blank																												X						
	Vertical Borehole	2	0.0 - 5.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				
			5.0 - 10.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				
			10.0 - 15.0 ft						X	X		X		X	X	X	X	X																	
			15.0 - 20.0 ft						X	X		X		X	X	X	X	X																	
			20.0 - 25.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				
			25.0 - 30.0 ft						X	X		X		X	X	X	X	X																	
			30.0 - 35.0 ft						X	X		X		X	X	X	X	X																	
			35.0 - 40.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				
			40.0 - 45.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				

Table 17.5-II

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-022(A) AND 21-022(F), ACID WASTE LINES AND SUMPS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Thorium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Sulfates/Chromates/Copper Salts	Alkalinity, pH	Nitrates, pH
		20.0 – 25.0 ft						X	X				X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		25.0 – 30.0 ft						X	X				X	X	X	X	X					E	E	E	E	E	E	E	E	E				
Rinsate Blank																		X				E	X	X	X	X	X	X	X	X				
Field Blank																		X				E	X	X	X	X	X	X	X	X				
		30.0 – 35.0 ft						X	X				X	X	X	X	X																	
		35.0 – 40.0 ft						X	X				X	X	X	X	X																	
		40.0 – 45.0 ft						X	X				X	X	X	X	X																	
		45.0 – 50.0 ft						X	X				X	X	X	X	X																	
		50.0 – 55.0 ft						X	X				X	X	X	X	X																	
		55.0 – 60.0 ft						X	X				X	X	X	X	X																	
Field Duplicate																						X	X	X	X	X	X	X	X	X				
Trip Blank																												X	X	X				
TA-21-173																																		
Vertical Borehole	1	0.0 – 5.0 ft						X	X				X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		5.0 – 10.0 ft						X	X				X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		10.0 – 15.0 ft						X	X				X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		15.0 – 20.0 ft						X	X				X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		20.0 – 25.0 ft						X	X				X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		25.0 – 30.0 ft						X	X				X	X	X	X	X					E	E	E	E	E	E	E	E	E				
Rinsate Blank																						X	X	X	X	X	X	X	X	X				
Field Blank																												X	X	X				
		30.0 – 35.0 ft						X	X				X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		35.0 – 40.0 ft						X	X				X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		40.0 – 45.0 ft						X	X				X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		45.0 – 50.0 ft						X	X				X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		50.0 – 55.0 ft						X	X				X	X	X	X	X					E	E	E	E	E	E	E	E	E				

Table 17.5-II

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-022(A) AND 21-022(F), ACID WASTE LINES AND SUMPS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture				Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Thorium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Sulfates/Chromates/Copper Salts	Alkalinity, pH	Nitrates, pH
		35.0 - 40.0 ft						X	X		X		X									E	E	E	E	E	E	E	E	E				
		40.0 - 45.0 ft						X	X		X		X									E	E	E	E	E	E	E	E	E				
		45.0 - 50.0 ft						X	X		X		X									X	X	X	X	X	X	X	X	X				
Rinsate Blank																																		
Field Blank																																		
		50.0 - 55.0 ft						X	X		X		X									E	E	E	E	E	E	E	E	E				
		55.0 - 60.0 ft						X	X		X		X									E	E	E	E	E	E	X	E	E				
Trip Blank																																		
Vertical Borehole	5	0.0 - 5.0 ft						X	X		X		X									E	E	E	E	E	E	E	E	E				
		5.0 - 10.0 ft						X	X		X		X									E	E	E	E	E	E	E	E	E				
		10.0 - 15.0 ft						X	X		X		X									E	E	E	E	E	E	E	E	E				
		15.0 - 20.0 ft						X	X		X		X									E	E	E	E	E	E	E	E	E				
		20.0 - 25.0 ft						X	X		X		X									E	E	E	E	E	E	E	E	E				
		25.0 - 30.0 ft						X	X		X		X									E	E	E	E	E	E	E	E	E				
		30.0 - 35.0 ft						X	X		X		X									E	E	E	E	E	E	E	E	E				
		35.0 - 40.0 ft						X	X		X		X									E	E	E	E	E	E	E	E	E				
		40.0 - 45.0 ft						X	X		X		X									E	E	E	E	E	E	E	E	E				
		45.0 - 50.0 ft						X	X		X		X									E	E	E	E	E	E	E	E	E				
		50.0 - 55.0 ft						X	X		X		X									E	E	E	E	E	E	E	E	E				
		55.0 - 60.0 ft						X	X		X		X									E	E	E	E	E	E	E	E	E				
Trip Blank																																		
Vertical Borehole	6	0.0 - 5.0 ft						X	X		X		X									E	E	E	E	E	E	E	E	E				
Field Duplicate		5.0 - 10.0 ft						X	X		X		X									E	E	E	E	E	E	E	E	E				
		10.0 - 15.0 ft						X	X		X		X									E	E	E	E	E	E	E	E	E				
		15.0 - 20.0 ft						X	X		X		X									E	E	E	E	E	E	E	E	E				

Table 17.5–II

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21–022(A) AND 21–022(F), ACID WASTE LINES AND SUMPS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis													
				Gross Gamma	Low–Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Thorium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Sulfates/Chromates/Copper Salts	Alkalinity, pH	Nitrates, pH	
		45.0 – 50.0 ft						X	X		X		X	X	X	X	X																	
		50.0 – 55.0 ft						X	X		X		X	X	X	X	X																	
		55.0 – 60.0 ft						X	X		X		X	X	X	X	X																	
Trip Blank																											X							
Vertical Borehole	4	0.0 – 5.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E					
		5.0 – 10.0 ft						X	X		X		X	X	X	X	X																	
		10.0 – 15.0 ft						X	X		X		X	X	X	X	X																	
		15.0 – 20.0 ft						X	X		X		X	X	X	X	X																	
		20.0 – 25.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E					
		25.0 – 30.0 ft						X	X		X		X	X	X	X	X																	
		30.0 – 35.0 ft						X	X		X		X	X	X	X	X																	
		35.0 – 40.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E					
		40.0 – 45.0 ft						X	X		X		X	X	X	X	X																	
		45.0 – 50.0 ft						X	X		X		X	X	X	X	X																	
Rinsate Blank																						X	X	X	X	X	X	X	X	X				
Field Blank																											X	X	X					
		50.0 – 55.0 ft						X	X		X		X	X	X	X	X																	
		55.0 – 60.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E					
Trip Blank																											X							
Vertical Borehole	5	0.0 – 5.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E					
		5.0 – 10.0 ft						X	X		X		X	X	X	X	X																	
		10.0 – 15.0 ft						X	X		X		X	X	X	X	X																	
		15.0 – 20.0 ft						X	X		X		X	X	X	X	X																	
		20.0 – 25.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E					
		25.0 – 30.0 ft						X	X		X		X	X	X	X	X																	
		30.0 – 35.0 ft						X	X		X		X	X	X	X	X																	

Table 17.5-II

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-022(A) AND 21-022(F), ACID WASTE LINES AND SUMPS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Laboratory Field Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture				Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Thorium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Sulfates/Chromates/Copper Salts	Alkalinity, pH	Nitrates, pH
Trip Blank		55.0 – 60.0 ft						X						X	X	X	X					E	E	E	E	E	E	X	E	E				
Vertical Borehole	2	0.0 – 5.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E		E	E				
		5.0 – 10.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E		E	E				
		10.0 – 15.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E		E	E				
		15.0 – 20.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E		E	E				
		20.0 – 25.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E		E	E				
		25.0 – 30.0 ft						X	X		X		X	X	X	X	X																	
		30.0 – 35.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E		E	E				
		35.0 – 40.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E		E	E				
		40.0 – 45.0 ft						X	X		X		X	X	X	X	X																	
		45.0 – 50.0 ft						X	X		X		X	X	X	X	X																	
		50.0 – 55.0 ft						X	X		X		X	X	X	X	X																	
		55.0 – 60.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E		E	E				
Trip Blank																																		
Vertical Borehole	3	0.0 – 5.0 ft						X	X		X		X	X	X	X	X																	
		5.0 – 10.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E		E	E				
Rinsate Blank																						E	E	E	E	E	E		E	E				
Field Blank																						E	E	E	E	E	E	X	E	E				
		10.0 – 15.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	X	E	E				
		15.0 – 20.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	X	E	E				
		20.0 – 25.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	X	E	E				
		25.0 – 30.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	X	E	E				
		30.0 – 35.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	X	E	E				
		35.0 – 40.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	X	E	E				
		40.0 – 45.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	X	E	E				

Table 17.5-II

SCREENING AND ANALYSIS FOR SUBSEQUENT INVESTIGATIONS AT SWMU 21-022(A) AND 21-022(F), ACID WASTE LINES AND SUMPS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture				Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Thorium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	Sulfates/Chromates/Copper Salts	Alkalinity, pH	Nitrates, pH
		35.0 - 40.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		40.0 - 45.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		45.0 - 50.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		50.0 - 55.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		55.0 - 60.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				
Trip Blank																																		
Vertical Borehole	6	0.0 - 5.0 ft						X			X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				
Field Duplicate		5.0 - 10.0 ft						X			X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		10.0 - 15.0 ft						X			X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		15.0 - 20.0 ft						X			X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		20.0 - 25.0 ft						X			X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		25.0 - 30.0 ft						X			X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				
Rinsate Blank																																		
Field Blank		30.0 - 35.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		35.0 - 40.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		40.0 - 45.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		45.0 - 50.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		50.0 - 55.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				
		55.0 - 60.0 ft						X	X		X		X	X	X	X	X					E	E	E	E	E	E	E	E	E				
Field Duplicate																																		
Trip Blank																																		

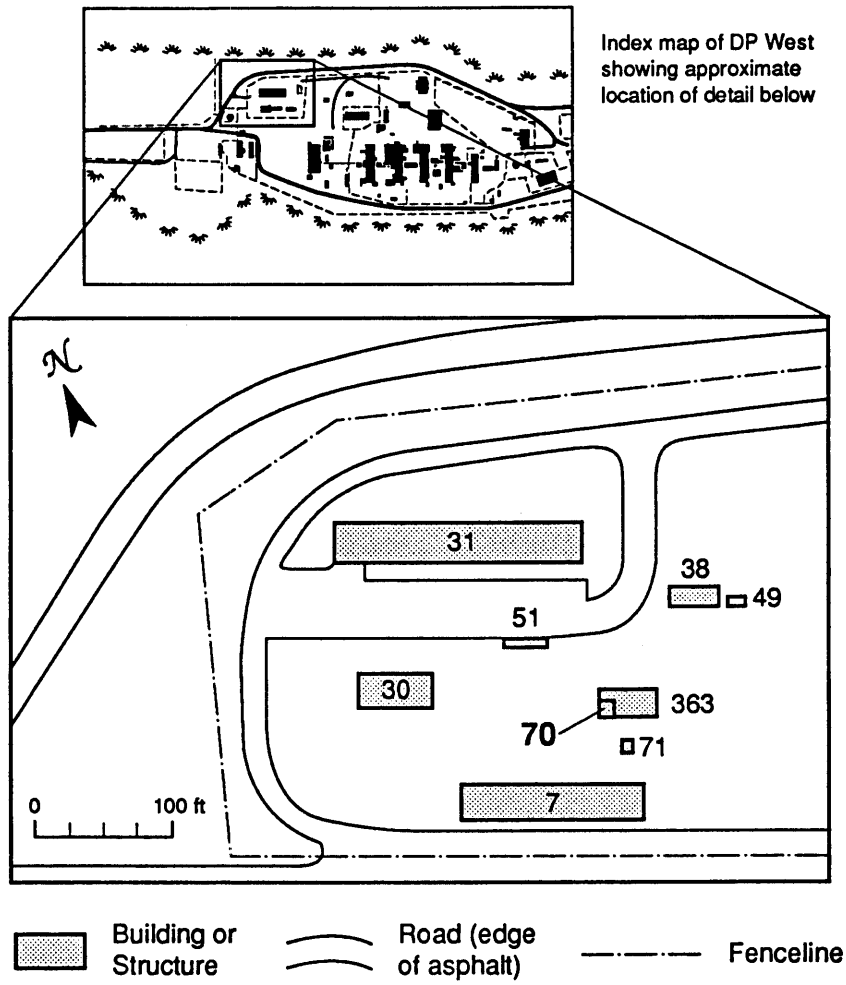


Fig. 17.6-1 Approximate location of acid pit TA-21-70. (LASL 1955)

1. Determine the location of the acid pit, TA-21-70. The location of the acid pit may be under an existing trailer, TA-21-363.

2. Identify if contaminants are present using Level II and III data. The acid pit contained nitric acid, but it is not known if any leaks occurred.

3. If contaminants are identified, determine the lateral and vertical extent of contaminant migration by subsurface soil sampling and Level III/IV analysis.

17.6.3 Field Sampling/Investigation Rationale

Two phases of investigations are planned for SWMU 21-005. Because the western end of portable office TA-21-363 was placed above the location of the former acid pit, contaminant assessment at TA-21-70 cannot be performed by vertical drilling. Therefore, the initial investiga-

17.6 SWMU 21-005 Acid Pit

17.6.1 Site Description

This section describes the field activities for the acid pit (SWMU 21-005) (Fig. 17.6-1). This SWMU addresses a site that used nitric acid to destroy classified correspondence but is no longer active. No releases from the acid pit to the environment are documented.

17.6.1.1 Site History

The acid pit, TA-21-70, was installed in 1946 to dispose of classified correspondence. The acid pit was a 3-ft square by 4-ft deep reinforced concrete structure covered with sheet iron. The acid pit contained concentrated nitric acid, which digested classified materials (LASL 1966). The volume and concentration of acid used were not documented.

The concrete structure was removed between January 3 and January 20, 1967, and disposed of at MDA G (LANL no date). Soil may have been placed inside the concrete structure to absorb the acid before it was lifted from the ground as a single unit (LASL1966). It is not known whether any soil from around the acid pit was removed during excavation. Presently, the west end of trailer TA-21-363 may occupy the former location of the acid pit (LANL 1990).

17.6.1.2 Existing Information

No data exist regarding contamination in the area of the former acid pit, TA-21-70. No releases from the acid pit to the environment were documented (LANL 1990).

17.6.1.3 Source Term

The only known material used in the acid pit was concentrated nitric acid. Although no data are available on whether other contaminants were present in the acid pit, no contaminants are suspected. There are no known releases from this unit (LANL 1990); however, it is not known how structurally sound the acid pit was during its period of use.

17.6.2 Objectives and Data Needs

The objective of this investigation is to confirm the absence of contamination at SWMU 21-005. Specific data required to assess contamination at SWMU 21-005 include the following:

Table 17.6-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-005, ACID PIT.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Thorium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	Sulfates/Chromates/Copper Salts	Alkalinity, pH	Nitrates, pH
TA-21-70																																		
Angled Borehole	1	0.0 – 2.5 ft					X	X	X		X	X	X																					X
		2.5 – 5.0 ft						X	X		X	X	X									E	E	E	E			E	E	E				X
Field Duplicate																						X	X	X	X			X	X	X				
		5.0 – 7.5 ft						X	X		X	X	X																					X
		7.5 – 10.0 ft						X	X		X	X	X									E	E	E	E			E	E	E				X
Rinsate Blank																						X	X	X	X			X	X	X				
Field Blank																												X	X	X				
Trip Blank																												X						

tion consists of angled drilling and subsurface soil sampling to confirm the absence of of contamination beneath TA-21-70 and to determine contaminant types and concentrations if necessary. These samples will be assessed for pH and nitrates.

If indications of leakage are found, then trailer TA-32-363 may need to be relocated to allow additional investigation. Additional vertical borehole sampling in and around the pit will constitute a subsequent investigation that will determine the lateral and vertical extent of contamination.

17.6.4 Sampling Plan

17.6.4.1. Initial Investigation

The location of the former acid pit will be surveyed and marked based on engineering drawings (LASL 1955) (for method see Sec. 11.3.2). One angled borehole will be drilled beneath the acid pit in line with its center. The borehole will be drilled approximately 5 ft from the trailer and will be drilled at approximately 45° from the vertical to pass beneath the pit in the depth interval between 5 and 10 ft below the surface. Figure 17.6-2 provides a graphic representation of the drilling to be performed at TA-21-70. The total core length will be approximately 10 ft and will reach a depth of approximately 7 ft. This provides sampling just below the disturbed zone that resulted from the acid pit's removal in 1967. Samples will be collected at 2.5-ft intervals (modified from method given in Sec. 11.5.3.3) resulting in a total of four samples.

The sampling and analysis requirements for the initial investigation are shown in Table 17.6-I. All samples will be submitted to the analytical laboratory for pH and nitrates analyses on a fast turnaround. Samples testing positive for low pH and high nitrates will be submitted for a full analytical suite, plus corrosivity. If none of the samples are acidic, two of the four will be submitted for a full analytical suite. For planning purposes, it is assumed that two samples will be analyzed for the full suite. If no contamination is identified, no further action will be taken at SWMU 21-005.

17.6.4.2. Subsequent Investigation

If contamination is found to be present, additional boreholes may be required. If necessary, Trailer TA-21-363 will be relocated for this portion of the investigation.

The vertical and lateral extent of contamination will be determined by drilling three vertical boreholes (for method see Sec. 11.5.3.2). The first borehole will be drilled through the center of the

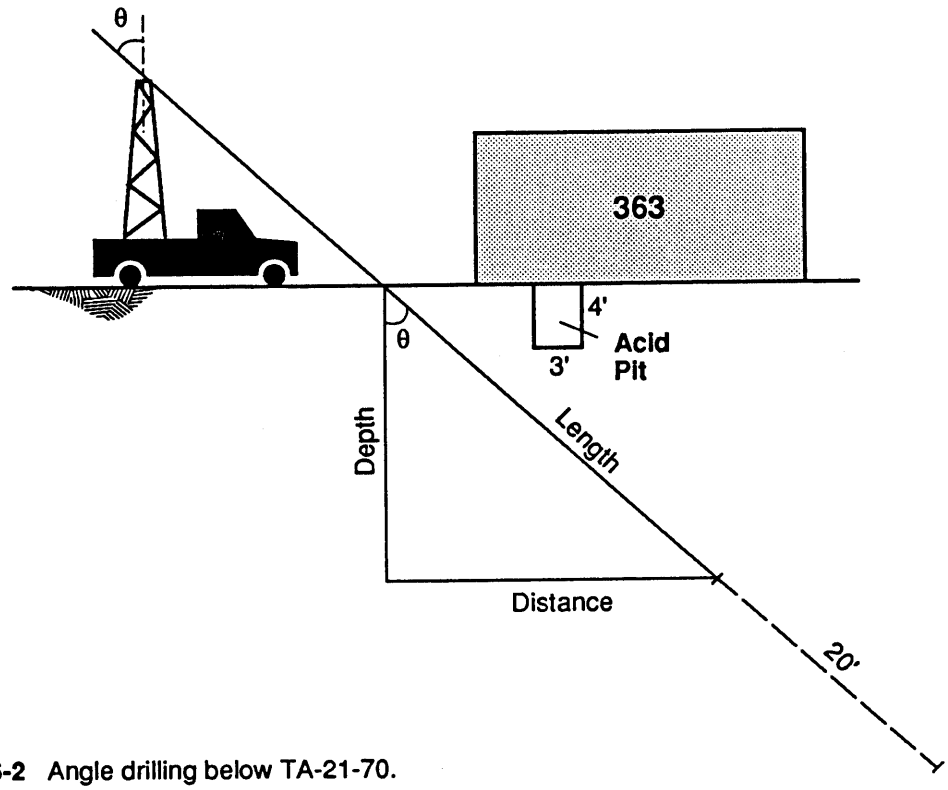


Fig. 17.6-2 Angle drilling below TA-21-70.

acid pit, and the remaining boreholes will be placed 3 ft to the north and 3 ft to the south of the acid pit. The nominal depth of the boreholes will be 15 ft.

It is anticipated that no more than three additional boreholes will be required to define the lateral and vertical extent of contamination. For planning purposes, however, it is assumed that no additional boreholes will be required.

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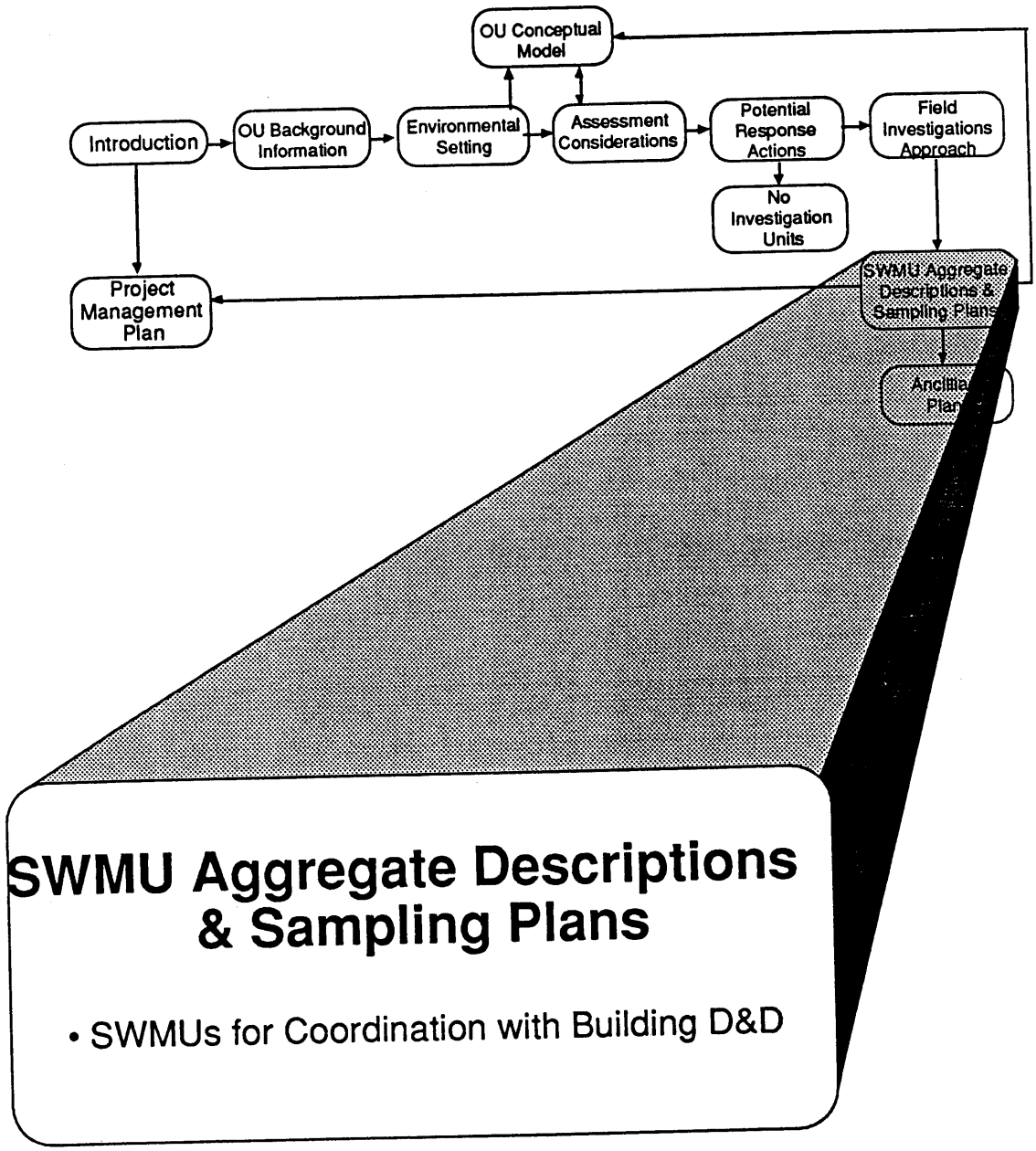
CHAPTER 18


OU Conceptual Model
Introduction
OU Background Information
Environmental Setting
Assessment Considerations
Potential Response Actions
Field Investigations Approach
No Investigation Units
Project Management Plan
SWMU Aggregate Descriptions & Sampling Plans
SWMU Aggregate Descriptions & Sampling Plans
• SWMUs for Coordination with Building D&D

18. SWMUS FOR COORDINATION WITH BUILDING D&D DESCRIPTION AND SAMPLING PLAN

18.1. Introduction

This chapter contains the histories and suggested sampling schemes for potential release sites, which are to be characterized during or after the decontamination and decommissioning (D&D) of buildings at TA-21, DP West. This approach is being taken because these potential release sites are within, surrounded, or covered by other buildings or structures scheduled for D & D, including structure demolition. These sites are currently inaccessible, and the exact locations of some of these sites are unknown. Also addressed are units with documented subsurface contamination that were partially cleaned up between 1978 and 1981 (Garde et al. 1982).

These potential release sites are grouped under four different SWMUs. The list below identifies the SWMUs addressed in this Chapter and the section in which they are addressed (see Fig. 18.1-1). Only Secs. 18.8 and 18.9 contain actual field sampling plans.

- Section 18.2

  SWMU 21-006(a), (c)–(f), Underground Seepage Pits

- Section 18.3

  SWMU 21-023 (a), (b), (d), Decommissioned Septic Systems

- Section 18.4

  SWMU 21-022 (a), Inactive Container Storage Areas

  SWMU 21-028(c), Active Container Storage Areas

- Section 18.5

  SWMU 21-022, Acid Waste Lines and Sumps

- Section 18.6

  Utility Tunnels

- Section 18.7

  C-21-001; -006; -027; -032, Areas of Concern

- Section 18.8

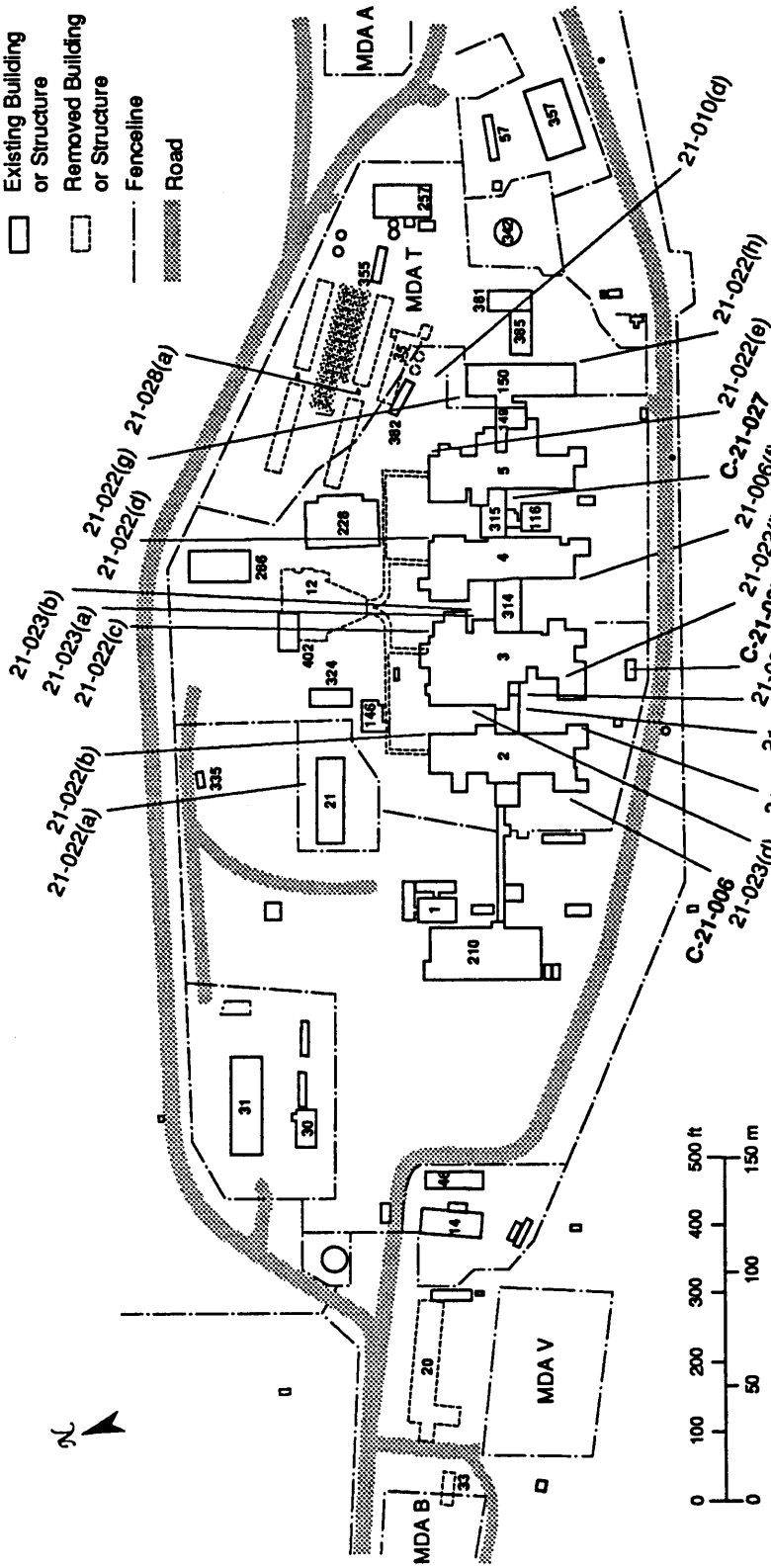


Fig. 18.1-1 Location of SWMUs and areas of concern to be addressed in conjunction with buiding D&D.

SWMU 21-022, (b), (e)–(g), Acid Waste Sumps

- Section 18.9

  SWMU 21-022, (h)–(j), South Side of Plutonium-Processing Complex

ER and D&D Program approaches to clean up these areas will, to the extent possible, be integrated. In the interim before full access to the SWMUs is possible, the lateral and vertical extent of potential contaminant plumes around DP West will be bounded and monitored to confirm that neither unknown nor uncontrolled contaminant migration is occurring. Complete site characterization activities will be deferred until D&D.

Therefore, the approach in this chapter is to detail what is known about each potential release site and propose a sampling plan that characterizes only the acid sumps, SWMU 21-022, because they are the most highly contaminated. The contaminated sumps received the largest volume and concentration of waste. These sumps are located throughout the old plutonium-processing facility, so that the lateral extent of contamination will also be defined. Because these acid sumps were removed or are no longer used, no water remains to facilitate contaminant movement to greater depths. The sampling plan to characterize SWMU 21-022 is developed as two field investigations in Secs. 18.8 and 18.9. The following paragraphs are a summary of the proposed field investigations.

The field investigation in Sec. 18.8 is to characterize subsurface contamination below the former location of five sumps that were located on the north side of the old plutonium-processing facility at TA-21. Contamination around and beneath the sumps was documented during their removal in 1979–1980. Of all the sites affected by the D&D program, the five sumps have the major documented releases and are believed to have the greatest potential for movement of contaminants into the subsurface. Surveys at the time of excavation showed gross alpha contamination in the soil, possibly from plutonium. Other potential contaminants include arsenic, boron, cobalt, molybdenum, niobium, nickel, lead, antimony, uranium, and zinc.

The objective of the field investigations at the five sumps is to determine the depth to which contaminants released from the sumps have migrated into the subsurface. By meeting this objective, the probable maximum extent of contaminant migration due to releases in the plutonium-processing complex will be determined. The strategy for the field investigation at the five sumps is presented in the decision flow diagram in Fig. 18.1-2. The primary data needs are

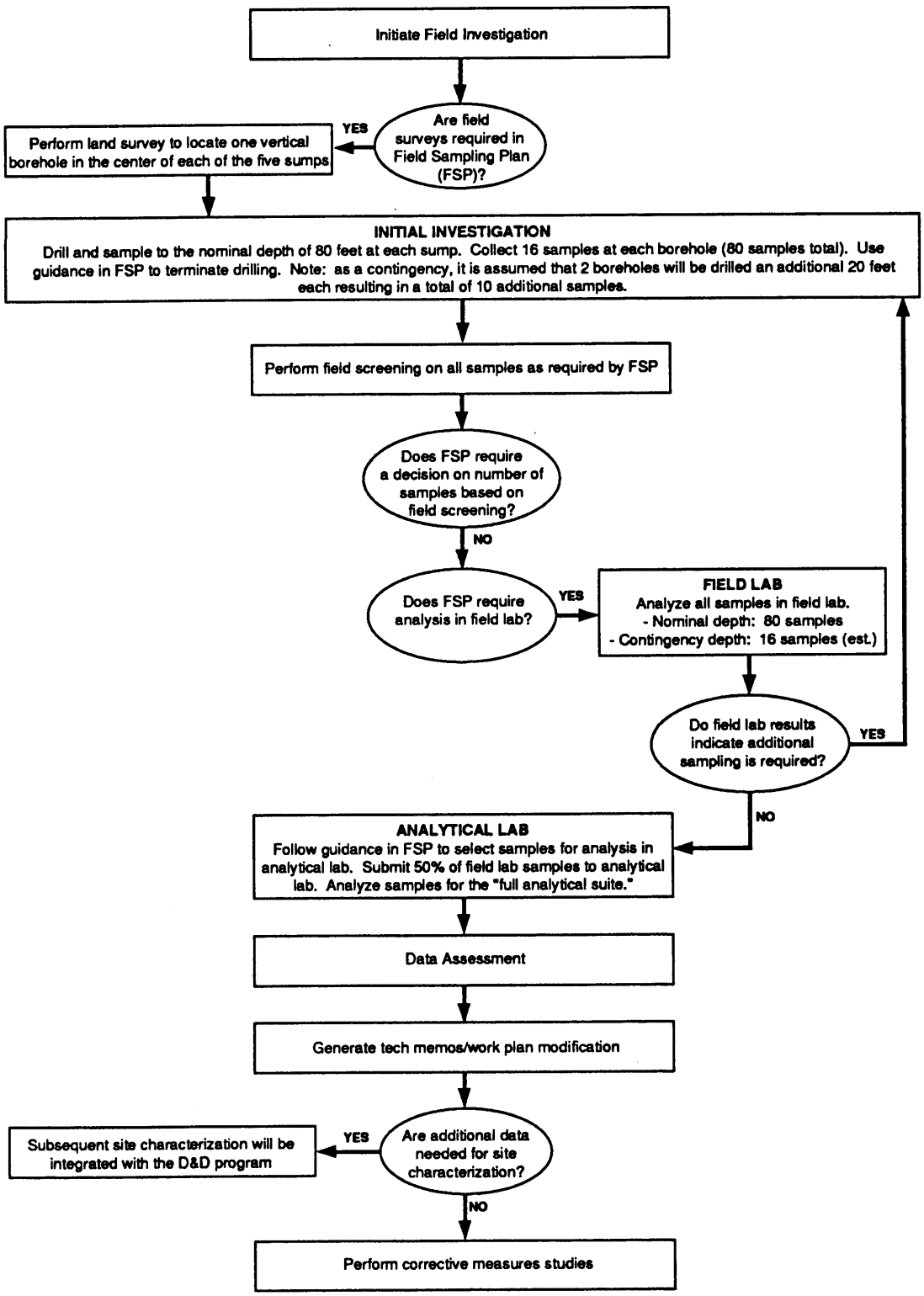


Fig. 18.1-2 Logic flow for the field investigation at acid waste sumps [SWMUs 21-022(b)–(e)].

18.1-II SUMMARY OF SAMPLE AND ANALYSIS FOR INITIAL INVESTIGATIONS BY SECTION FOR CHAPTER 18.

	18.8	18.9									Total
Field Sample Screening											
Gross Gamma	96	38									134
Gross Alpha	96	38									134
Organic Vapor	96	38									134
Combustible Gas/Oxygen	96	38									134
Lithological Logging	96	38									134
Field Laboratory Measurements											
Gross Alpha	96	38									134
Gamma Spectrometry	96	38									134
Tritium	96	38									134
Volatile Organics	96	38									134
PCB											
Soil Moisture											
Laboratory Analysis											
Gamma Spectrometry	57	23									80
Tritium	57	23									80
Total Uranium	57	23									80
Isotopic Plutonium	57	23									80
Isotopic Uranium											
Strontium 90	57	23									80
VOA (SW 8240)	68	29									97
Semivolatiles (SW 8270)	63	26									89
Metals (SW 6010)	63	26									89
PCB (SW 8080)											
TCLP Metals											
Isotopic Thorium	57	23									80

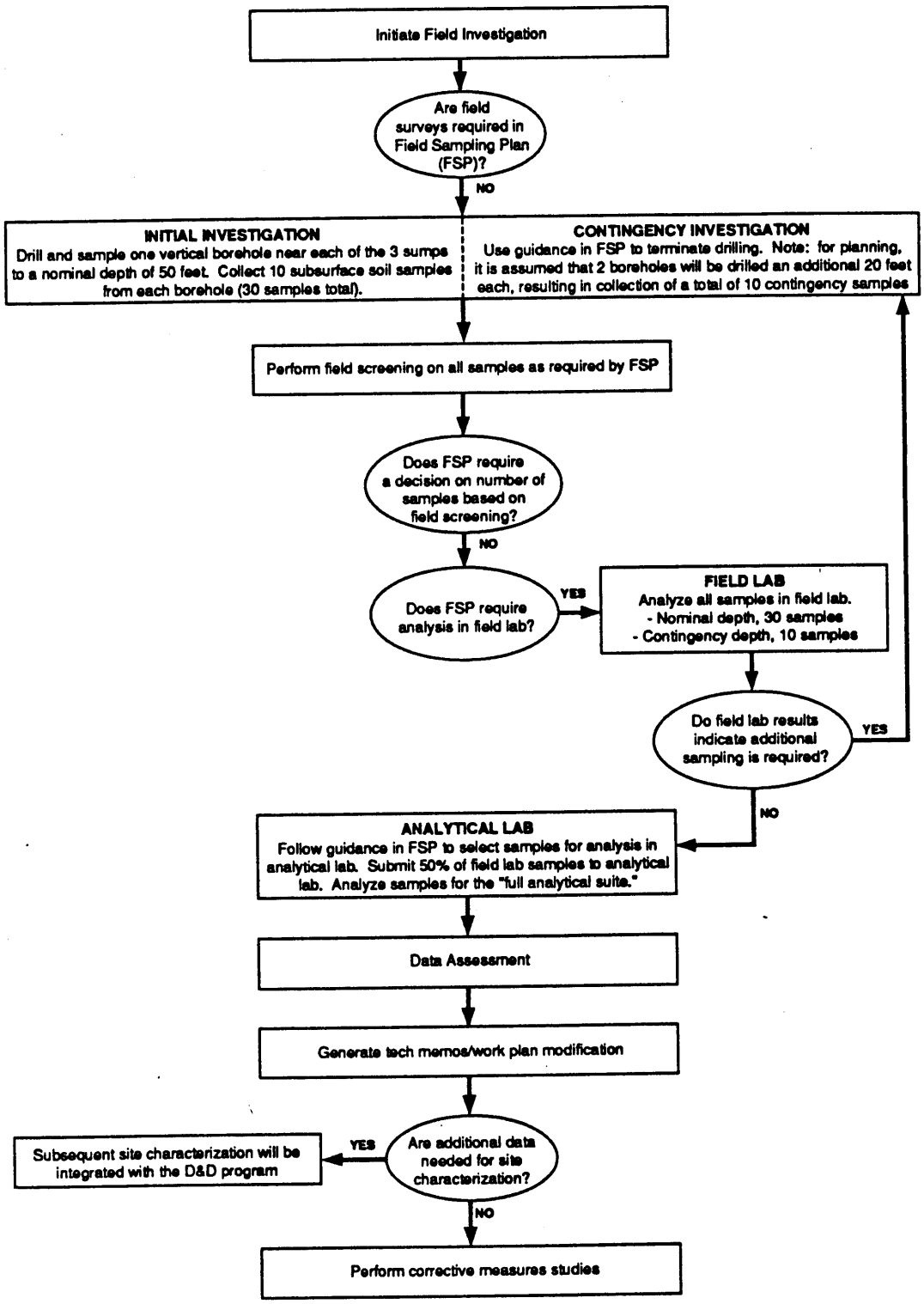


Fig. 18.1-3 Logic flow for the field investigation at SWMUs 21-022(h)–(j) sumps.

Table 18.1-II presents a summary of measurements to be taken during the field investigation and a summary of analyses for subsurface soil samples collected from the three boreholes to be taken during the field investigation.

The field investigation described in Secs. 18.8 and 18.9 will provide important information on the nature and extent of subsurface contamination from the former plutonium-processing complex. In addition to the acid waste sumps, the area investigated may include contaminants released from SWMUs 21-006, 21-023, and 21-028 that are discussed in this chapter. The investigations will also provide information for planning subsequent D&D and ER characterization efforts.

No subsequent sampling is planned prior to removal of structures, unless results of the initial investigation at SWMU 21-022 indicate it is necessary. Sampling plans specific to the remaining SWMUs will not be developed at this time. D&D and ER will work closely to plan their activities to meet both program objectives. Known SWMU locations and selected structure locations will be surveyed prior to building demolition to facilitate field reconnaissance once buildings are removed. D&D will remove units adjacent or beneath former building locations and will notify ER if any SWMUs are located in these activities. Removal and verification sampling may be conducted in lieu of SWMU characterization. Once D&D is complete, ER investigation of residual contamination will characterize the nature and extent of remaining contamination at each former SWMU location. Additionally, the entire area formerly occupied by buildings will be randomly sampled to verify that no residual contamination is present.

- subsurface samples from boreholes placed through the former locations of the five sumps with
    - Level I/II data to guide the drilling and selection of samples for submittal to an analytical laboratory for Level III/IV analysis; and
    - Level III/IV data for a selected subset of the borehole samples to identify contaminant species and to determine the depth to which contaminants have penetrated. The selected subset includes samples from directly beneath the backfill materials emplaced when the sumps were removed, highly contaminated samples that are identified from field screening and field laboratory results, samples along fractures that are penetrated, and samples from the very bottom of the boreholes.

Tables 18.1-I and 18.2-II present a summary of measurements to be taken during the field investigation and a summary of analyses for subsurface soil samples collected from the five boreholes.

The purpose of the field investigation in Sec. 18.9 is to characterize subsurface contamination from three inactive sumps located along the south side of the plutonium-processing complex. Deep contaminant releases are not expected from these SWMUs as they are for the acid waste sumps described above. No information is available on radioactive or hazardous constituents present at these units. Potential contaminants are plutonium, uranium, other radionuclides, organics, and various acids resulting from plutonium-processing operations.

The strategy for the field investigation at the inactive sumps is presented in Fig. 18.1-3. The primary data needs are

- subsurface soil samples from three boreholes along the southern side of the plutonium processing complex with
    - Level I/II data to guide the drilling and selection of samples for Level III/IV analyses; and
    - Level III/IV data for a selected subset of the subsurface samples to identify contaminants.

18.1–I SUMMARY OF INITIAL INVESTIGATIONS BY SECTION FOR CHAPTER 18.

Section	Description	Survey Areas		
		Land	Radiological	Geophysical
18.8	Acid Waste Sumps	5		
18.9	South Side Pu Complex			
	Total	5		

Section	Description	Boreholes						Q A
		Shallow			Vertical			
		Number	Total Footage	No. of Samples	Number	Total Footage	No. of Samples	
18.8	Acid Waste Sumps				5	480	96	20
18.9	South Side Pu Complex				3	190	38	10
	Total				8	670	134	30

18.2. SWMU 21-006, Underground Seepage Pits

18.2.1. Site Description

This section describes potential release sites identified as underground seepage pits, SWMU 21-006(a), (c)–(f), (Fig. 18.2-1). SWMU 21-006(b) is discussed in Chapter 17, Subsurface Units Description and Sampling Plan. The exact number and location of the seepage pits is uncertain. Release sites SWMU 21-006(a), (c), and (d) may actually be the same site. Similarly, release sites SWMU 21-006(e) and (f) may be the same site.

18.2.1.1. Site History

SWMU 21-006(a) is described as an unmarked, underground seepage pit, approximately 0.1 acre, located between buildings TA-21-2 and TA-21-3 (LASL 1978). This pit was used to dispose of liquids from the Hanford container washing operation. It is not known whether this seepage pit is located on the south side or the north side of the corridor connecting Buildings TA-21-2 and TA-21-3 (Fig. 18.2-2). If it is on the south side of the corridor, this seepage pit may be the same site as SWMU 21-006(c) and (d). If it is on the north side of the corridor, it may be the same as structure TA-21-187, SWMU 21-023(d), which is discussed in Sec. 18.5.

SWMU 21-006(c) is 15 ft outside of the door to the bomb cleaning room 322, at Building TA-21-3. This seepage pit reportedly received "bomb electrolytic decontamination solution" from a drain in Room 322, which may have been contaminated with plutonium (Tribby 1947). The length of time this seepage pit was used is not known. At one time, the location of Room 322 was very near the northeast corner of the southern bay between Buildings TA-21-2 and TA-21-3 (Fig. 18.2-3). However, additions have been made to the southern portion of Building TA-21-3, and its location may be partially or entirely beneath either the center of Room 3131 or 3133 of the new addition.

SWMU 21-006(d) may be associated with a concrete pad and French drain system called the TA-21-272 dock (Fig. 18.2-3). Waste from a second story chemical make-up room was dumped or pumped into a stone-filled seepage pit (Walker 1979; Maraman and Christensen 1987) somewhere in the area. No other information regarding this seepage pit is available. Because the TA-21-272 dock seepage pit, SWMU 21-006(d), and the Room 322 seepage pit, SWMU 21-006(c), are in close proximity, these two seepage pits may be the same release site. Seepage pit, SWMU 21-006(a), located between Buildings TA-21-2 and TA-21-3, is also in the general vicinity of SWMUs 21-006(c) and (d) and may also be related.

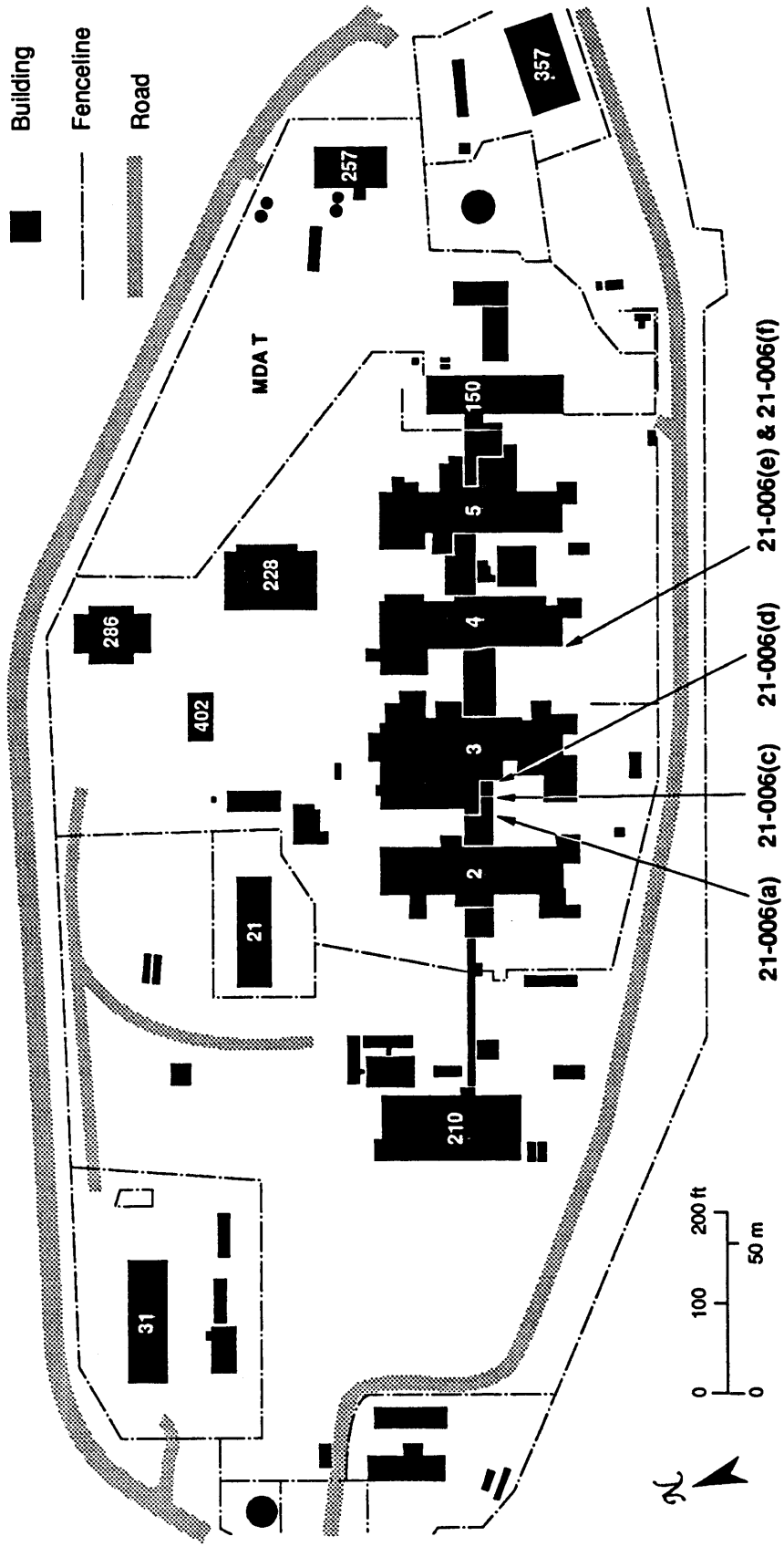


Fig. 18.2-1 General location of underground seepage pits, SWMUs 21-006(a), (c)–(f). (LANL 1990)

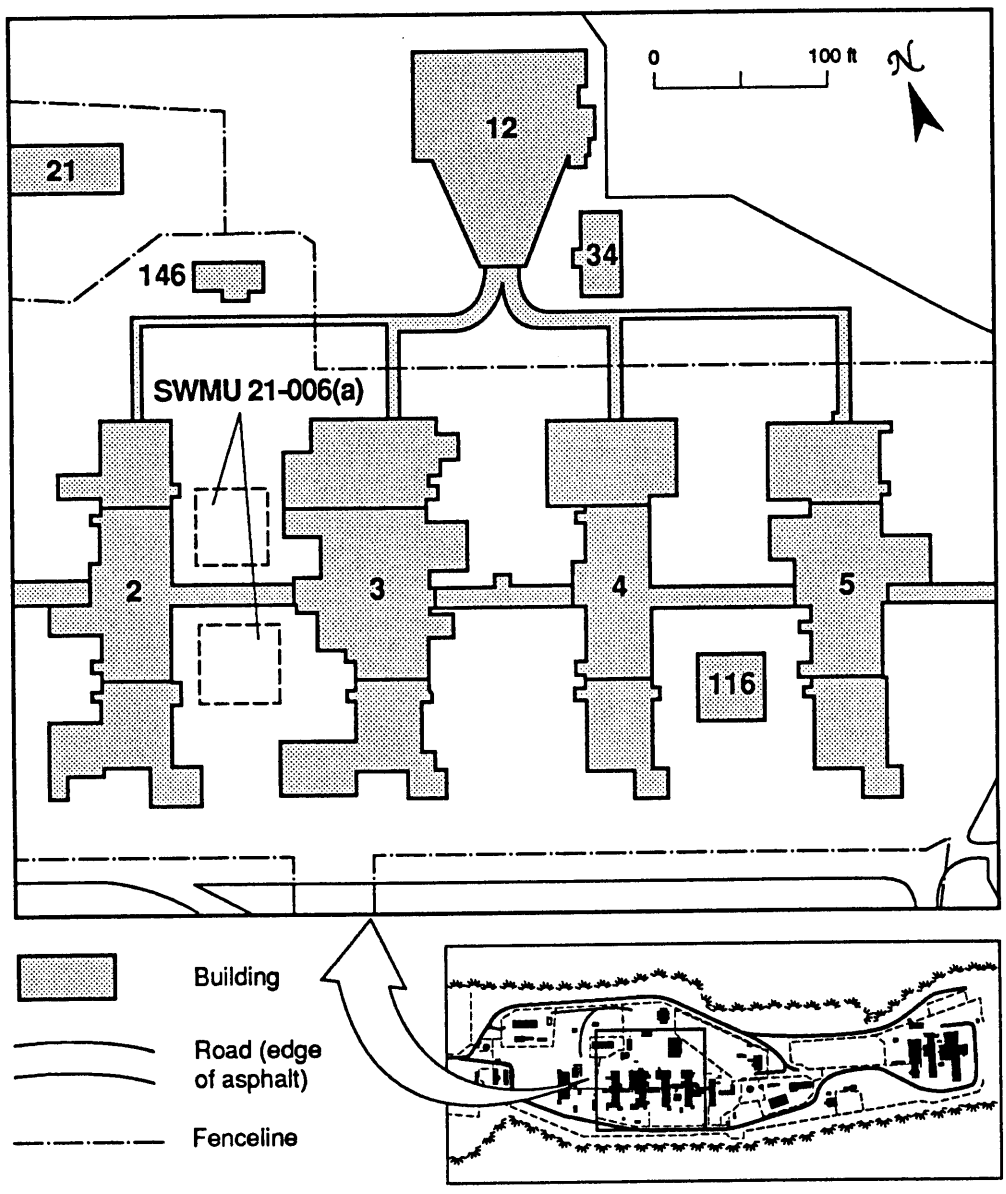


Fig. 18.2-2 General location of SWMU 21-006(a) and the 1964 configuration of Buildings 2 and 3 at TA-21. (LASL 1964)

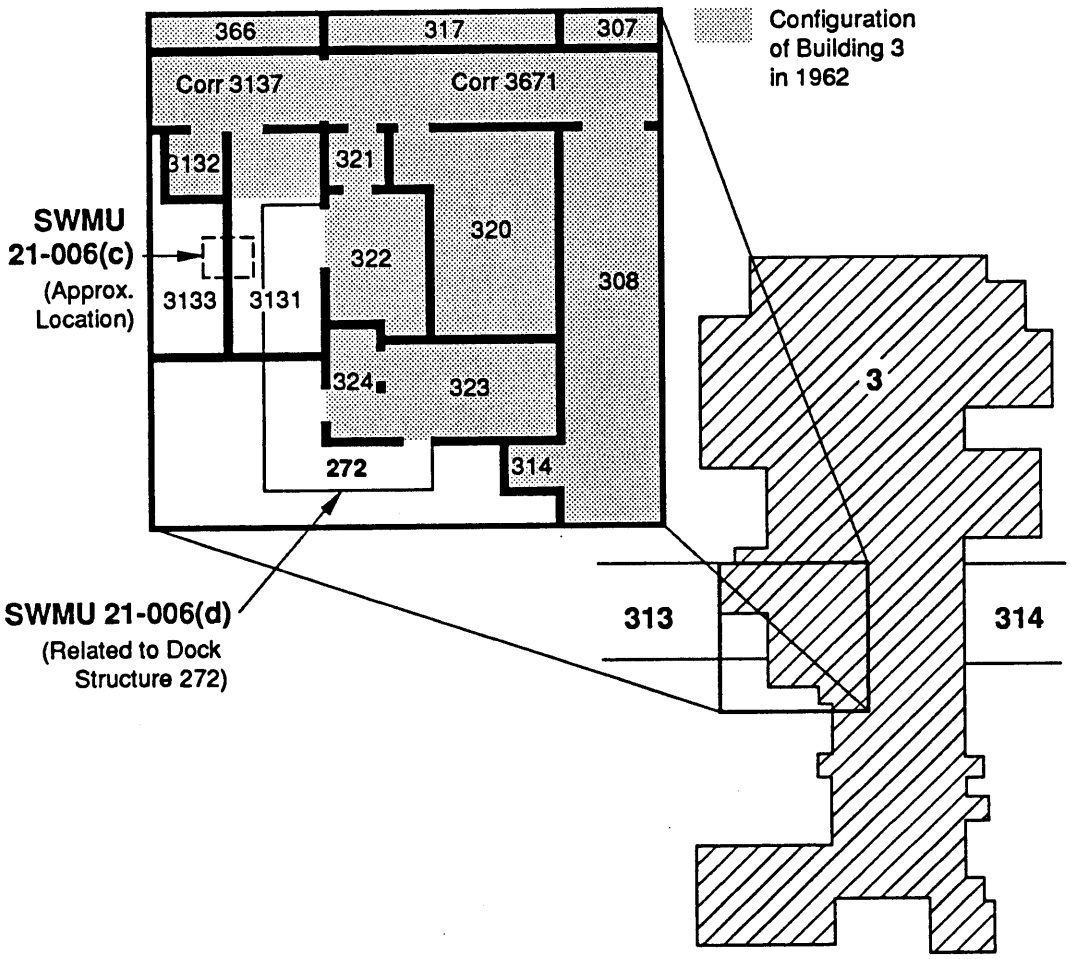


Fig. 18.2-3 Approximate location of SWMU 21-006(c) and (d) near Room 322 in Building 3 as seen in 1962 and 1983. (LASL 1962; LANL 1983b).

SWMU 21-006(e) may be located south of Building TA-21-4 (IT Corp 1989) (Fig. 18.2-1). The location of this seepage pit is unclear. No other information regarding this potential release-site exists. Seepage pit, SWMU 21-006(e), may be the same release-site as seepage pit, SWMU 21-006(f).

SWMU 21-006(f) has been described as a gravel seepage pit located on the south side of the DP West complex (Tribby 1947) (Fig. 18.2-1). This seepage pit may have received up to 4,000 L per day of hydrogen fluoride waste water effluent from a hydrofluorination process located in Room 413, the southernmost room of Building TA-21-4 (Tribby 1947). Wastewater from this seepage pit may have emptied into Los Alamos Canyon, although how this occurred is unknown. The length of time this seepage pit was used is also not known.

18.2.1.2. Existing Information

No data exist regarding contamination in and around the seepage pit areas, SWMU 21-006(a), (c)–(f).

18.2.1.3. Source Term

SWMUs 21-006(a), (c), (d) include seepage pits that reportedly disposed of Hanford container wash water, bomb electrolytic decontamination solution (ethylene glycol, phosphorous acid, and plutonium), and chemical makeup room wastewater. Approximately 12 gal. of ethylene glycol and phosphorous acid electrolytic solution may have been emptied into the drain in Room 322 each day. Assays of the liquid waste source indicated that approximately 1.9 mg of plutonium were released daily (Tribby 1947). The "Radioactive Waste Management Site Plan" (LASL 1978) indicated that the estimated radioactivity associated with SWMU 21-006(a) was high. Plutonium may be the principal radionuclide in waste in SWMU 21-006(a), (c)–(f) (Balo and Warren 1986), but ethylene glycol, phosphorous acid, and other radionuclides may be present (Tribby 1947; IT Corp 1988).

SWMU 21-006(e), (f) may have received hydrogen fluoride waste water effluent from a hydrofluorination process located in Room 413, the southernmost room of Building TA-21-4 (Tribby 1947). Assays performed on the effluent source yielded approximately 0.18 micrograms of plutonium per L of effluent, or approximately 0.72 mg of plutonium per day (Tribby 1947). Based upon a maximum daily discharge volume of 4,000 L, an estimated 0.72 mg of plutonium per day could have been discharged into this seepage pit.

18.2.2. Data Needs

Investigations will be performed in conjunction with the D&D program at TA-21. The locations of these SWMUs will be determined during the D&D characterization process or during site D&D when waste lines and residual contamination are chased. When access to these SWMUs is provided, ER activities will be coordinated with any continuing D&D activities. Removal and verification sampling may be conducted in lieu of SWMU characterization. As appropriate, characterization to address the specific data needs for SWMU 21-006(a), (c)–(f) listed below will be performed.

1. Determine the location and survey each of the five seepage pits.

2. Perform field reconnaissance at each of the five seepage pits to determine the nature and extent of contamination.

3. Identify the presence of environmental contamination resulting from the seepage pits by analysis of subsurface soil samples from within each area.

4. If contaminants are identified, determine the vertical and lateral extent of contamination by additional subsurface soil sampling and analyses.

18.3. SWMU 21-023 Decommissioned Septic Systems

18.3.1. Site Description

This section describes three potential release sites identified as decommissioned septic systems under existing buildings in SWMU 21-023(a), (b), (d) (Fig. 18.3-1). SWMU 21-023(c), septic tank TA-21-62, is discussed in Chapter 15, Outfalls (Sec. 15.2), because it is part of a septic system that has an identified outfall.

18.3.1.1. History

SWMU 21-023(a), septic tank TA-21-225, is located between two additions to Building TA-21-3 (Fig. 18.3-1). It is not known what portions of Building TA-21-3 were served by the septic tank, nor when it was installed. The tank was constructed of reinforced concrete with dimensions 5 ft by 9 ft with a depth of 6 ft. The tank and associated sewer line were removed July 18, 1966 (LASL no date). Assays for gross alpha on sludge samples did not indicate contamination was present. No alpha activity was detected in the associated piping (Romero 1966). This tank was disposed of without restriction (Kennedy 1966).

SWMU 21-023(b), sanitary waste septic system, TA-21-142, was installed in September 1945 (Fig. 18.3-2). This system included a 500-gal. capacity steel tank and associated sewer lines. This septic system received wastewater from the shower room, 363, in Building TA-21-3 and drained into acid sump TA-21-84, SWMU 21-022(c), (LANL 1990; LASL 1959a) discussed in Sec. 18.5. The septic tank was removed in February 1966, and its former location is now beneath Rooms 361 and 362.

SWMU 21-023(d), septic system, TA-21-187, included a reinforced concrete septic tank installed in June 1960, with dimensions of 5 ft by 3 ft with a depth of 5.5 ft (LANL 1990) and 80 ft of pipe (Russo 1965) (Fig. 18.3-3). The septic tank collected industrial waste and sewage from Building TA-21-3. The drain line carried waste from TA-21-187 north to the contaminated waste line serving acid waste sump TA-21-82, SWMU 21-022(b), discussed in Sec. 18.5. This tank was removed and disposed of without restriction in October 1966 (Kennedy 1966). Its former location is now beneath a new addition to Building TA-21-3.

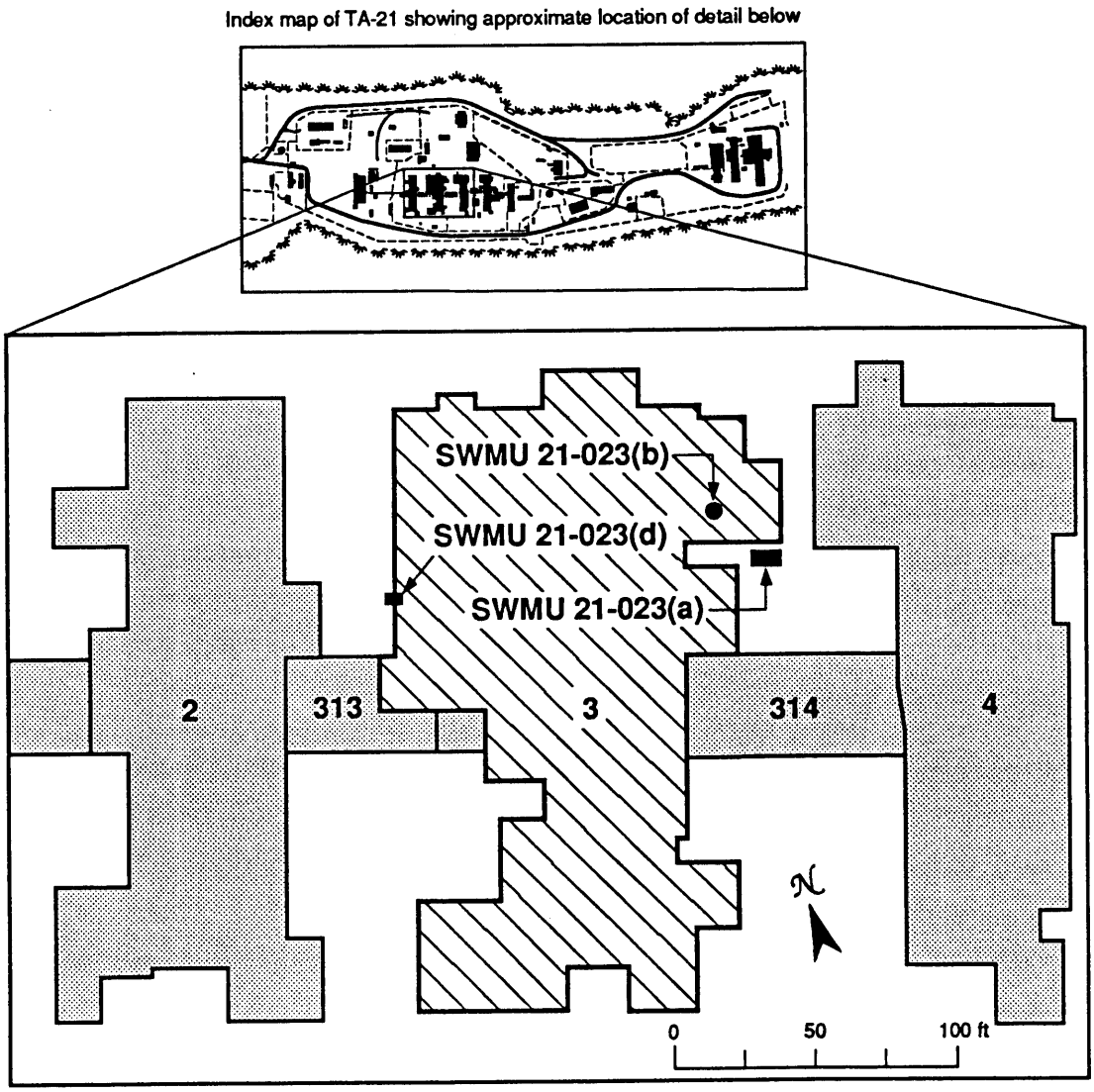


Fig. 18.3-1 Location of SWMUs 21-023(a), (b), and (d) in relation to current configuration of Building 3. (LASL 1964, 1968a)

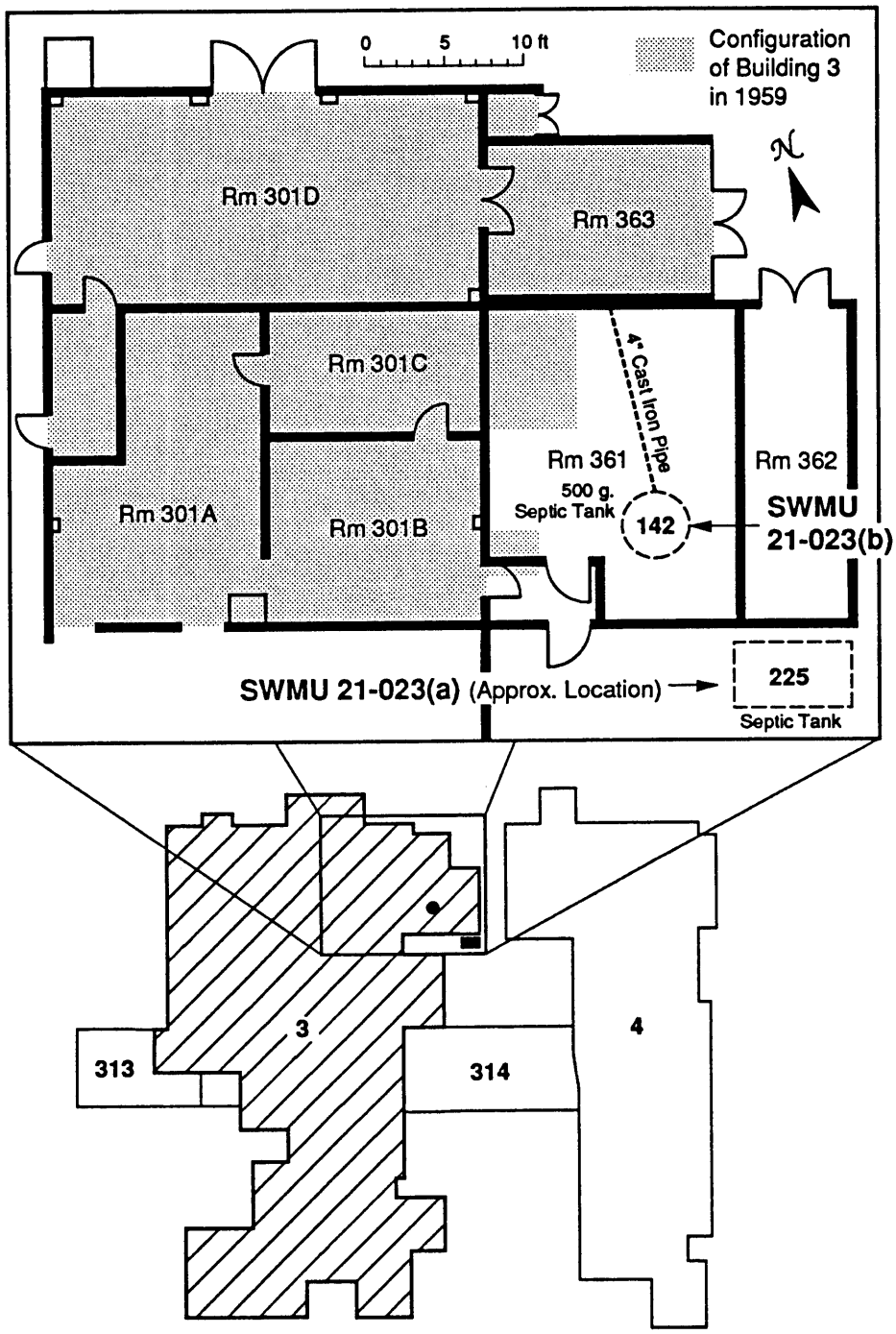


Fig. 18.3-2 Location of SWMU 21-023(b) (septic tank TA-21-142) and SWMU 21-023(a) (septic tank TA-21-225) in relation to Building 3 in 1959 and 1966. (LASL 1959a, 1966)

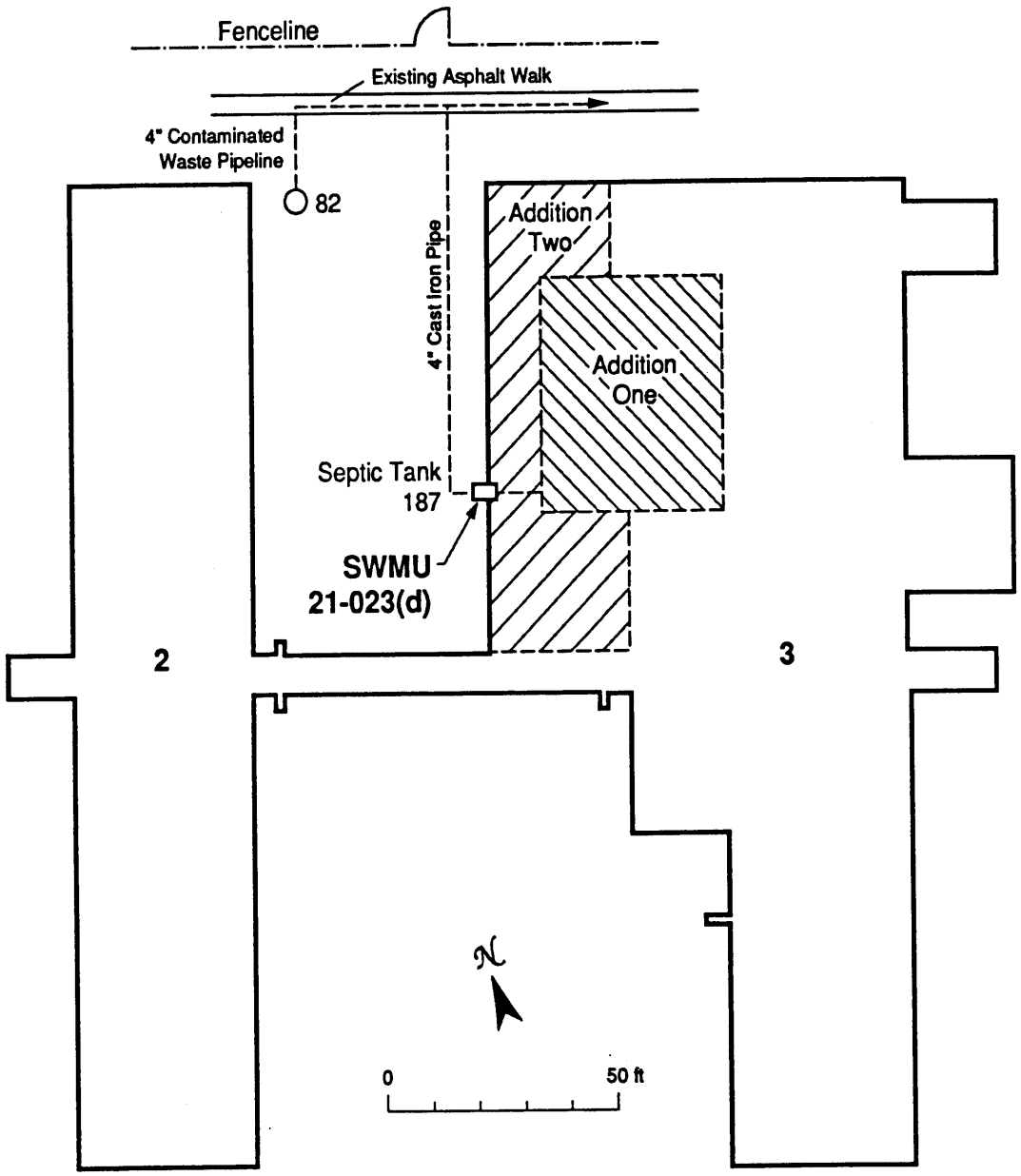


Fig. 18.3-3 Location of SWMU 21-023(d) (septic tank 187) and drain lines. (LASL 1959b, 1968b)

18.3.1.2. Existing Information

Assays from sludge in the two septic tanks, SWMUs 21-023(a), (d), indicated that no alpha activity was detected (Romero 1966). The piping associated with these tanks was also monitored, and no contamination was detected (Romero 1966). No data exist regarding contamination in and around the third decommissioned septic system, SWMU 21-023(b).

18.3.1.3. Source Term

SWMUs 21-023(a), (c), (d) include decommissioned septic systems, which have not been evaluated with the exception of sludge and piping associated with TA-21-225 and TA-21-187. Based on the material handled in the buildings that served these septic systems, these systems could contain radioactive contamination and/or hazardous materials. The amounts of these contaminants are unknown.

18.3.2 Data Needs

Investigations will be performed in conjunction with the D&D program at TA-21. If these former septic system locations are discernible, they will be determined during the D&D characterization process or during site D&D when waste lines and residual contamination are chased. When access to these SWMUs is provided, ER activities will be coordinated with any continuing D&D activities. Removal and verification sampling may be conducted in lieu of SWMU characterization. As appropriate, characterization to address the specific data needs for SWMU 21-006(a), (c)–(f) listed below can be performed.

1. If the locations of these former septic systems are identified, determine the location, and survey each of the septic systems.
2. Perform field reconnaissance at each of the septic systems to determine the nature and extent of contamination.
3. Identify the presence of environmental contamination resulting from the septic systems by analysis of subsurface soil samples from within each area.
4. If contaminants are identified, determine the vertical and lateral extent of contamination by additional subsurface soil sampling and analyses.

18.4. SWMU 21-028, Active Container Storage Areas

18.4.1. Site Description

This section describes two potential release sites, inactive container storage areas in SWMU 21-002(a), and an active container storage area, SWMU 21-028(c) (Fig. 18.4-1). SWMU 21-002(b) was addressed in Sec. 14.6 because it has an identifiable location. SWMU 21-028(a) is addressed in Sec. 16.3 because it is located within MDA T. SWMU 21-028(b) and those parts of 21-028(e) addressing active container storage areas within buildings are recommended for no further action in Chapter 20. SWMU 21-028(d) and remaining parts of 21-028(e) are addressed in Chapter 14, Surface Units, because they are associated with Buildings TA-21-209 and TA-21-210, which are not currently planned for decontamination and decommissioning.

18.4.1.1. Site History

SWMU 21-002(a) is intended to include all inactive container storage areas located throughout TA-21, except SWMU 21-002(b) (LANL 1990). Drums, gas cylinders, and other containers were reported to have been stored in "several locations" throughout TA-21, and some were reported to have leaked.

The drum and gas cylinder storage in "several locations" cannot be addressed in this sampling plan because the locations of these storage areas cannot be identified specifically. However, each of these storage areas would have been associated with operations at a specific TA-21 facility, and it is reasonable to assume that decontamination and decommissioning of those facilities will include removal of contamination originating from any spills at these storage areas. Thus, any potential contamination resulting from SWMU 21-002(a) will be addressed by the general activities described in this sampling plan.

SWMU 21-028(c) consists of four satellite container storage areas located around Building TA-21-3 (Fig. 18.4-2). The four container storage areas at Building TA-21-3 are located at the door to Room 301 on the north dock, at the outer door to Room 360, at the northeast side of the fan Room, 3N, and inside a chemical safety cabinet in Room 362. These container storage areas have been used from an unknown starting date through the present (LANL 1990). Storage may have begun as early as 1945 when Building TA-21-3 was completed (Nyhan 1990).

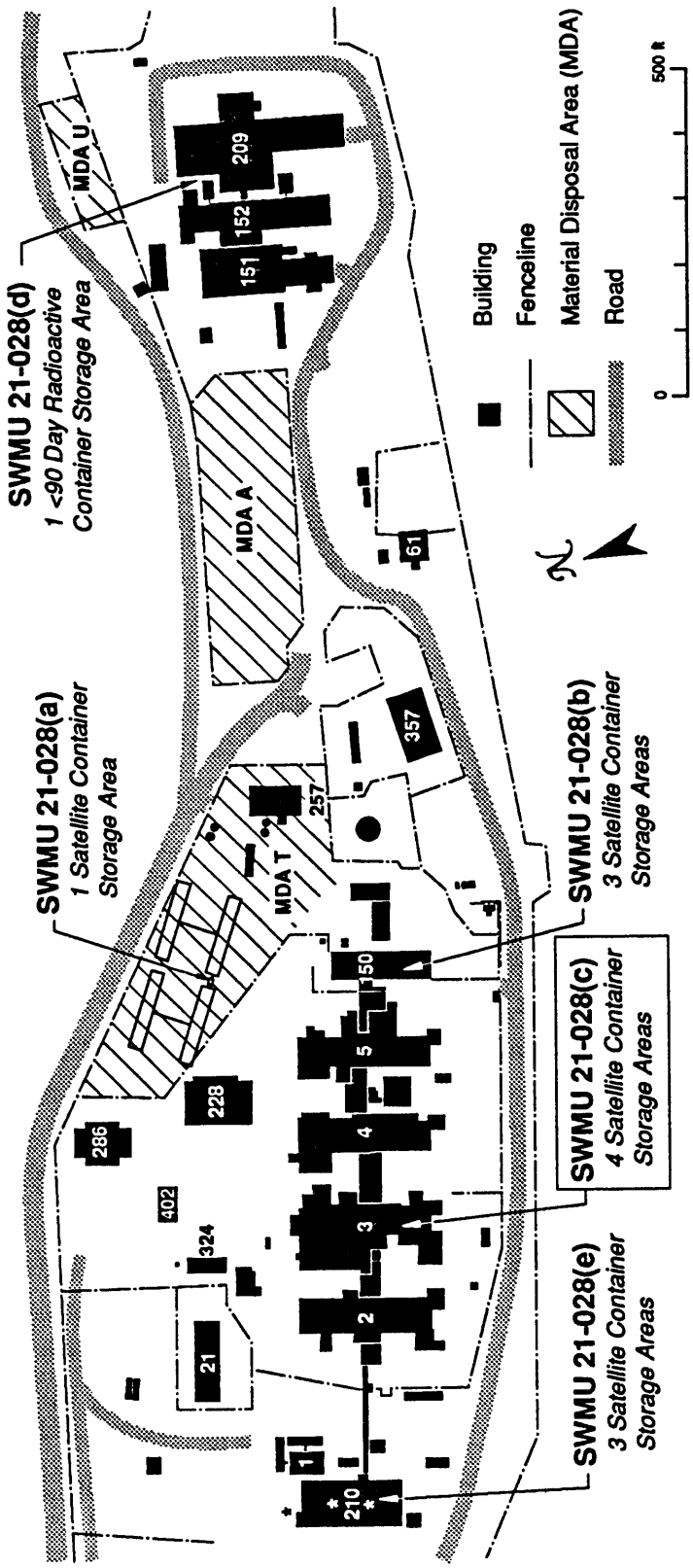


Fig. 18.4-1 Locations of the active container storage areas at TA-21 [SWMUs 21-018(a)–(e)].

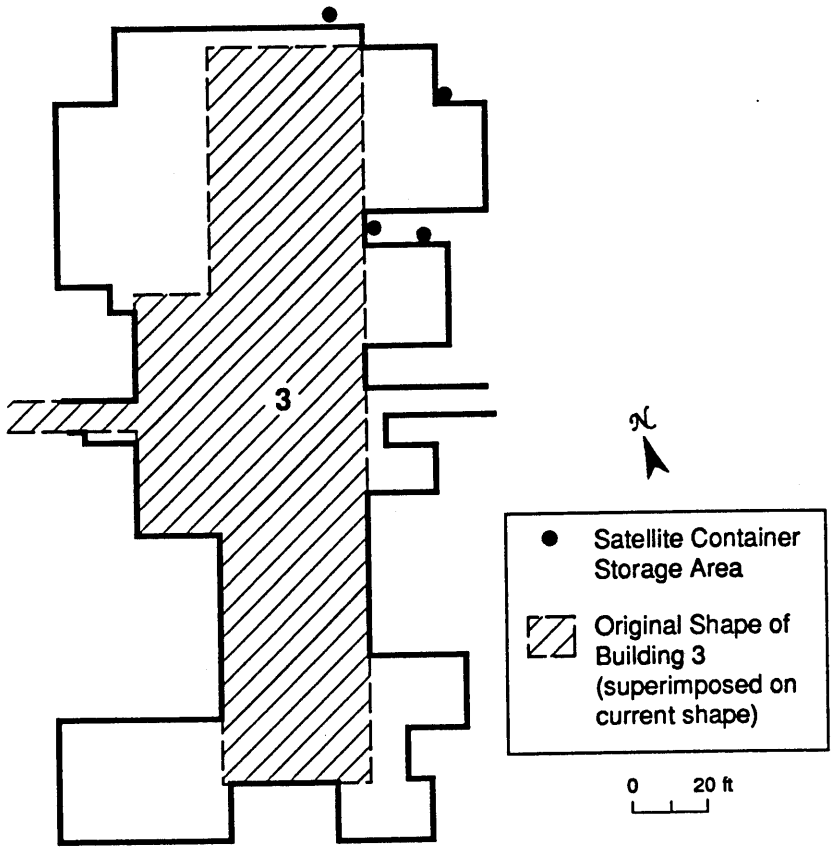


Fig. 18.4-2 Locations of the active container storage areas in relation to the 1966 and current configurations of Building 3.

18.4.1.2. Existing Information

No information regarding sampling and analysis in or around SWMU 21-028(c) is available.

18.4.1.3. Source Term

SWMU 21-028(c), the satellite storage areas at Building TA-21-3, include the following material stored outside of the chemistry research lab, Room 301, by the dock:

- halogenated organic chemicals—chloroform, alkyl halides, carbon tetrachloride, and methyl chloride; and
- nonhalogenated organic chemicals—tetrahydrofuran, acetone, toluene, benzene, ethanol, methanol, butanol, diethyl ether, and isopropanol.

These chemicals may be contaminated with thorium, depleted uranium, technetium, and other metals (LANL no date b). Nothing is currently stored at this location, and no stains are present on the loading dock or asphalt surrounding the dock (Roy F. Weston 1990).

The materials currently being stored in a safety cabinet outside of the organometallic research lab, Room 360, at Building TA-21-3, include the following:

- liquids—acetone, ethanol, toluene, Et20, hexane, benzene, benzene d6, and THF;
- inorganic and organic reagents—phosphines, ethyl acetate, cycloheptariene, propionitrile, depleted uranium and thorium, phosphites, zinc, silver, tungsten, ruthenium, iron, molybdenum, cobalt, boron, and copper salts, various acids, arsines, amines, various tin, lithium, bismuth, and metal salts, toluene-d8, thiols, and filtering agent celite (LANL no date b).

These chemicals are stored in a chemical safety cabinet (Roy F. Weston 1990). This lab is dedicated to the synthesis of new, previously unknown complexes and uses a wide variety of inorganic and organic reagents in small quantities. The reagents used change constantly, as does the composition of the wastes generated here (LANL no date). No stains are observable on the soil surrounding the storage cabinet (Roy F. Weston 1990).

The materials being stored in a chemical safety cabinet on the northeast side of the fan room, small-scale synthetic inorganic lab, at Building TA-21-3 include the following:

- diethyl ether, alkanes, tetrahydrofuran, acetonitrile, chloroform, dimethoxyethane, organic isocyanides, D38 and natural thorium salts, phosphines, phosphites, acetone, toluene, alcohols, carbon tetrachloride, methylene chloride, bismuth salts, and barium salts (LANL no date).

In addition, four 5- to 10-gal. plastic containers labeled "Haz. Waste: non chlorinated, non rad." and "Haz. Waste: rad waste" were present (Roy F. Weston 1990). A large variety of materials may appear in the wastes at this site. Some of these are

- depleted ^{238}U salts, transition metal salts, metal sulfides, cycloheptatriene, organic esters, and propionitrile (LANL no date).

No stains are present on the asphalt around the storage area (Roy F. Weston 1990).

The materials being stored in a chemical safety cabinet outside of Room 362, at Building TA-21-3, include used chromic acid, waste mercury, waste nitric acid, and waste sulfuric acid. Some of the bottles of waste chromic acid were also wrapped in plastic garbage bags. Stains were noted on the soil surrounding the storage cabinet (Roy F. Weston 1990).

18.4.2. Data Needs

Investigations will be performed in conjunction with the D&D program at TA-21. During site D&D, all interior portions of these SWMUs will be removed with the buildings. Exterior areas will be sampled, characterized, and removed as well. If these SWMUs are removed during D&D, ER will conduct verification sampling afterwards. The following data needs will be assessed during the D&D process:

1. If necessary, determine the location and survey each of the active container storage areas.
2. Perform field reconnaissance at each of the active container storage areas to determine the nature and extent of contamination.
3. Identify the presence of environmental contamination resulting from the active container storage areas by analysis of subsurface soil samples from within each area.
4. If contaminants are identified, determine the vertical and lateral extent of contamination by additional subsurface soil sampling and analyses.

18.5. Acid Waste Lines

18.5.1. Site Description

The acid lines covered in this section are part of SWMU 21-022(b)–(e), (g). These lines drain the acid sumps TA-21-82, 84, 87, 89, and 189, which are covered in Sec. 18.8. The acid lines are being discussed separately from the sumps because the lines will not be investigated prior to D&D. This is because the area in which the acid lines are buried contains numerous water, electrical, gas, and steam lines, which are currently in use, making any investigation of the lines difficult and dangerous. In addition, as part of D&D, all lines connected to the building will be removed. Sampling will best be accomplished at this time.

18.5.1.1. History

Between 1945 and 1952, a 6-in. iron pipe carried liquid waste from sumps TA-21-82, 84, 87, and 89 to MDA T (SWMU 21-016) (Fig. 18.5-1). This pipe was installed between 6.5- and 8-ft deep.

In 1952, the waste disposal plant, TA-21-35 (SWMU 21-010), was constructed, and a new 4-in. extra heavy cast iron (EHCI) waste line was installed parallel and approximately 20 ft north of the old pipe, which was abandoned in place (LANL 1990). In addition, three 1.5-in. stainless steel lines were installed 1 ft above the new 4-in. waste line in the same trench. One of these lines originated from the northeast corner of TA-21-2 and carried "special waste" directly to TA-21-35. The remaining two carried raffinate from TA-21-3 and 5 to holding tanks and then into TA-21-35 (LASL 1976).

In 1962, a 4-in. cast iron line from sump TA-21-189 was connected to the existing 4-in. EHCI line to TA-21-35.

The 4- and 1.5-in. waste lines were rerouted in 1967 when TA-21-35 was removed, and a new waste disposal plant (TA-21-257, SWMU 21-011) began operation. The line segments from the new portion of the lines to TA-21-35 were removed (LASL 1976a).

18.5.1.2. Existing Information

During the summer of 1989, a section of acid waste line was removed from the utility tunnels within and beneath TA-21-3 and -4 north (Montoya 1989). Semiquantitative analyses by ICP-MS were performed on sludge found in a 1-ft section of this pipe, which fed sumps TA-21-84 and 87.

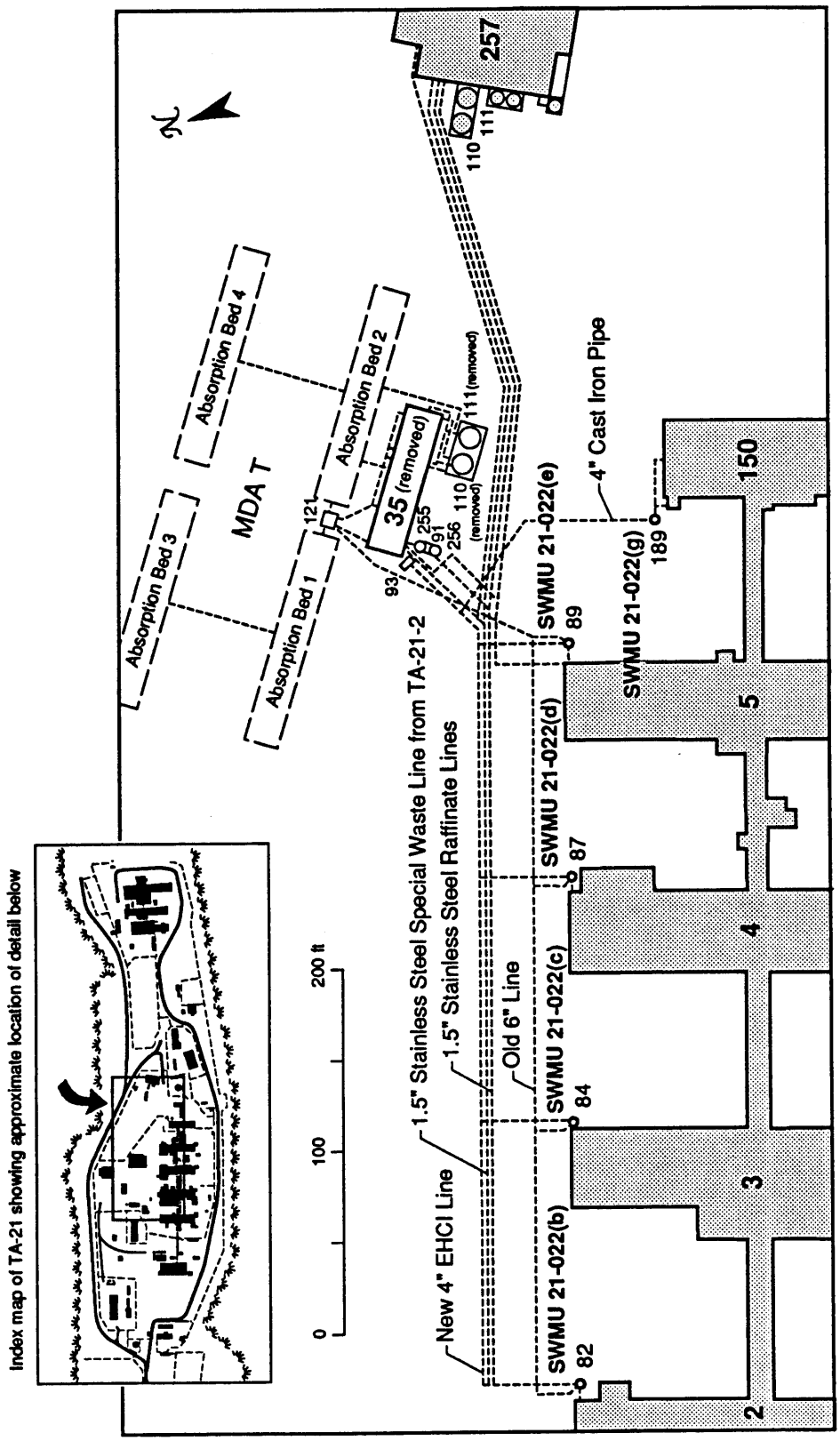


Fig. 18.5-1 Location of acid waste lines and sumps as they appeared in 1954 and 1962 on the north end of Buildings 2, 3, 4, 5, and 150. (LASL 1961, 1976b)

These data provide an indication of the contaminants expected in the acid waste lines that drained these sumps (Garde 1990). The analyses of that sludge are presented (Table 18.5-I) as a guide for constituents that should be expected to be present in unknown concentrations in the acid waste lines to the north of TA-21-2,3,4, and 5. The uncertainties associated with these results are large. Plutonium was also present, but because of a standards problem was not quantified.

A comparison of these results with the background level data given in Sec. 4.2.4 indicates above-background concentrations of arsenic, boron, cobalt, molybdenum, niobium, nickel, lead, antimony, uranium, and zinc. Plutonium was also present, but not quantified.

18.5.1.3. Source Term

The acid lines are likely to be contaminated with nitrates, chlorides, and fluorides as a result of nitric, hydrochloric, and hydrofluoric acids discharged to them from the plutonium separation operations. Surveys at the time of excavation of the sumps showed gross alpha contamination in the soil around sumps TA-21-82, 84, 87, and 89 (Garde et al. 1982; see Sec. 18.8). In addition, the analyses of the sludge indicates arsenic, boron, cobolt, molybdenum, niobium, nickel, lead, antimony, uranium, and zinc are present.

18.5.2. Data Needs

Investigations will be performed in conjunction with the D&D program at TA-21. The locations of these lines will be determined during site D&D when waste lines and residual contamination are chased. Removal and verification sampling may be conducted in lieu of SWMU characterization. As appropriate, characterization to address the following data need will be performed:

- Determine the nature and extent of contamination in soils around former acid line locations.

TABLE 18.5-I SEMIQUANTITATIVE ICP-MS ANALYSES OF SLUDGE FROM WASTE LINE REMOVED IN 1989[a]

Element	Conc (µg/g)	Mean $\bar{x}$	Std. (s)	Upper Limit of Background (µg/g) $\bar{x}$ + 2s
Ag	24	—	—	not reported
As	11	3.9	1.6	7.1
B	45	16	7.2	30.4
Bi	66	—	—	not reported
Ce	18	—	—	65 ± 1.71[b]
Co	11	—	—	7.1 ± 1.97[b]
Cr	47	27	24	75
Eu	77	—	—	not reported
Ho	58	—	—	not reported
Li	32	24	4.6	33.2
Mn	62	510	130	770
Mo	44	—	—	0.85 ± 2.17[b]
Na	64	—	—	9.700 ± 1.95[b]
Nb	16	—	—	8.7 ± 1.82[b]
Ni	180	8.9	4.8	18.5
Pb	93	24	15	54
Rb	40	120	15	150
Sb	24	—	—	0.47 ± 2.15[b]
Sr	65	—	—	200 ± 2.16[b]
Ta	47	—	—	not reported
Ti	1300	—	—	not reported
U	34	—	—	2.5 ± 1.45[b]
V	31	—	—	70 ± 1.95[b]
W	49	—	—	not reported
Zn	330	54	12	78
Zr	21	—	—	160 ± 1.77[b]

[a]Only results over 10 µg/g are reported.

[b]Geometric mean ± geometric standard deviation (Shacklette and Boerngen 1984).

18.6. Utility Tunnels

18.6.1 Site Description

Several of the SWMUs associated with the plutonium-processing complex (Buildings TA-21-2, TA-21-3, TA-21-4, TA-21-5, and TA-21-150) originate from the acid-liquid waste system that served the complex. The acid waste system begins in the utility tunnels that encircled the original foundations of those buildings. Releases of contaminants into the subsurface from within the utility tunnels have not been documented, but are suspected. This section describes potential SWMUs that must be evaluated during the decontamination and decommissioning of the several buildings.

18.6.1.1. Site History

Utility Tunnels. TA-21-2, -3, -4, and -5 were constructed with utility tunnels that circled the perimeter of each building (Fig. 18.6-1). These utility tunnels contain the water, vacuum, chilled cooling water, air, steam, acid waste, acid supply, and caustic lines servicing each building. These service lines are connected to the interior of the building by pipe troughs, which pass through all the major rooms.

The utility tunnels are 4-ft wide by 4-ft deep with dirt floors (LASL 1945a). Typically, there are six entrances to a building's utility tunnels: access airways at the north and south ends and two access manholes on both the east and west sides.

The pipe troughs that connect the utility tunnels to the interior of the building are 1-ft 3-in. wide, 6-in. deep at the west end, and approximately 1.5-ft deep at the east end. They are constructed of reinforced concrete as part of each building's foundation.

Between 1979 and 1981, the plutonium-processing facilities at DP West were decontaminated. This project covered Rooms 308 and 312 in TA-21-3, Rooms 401 East, 401-A, 401-B, 401-C, 403, 404, 406, and 407 in TA-21-4, and all of TA-21-2 and -5. As part of the project, the pipe troughs in the floors of these areas were cleaned until no removable radioactive contamination was detected. They were then painted and filled-in with concrete. Fixed contamination remaining in the pipe troughs after decontamination ranged from 2 x 104 dpm/100 cm^2 to 1 x 106 dpm/100 cm^2 of alpha activity (LANL no date a, b, c, and d).

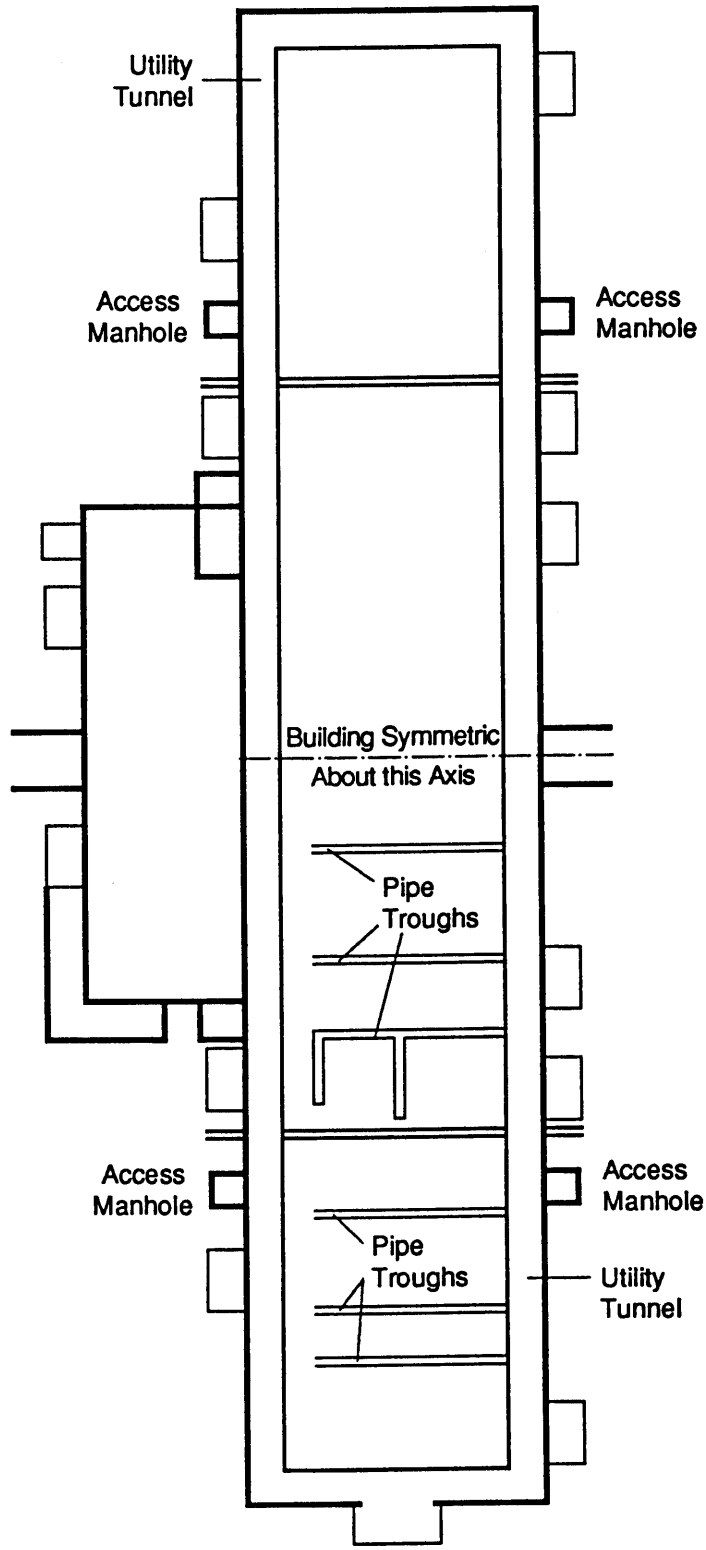


Fig. 18.6-1 Foundation plan for Building 3. (LASL 1945c)

In addition to pipe troughs, the perimeter utility tunnels around TA-21-2, -5, and the north end of TA-21-4 were partially decontaminated by removing all process piping including acid waste and vacuum lines. During decontamination, it was found that the utility tunnels were generally contaminated with plutonium. Soil in the most highly contaminated areas, located under Room 501 in the northeast corner of TA-21-5 and between Rooms 218 and 213 in the southwest corner of TA-21-2, was removed. The remaining contamination in the utility tunnels was fixed by spraying the surfaces of the tunnels with water-based asphalt. The utility tunnel entrances were sealed off from the rooms (LANL no date a, b, c, and d).

Pits. Anecdotal information indicates the potential presence of pits created by acid leaks in the utility tunnels around Buildings TA-21-2 and TA-21-4. The pits may have been formed by the leaching action of acidic fluids, primarily hydrogen fluoride, from leaks in the acid lines. There is no information about the depth of any pits that may exist, and no remediation is known to have been performed. Pits have been rumored to exist at three locations. One each may be in the northeast and southeast portions of the TA-21-4 utility tunnel (Christensen 1986), and another was reported to be present in the utility tunnel in the southwest corner of TA-21-2 between Rooms 218 and 213 (Wenzel 1990). However, the TA-21-2 utility tunnel between Rooms 218 and 213 was decontaminated in 1980, and no evidence of a pit was found (Cox 1991).

Acid Supply Line. In addition to the perimeter utility tunnels and pipe troughs, there was an acid line running from the southwest side of TA-21-2 to equipment room 3A on the southwest side of TA-21-3. This 3/4-in. line of unspecified type carried nitric acid from TA-21-2 to the nitric acid tank located on the dock outside of Room 313. This line carried only pure nitric acid, but other lines carrying unspecified liquids are believed to have been present in the same trench (Cox 1991).

18.6.1.2. Existing Information

Utility Tunnels. Soil removed from the southwest corner of the TA-21-2 utility tunnel had an average plutonium contamination of 240 nCi/g with a high of 1650 nCi/g (LANL 1980a). Three additional soil samples taken after excavation had plutonium levels of 8.8, 524, and 75.7 nCi/g (LANL 1980b). Samples collected from throughout the TA-21-5 utility tunnel showed plutonium concentrations ranging from less than 1 nCi/g to 46 nCi/g. The highest values were from the area under Room 501 in the northeast corner of TA-21-5 (LASL 1979). Contamination was measured in pipe troughs prior to painting and filling with concrete. Readings ranged from 2 x 104 dpm/100 cm^2 to 1 x 106 dpm/100 cm^2 of gross alpha activity (LANL no date a, b, c, and d).

Pits. No information exists for contaminants present in potential pits.

Acid Supply Line. No quantitative information exists on potential contaminants from this line.

18.6.1.3. Source Term

Utility Tunnels were sampled during the D&D of TA-21-2 and -5. This sampling indicates general contamination from plutonium throughout the tunnels. It can be reasonably expected that the utility tunnels around TA-21-3 and -4 have similar levels of contamination. No information is available on chemical contaminants present in the utility tunnels. It is likely that various acids and caustics, as well as organic contaminants, are present due to leaks in the process piping that ran through the tunnels.

Pits. If pits do exist, they may have been created by acids used in plutonium separation processes. However, the specific origin of these acids is unknown.

Acid Supply Line. Nitrates resulting from nitric acid leaks in the line from TA-21-2 to TA-21-3 may be present. Additional radioactive and nonradioactive contaminants may be present from leaks in other lines potentially in the same trench.

18.6.2. Data Needs

Investigations will be performed in conjunction with the D&D program at TA-21. Removal and verification sampling may be conducted in lieu of characterization. As appropriate, the following characterization to address the specific data needs listed below can be performed:

- determination of the location of any pits in coordination with D&D efforts;
- determination of presence or absence of contamination beneath any pits, utility tunnels, and acid supply line;
- Level III data from soils beneath the utility tunnels and any identified pits;
- Level III data from the acid supply line trench; and
- determination of the lateral and vertical extent of any contamination identified using Level III/IV data.

18.7 Areas of Concern

18.7.1 Site Description

This section addresses areas of concern located either within, or immediately adjacent to, existing structures. The sites in this category are C-21-001; -006; and -027. Remaining areas of concern are addressed in Chapter 19 and in other chapters as detailed therein. With the exception of C-21-006, all available data on each of these sites are presented in Table 18.7-I. No additional data are available. Locations of these areas of concern are shown in Fig. 18.7-1.

Area of concern C-21-006 is an approximate 25-sq-ft site (Wenzel 1977) where ^{241}Am was routinely spilled from a transportable trailer. This site is adjacent to the west side of Building TA-21-2 and has subsequently been covered with asphalt (Wenzel 1977).

18.7.1.1 History

Area of concern C-21-006. From 1949 (or 1950) to 1979, tanker trailers were loaded on the north side of Room 218 at Building TA-21-2. Room 218 was located on the southwest corner of the building (Maraman 1987). On occasion, overflow from the tanker trailers was thought to have occurred south of Building 2 to the canyon (Walker 1979). Trailers were loaded by pulling a vacuum on the trailer tank. When the trailer was full, it was moved to Building TA-21-257, the waste treatment plant, where the contents were emptied and treated.

In 1977, a large area at TA-21 was contaminated with ^{241}Am when a transportable trailer leaked (Wenzel 1977). It is not clear how the leak occurred because procedures for filling and emptying trailers were in place. If the trailer was filled to the overflow mark, the overflow should have gone back into the plant or into the vacuum system and its traps (Maraman 1987).

18.7.1.2 Existing Information

At area of concern C-21-006, a survey performed at the time of the spill indicated that contamination existed up to $5x10^4$ counts per minute per 100 cm^2 (Wenzel 1977). The area of the main spill, which covered an area of approximately 25 sq ft, has subsequently been covered with asphalt. It is possible that the road between Buildings TA-21-2 and TA-21-257 was also contaminated. No other information exists regarding sampling or analyses at this site. This contamination is presumed to be ^{241}Am only, and no other contaminants are known to exist.

TABLE 18.7-I
AREAS OF CONCERN FOR COORDINATION WITH BUILDING DECONTAMINATION AND DECOMMISSIONING

SITE NO.	ASSOCIATED STRUCTURE	DESCRIPTION
C-21-001	TA-21-17	A hydrogen fluoride spill in a corridor of this building. (Task 10, Record 176.)
C-21-006	TA-21-2	Release of ^{241}Am from a leaking transport trailer. The contaminated area was covered with asphalt. (CEARP ID No. TA21-8-CA-I-RW/HW; Task 10, Record 182).
C-21-027	TA-21-143	A chilled water recirculator which is still active. (Task 10, Record 172).

Data source in parentheses is TA-21 Release Site Data Base, EES-15, September 1989.

18.7.1.3 Source Term

The spills were contaminated with ^{241}Am. No other contaminants are known to exist.

18.7.2 Data Needs

Because existing information on these areas of concern is minimal and associated spills are clearly bounded by acid waste sump field investigations detailed in Sec. 18.8, these sites will not be investigated until D&D occurs at DP West. Additionally, in the case of C-21-001 and C-21-006, it is impossible to tie any contamination found now back to these past spills. However, in the general cleanup of DP West by D&D and the ER Program, any contamination remaining at these two sites will be removed. Removal and verification sampling may be conducted in lieu of characterization once structure TA-21-143 (area of concern C-21-027) is removed.

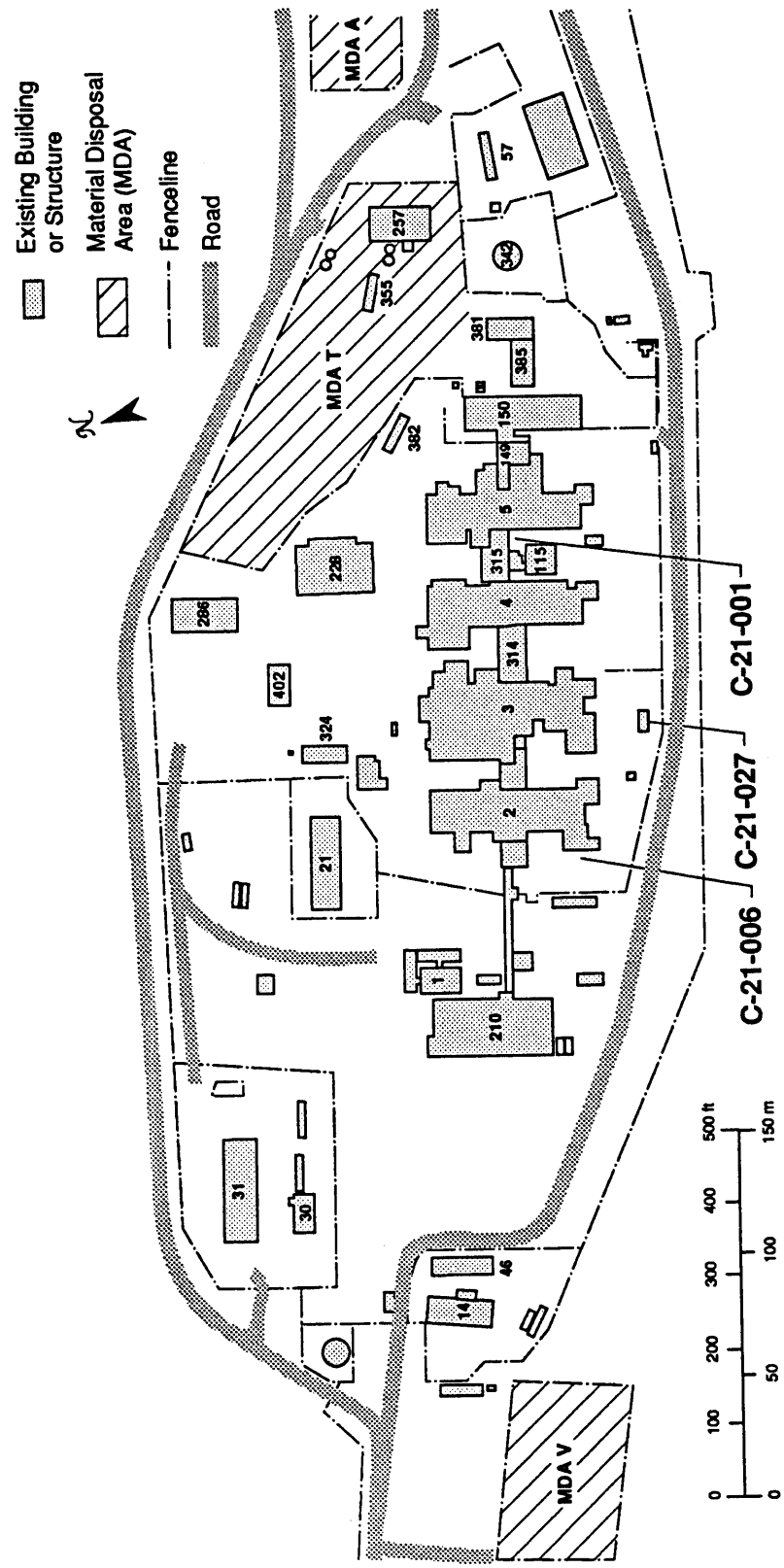


Fig. 18.7-1 Location of three areas of concern to be addressed in conjunction with building D&D.

18.8. Acid Waste Sumps

18.8.1 Site Description

Five underground liquid waste holding sumps (SWMUs 21-022(b)–(e), (g) were located along the north side of the plutonium-processing complex at TA-21 (Fig. 18.8-1). During removal of these sumps in 1979–1980, extensive contamination around and beneath the sumps was documented. Leakage of plutonium-bearing liquid wastes over the nearly 40–yr history of some of the sumps may have resulted in considerable migration of contaminants into the subsurface.

As part of the complex of buildings for which decontamination and decommissioning (D&D) is being planned, these sumps represent significant release sites for which characterization and remediation must be coordinated with the D&D program. Of all of the sites affected by the D&D program, these sumps have the major documented releases and are believed to have the greatest potential for significant liquid releases leading to movement of contaminants into the subsurface. Because of this, as well as the accessibility of the sump locations, it is proposed that limited site investigation be conducted to determine the depth of contaminant penetration beneath the sumps. Determining the depth of contamination beneath the sumps should bound the depth of contaminant releases throughout the complex of buildings to be decontaminated and decommissioned. Additionally, it should provide information allowing an assessment of the potential for significant migration prior to the implementation of D&D.

18.8.1.1. Site History

SWMUs 21-022(b)–(e) are brick sumps constructed to receive liquid wastes before disposal and to provide a point where samples could be collected. The sumps were located adjacent to the northeast corners of Buildings TA-21-2, -3, -4, and -5. They had structure numbers TA-21-82, TA-21-84, TA-21-87, and TA-21-89, respectively, and were constructed between June and July 1945 (Fig. 18.8-1). These sumps received all of the liquid waste discharges, including the floor drains, janitor sinks, and chilled water overflows from their associated buildings (Maraman and Christensen 1987).

Each sump was approximately 5 ft 5 in. in diameter and 10-ft deep (LASL no date). Construction drawings (Fig. 18.8-2) show a 2-ft diameter, 5-ft deep, steel catch basin within each sump. In 1963, plastic liners were placed inside and grouted to the walls of each sump.

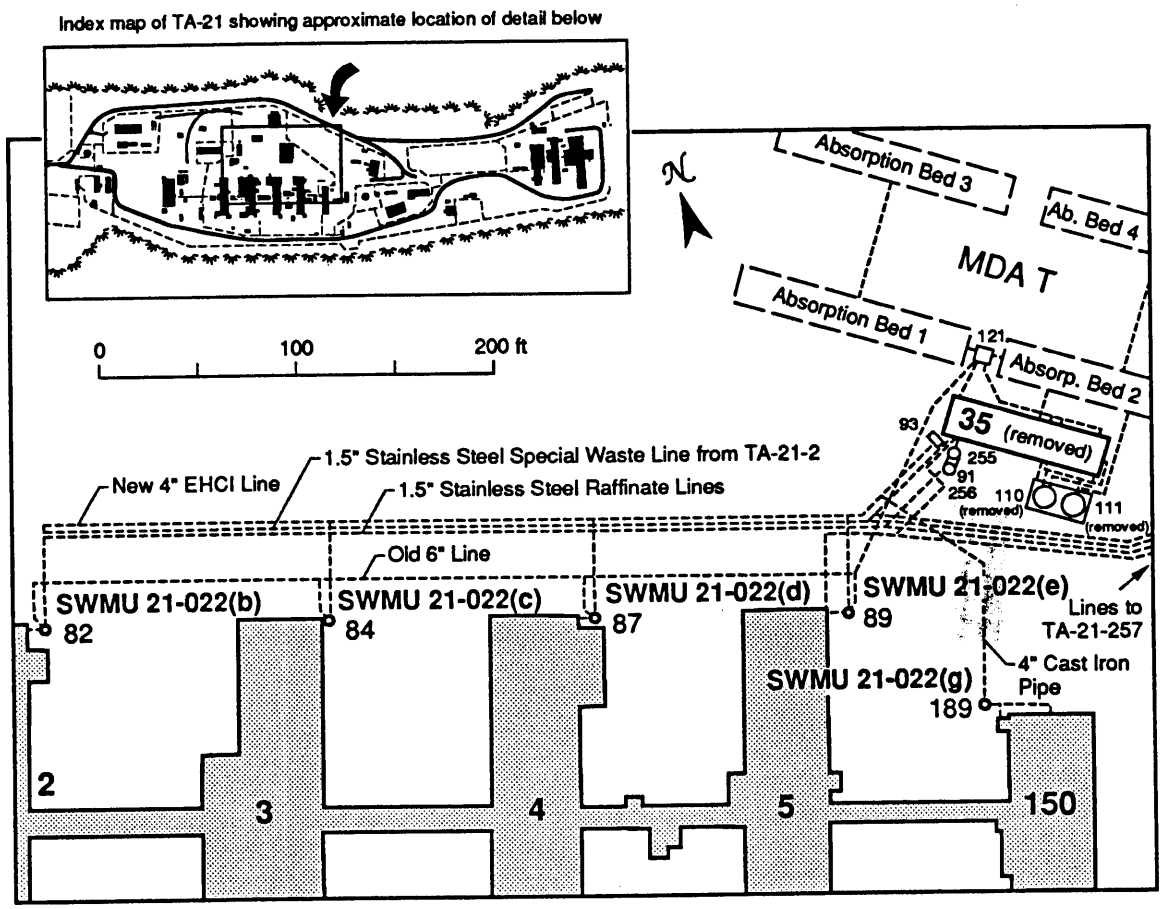


Fig. 18.8-1 Location of acid waste lines and sumps as they appeared in 1954 and 1962 on the north end of Buildings 2, 3, 4, 5, and 150. (LASL 1961, 1976b)

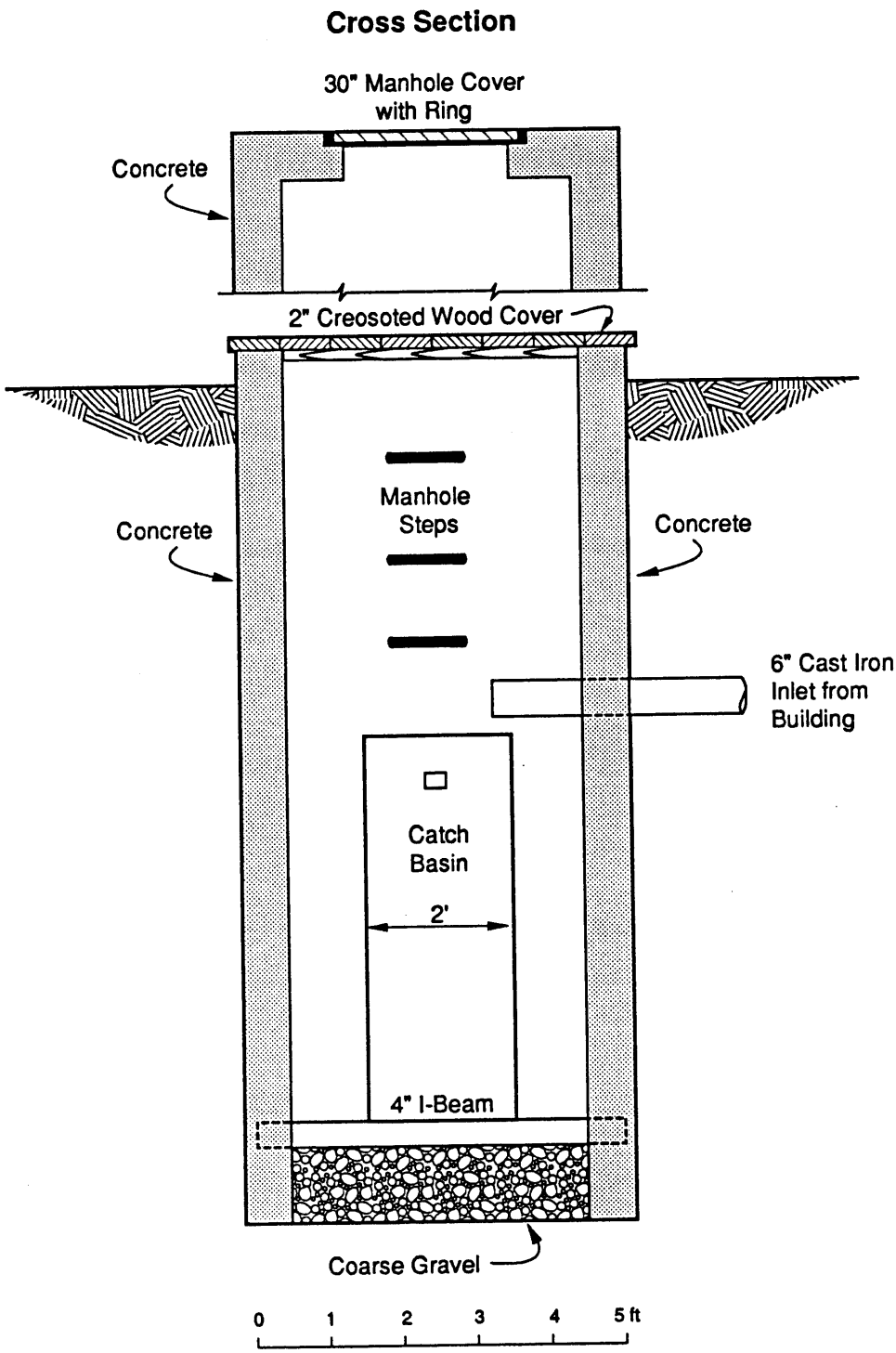


Fig. 18.8-2 Design of acid sumps TA-21-82, 84, 87, and 89. (LASL 1945e)

During 1979–80, these sumps and SWMU 21-022(g) (see below) were excavated and disposed of at MDA G (Garde et al. 1982). Following removal, the waste line entering each sump was reconnected to the line that had exited the sump, forming a direct connection. The brick construction of sump TA-21-82 [SWMU 21-022(b)] collapsed during removal; the other three remained intact when removed by crane, indicating that the brick was cemented together.

Contaminated soil was removed around the sumps until further excavation jeopardized the buildings. Additional soil was judged best to be removed at a later date when the buildings or waste lines were decommissioned (Garde et al. 1982). Excavation pit walls were sprayed with asphalt to alert future excavators, and the pits were backfilled with clean soil (Garde et al. 1982).

Two-inch-wide cracks were found in the tuff at the bottom of the excavation around TA-21-82. The cracks provide a path for liquids leaking from the sump to migrate downward into the tuff.

SWMU 21-022(g), sump TA-21-189, is located off of the northwest corner of TA-21-150, the plutonium fuel service building (Fig. 18.8-1). It was constructed in 1961–62 of concrete (LANL no date) and had dimensions of 4 ft by 4 ft by 11 ft 1 in. (LASL 1962). This sump was also removed in 1979 (Garde et al. 1982). The drain line that carried waste from TA-21-189 was a 4-in. diameter cast iron pipe. It connected to the 4-in. waste line that connected the other four sumps to TA-21-35.

18.8.1.2. Existing Information

SWMUs 21-022(b)–(e) were excavated, and the radioactive contamination remaining on the walls and bottoms of the pits was monitored using a ZnS alpha scintillator (Ahlquist et al. 1977). The results were graphed in internal reports (LANL 1982a, b, c, d, e) and are reproduced here in Figs. 18.8-3 to 18.8-8.

All values in the figures are pCi/g gross alpha (Garde 1990). The depths of the excavations at all four sumps were approximately 15 ft; thus contamination at that depth may be assumed.

In addition, a sludge sample taken from a section of acid waste line that fed sumps TA-21-84 and 87 was analyzed by ICP-MS. The analyses on the sludge sample are described in Sec. 18.5.1.2. The analyses indicate above-background concentrations of arsenic, boron, cobalt, molybdenum, niobium, nickel, lead, antimony, uranium, and zinc.

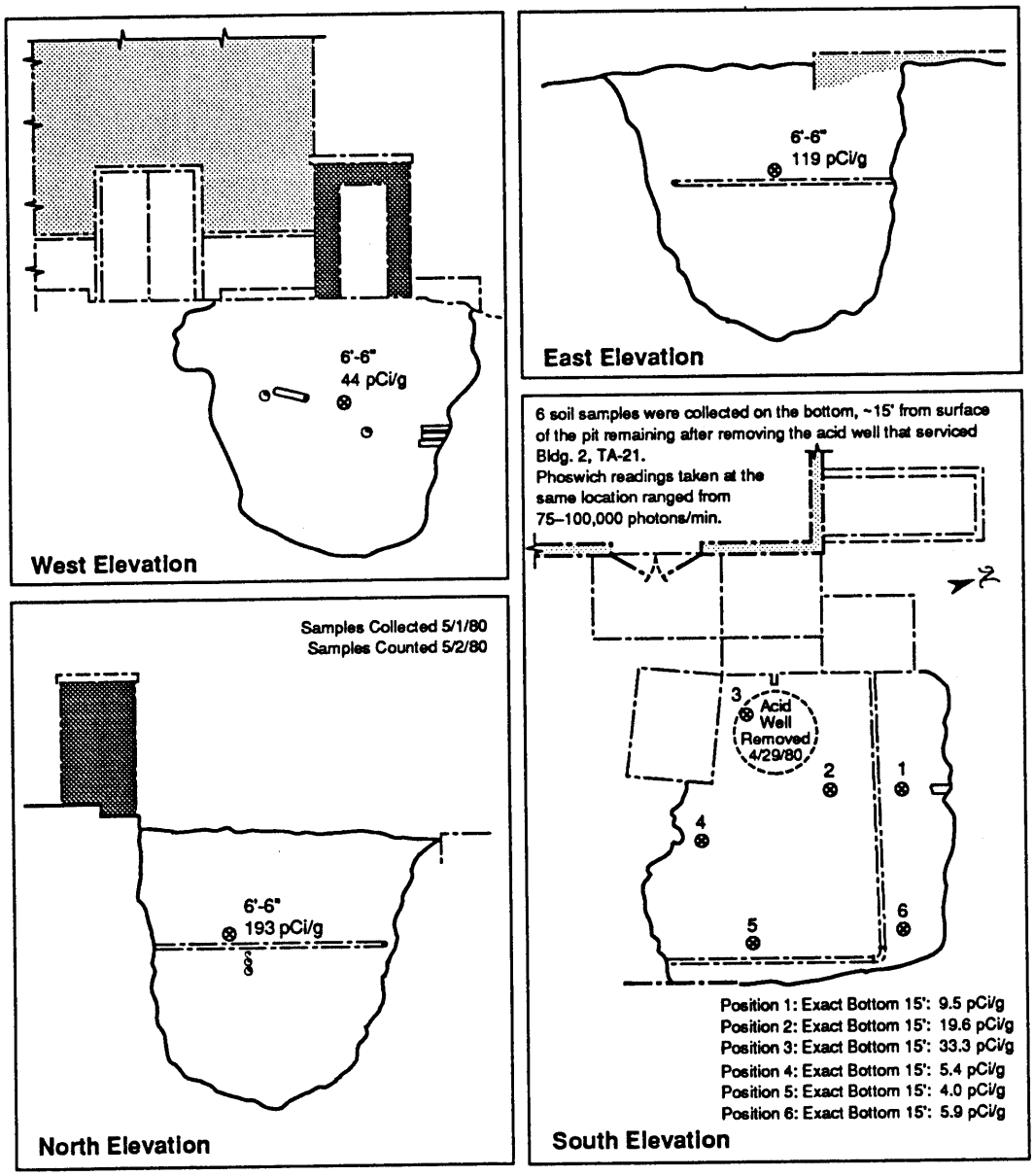


Fig. 18.8-3 Gross alpha contamination remaining after excavation of sump TA-21-82 [SWMU 21-022(b)]. (LANL 1982b)

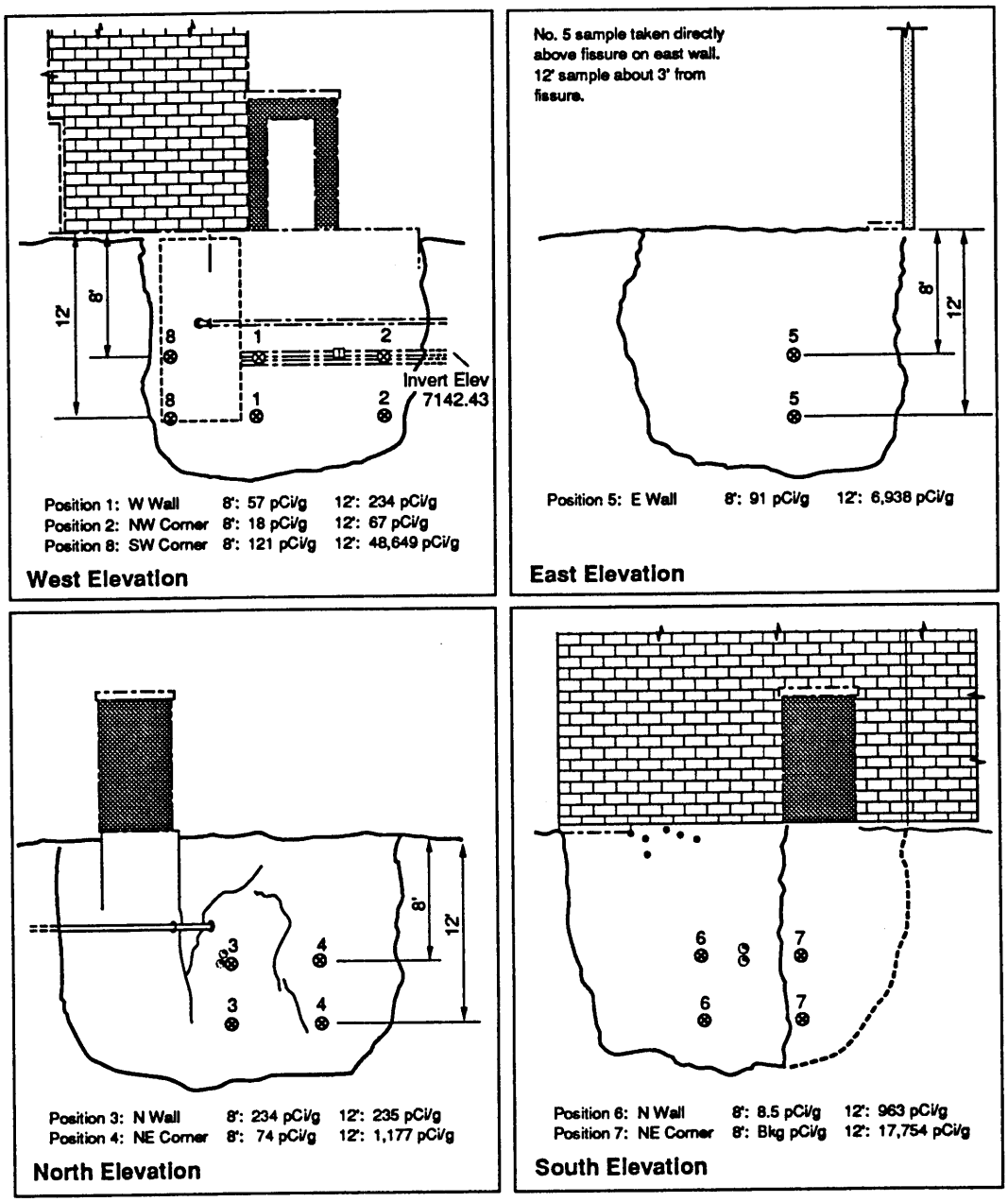


Fig. 18.8-4 Gross alpha contamination remaining after excavation of sump TA-21-84 [SWMU 21-022(c)]. (LANL 1982c)

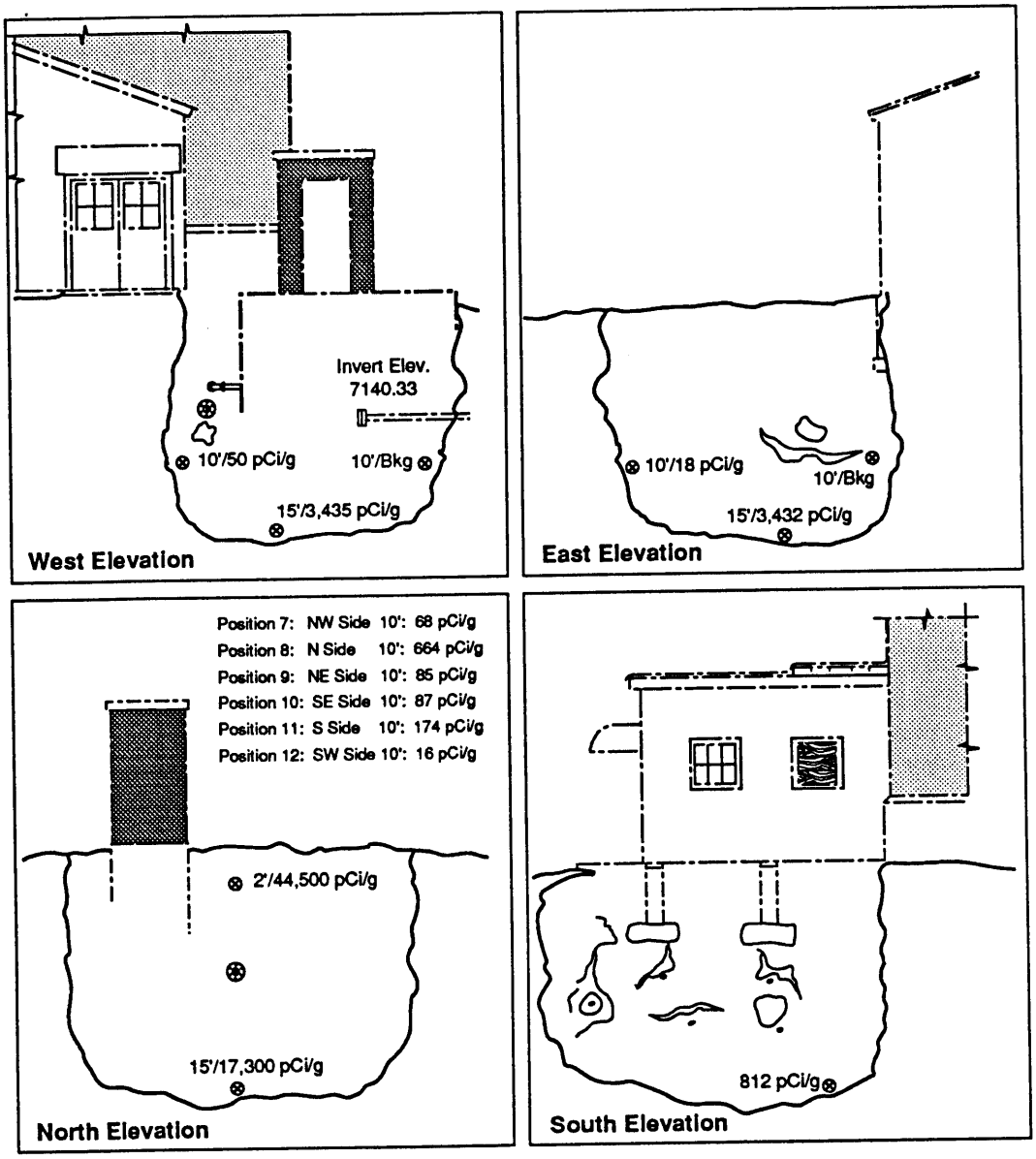


Fig. 18.8-5 Gross alpha contamination remaining after excavation of sump TA-21-87 [SWMU 21-022(d)]. (LANL 1982d)

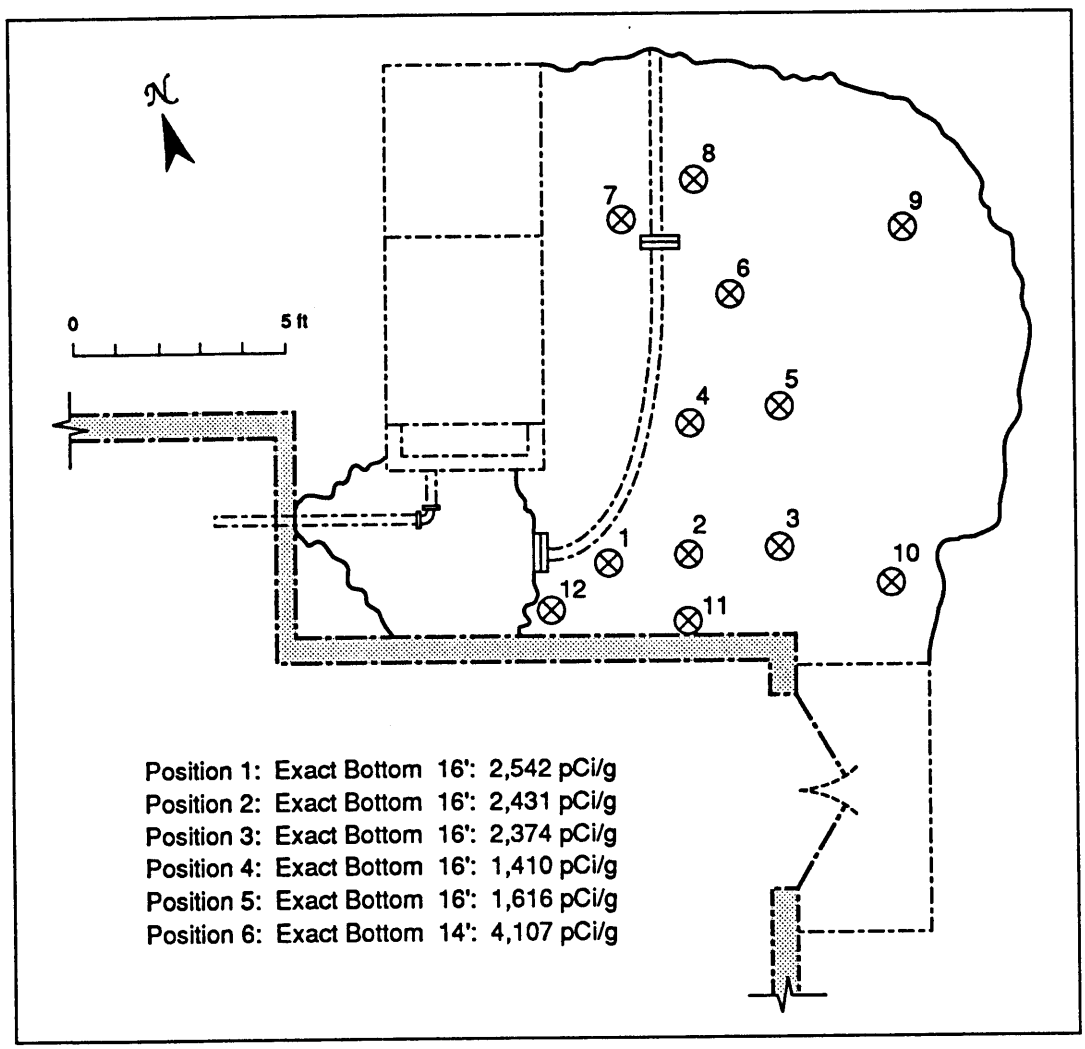


Fig. 18.8-6 Gross alpha contamination remaining on bottom after excavation of sump TA-21-87 [SWMU 21-022(d)]. (LANL 1982d)

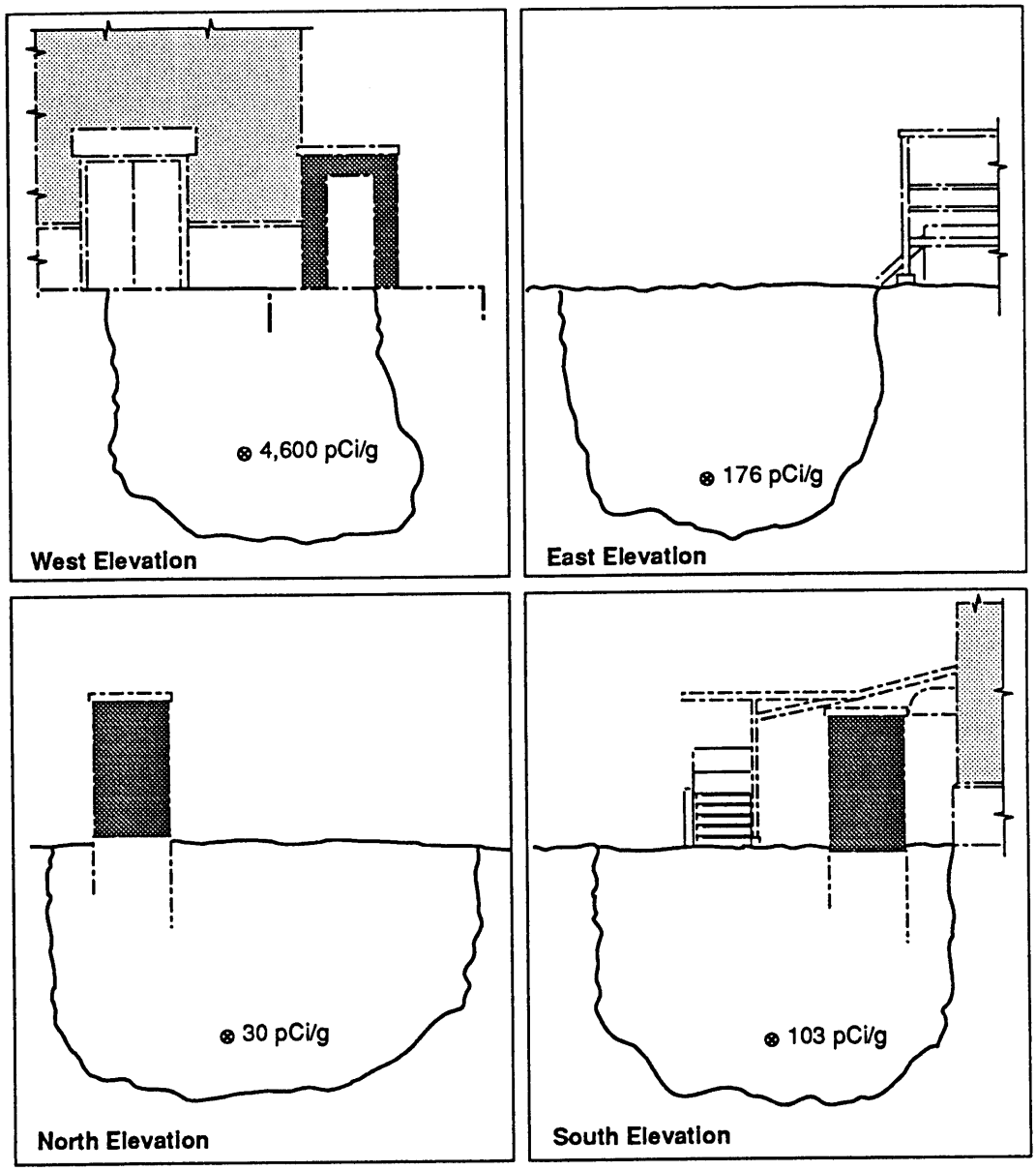


Fig. 18.8-7 Gross alpha contamination remaining after excavation of sump TA-21-89 [SWMU 21-022(e)]. (LANL 1982e)

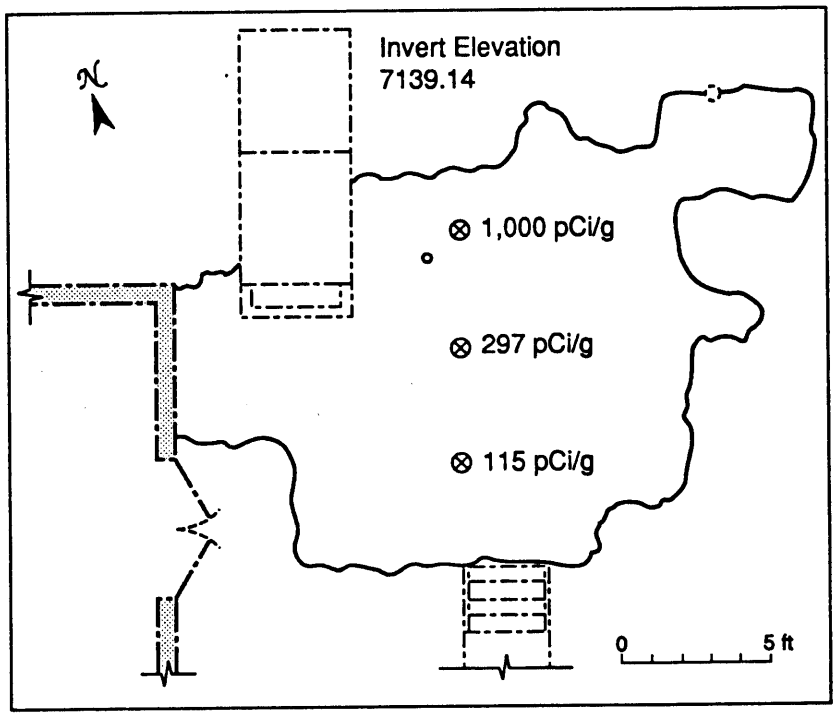


Fig. 18.8-8 Gross alpha contamination remaining on bottom after excavation of sump TA-21-89 [SWMU 21-022(e)]. (LANL no date e)

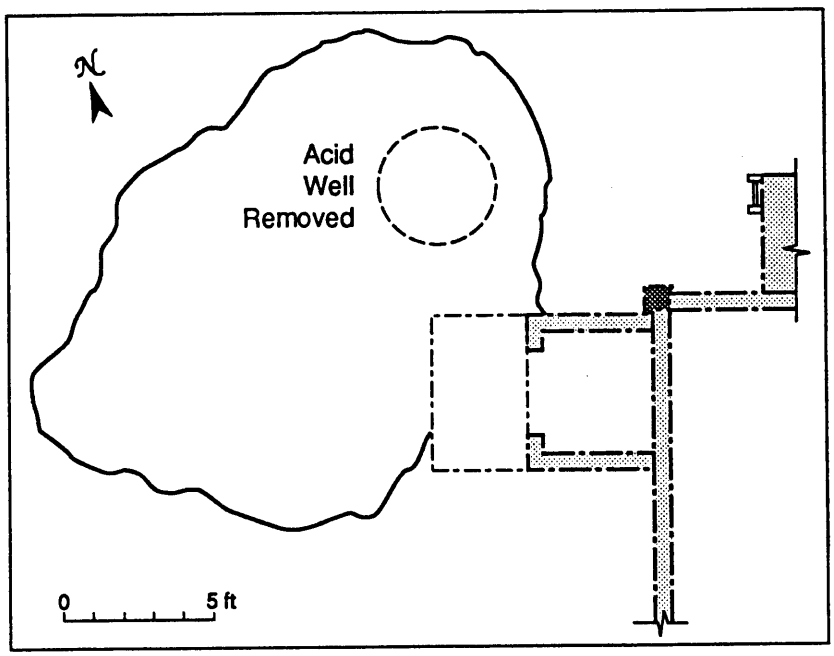


Fig. 18.8-9 Gross alpha contamination remaining after excavation of sump TA-21-189 [SWMU 21-022(g)]. All samples were less than 25 pCi/g. (LANL 1982a)

SWMU 21-022(g) was excavated and surveyed for gross alpha contamination in the same manner as SWMU 21-022(b)–(e) above. All soil samples taken from the pit walls and the bottom of the pit contained less than 25 pCi/g gross alpha (Fig. 18.8-9).

18.8.1.3. Source Term

SWMUs 21-022(b)–(e) are likely to be contaminated with nitrates, chlorides, and fluorides as a result of nitric, hydrochloric, and hydrofluoric acids discharged to the sumps from the plutonium separation operations. Surveys at the time of excavation showed gross alpha contamination in the soil around each sump, possibly from plutonium. In addition, previous sampling of drain line sludge indicates arsenic, boron, cobalt, molybdenum, niobium, nickel, lead, antimony, uranium, and zinc are present. No estimate of the volume of liquid waste leakage is possible.

SWMU 21-022(g). Sampling performed after the removal of this sump indicated levels of gross alpha radiation in the excavated pit were below the detection limit of the screening instrument (25 pCi/g). However, analysis for other contaminants was not performed. Therefore, it is possible that the other contaminants listed for SWMU 21-022(b)–(e) are also present at TA-21-189. No estimate of the volume of liquid waste leakage is possible.

18.8.2. Objectives and Data Needs

The objective of the investigations at the acid waste sumps is to determine the depth to which contaminants released from the sumps have migrated into the subsurface. By meeting this objective, the probable maximum extent of contaminant migration due to releases from operations in the plutonium-processing complex will be determined. This includes releases from SWMUs 21-006, 21-023, and 21-028 discussed previously in this chapter. The primary data needs are as follows:

- subsurface samples from boreholes placed through the former locations of the five sumps with
  - Level II/III field data laboratory data to guide the drilling and selection of samples for subsequent Level III/IV analysis; and
  - Level III/IV data for a selected subset of the borehole samples to identify contaminant species and to determine the depth to which contaminants have penetrated.

18.8.3 Sampling/Investigation Rationale

A single borehole will be drilled through the former location of each sump. Because these sumps leaked large amounts of liquid waste, they present the greatest potential for contamination at depth of any SWMU discussed in this chapter. These boreholes will determine the depth of contaminated tuff and will bound the probable maximum depth of releases from the plutonium-processing complex.

The nominal depths selected for the initial investigations will be sufficiently deep to allow an assessment of the importance of horizontal fractures in the tuff as a lateral transport pathway for contaminants at depth. Field screening of samples will pay particular attention to tuff fractures in the cores. The absence of detectable contaminants in field laboratory analyses will be used to guide the decision to terminate the drilling of each hole. If contaminants continue to be detected, the drilling will continue deeper than the nominal depth to document the nature and depth of the contaminant penetration.

No additional boreholes will be placed laterally away from the boreholes through the former sump areas due to the large number of underground utility lines to the north of this area. Thus lateral extent of any contaminant plumes cannot be addressed until the D&D process has resulted in the removal of the obstructions.

In addition to guiding the depth of borehole sampling, results of field laboratory analyses will aid in selecting samples to be submitted to an analytical laboratory. For this investigation, identification of the depth of contaminant penetration is critical; thus the selection of samples for laboratory analyses will focus first on those close to the detection limits of the field laboratory techniques and the deeper samples in the boreholes. A secondary focus will be to identify all contaminant species potentially of interest. For this purpose, the most contaminated samples identified in the field laboratory or the samples directly beneath the sump excavation should be used. It is not expected that samples from within the backfilled sump excavation will be submitted to an analytical laboratory.

It is assumed that 50% of the total number of samples collected will be submitted to the analytical laboratory. The selection of samples will be biased as noted above. If no data from the field laboratory allow biased selection of the samples, then sample selection should concentrate on the depth intervals immediately below the back-filled sump excavations, with widely spaced samples selected at random from deeper in the boreholes. Given the availability of supporting Level II/III data from the field laboratory, it is expected that the investigation goals can easily be

achieved with a 50% submission to an analytical laboratory for Level III/IV data. Those higher level analyses will be focused on contaminant identification and on defining the depth of contaminant penetration.

18.8.4 Sampling Plan

The sump locations will be determined by surveying prior to drilling. All boreholes will be drilled according to the method in Sec. 11.5.3.2, Vertical Split Barrel Core Samples. Table 18.8-I identifies the screening and analyses to be performed on each of the samples.

18.8.4.1 Initial Investigations

SWMUs 21-022(b)–(e), (g) will be sampled by drilling a borehole to a nominal depth of 80 ft through the former sump locations (Fig. 18.8-1). For the five boreholes, this will result in the collection of a total of 80 samples (5-ft core interval).

The exact location of the reconnected drain lines within each backfilled sump excavation should be determined prior to drilling. The initial samples from these boreholes are expected to be uncontaminated because the excavations to remove the sumps were backfilled with clean material. These should not be selected for submission to the analytical laboratory. Careful attention will be given to identifying asphalt in the cores of the boreholes because asphalt will mark the boundary between the clean backfill material and unexcavated soil.

Because contaminant releases have been documented, it is reasonable to allow a contingency for drilling the boreholes to deeper depths if contaminated soils persist. For planning purposes, it is assumed that an additional 40 ft of core sampling may be needed for two of the five boreholes. This contingency adds 16 additional samples. These samples are indicated in Table 18.8-1 as 40 ft additions to two of the boreholes; but in the field, the contingency may be applied as needed to one or several of the holes.

18.8.4.2 Subsequent Investigations.

No subsequent investigations are envisioned prior to the D&D of the buildings and waste lines. At that time, the D&D Program will remove all structures, chase all waste and utility lines, and remove associated contamination. The ER Program will integrate SWMU investigations with D&D Program cleanup efforts and will assess the need for additional remediation on the basis of any residual contamination remaining following D&D.

Table 18.8-1

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-022(B)-(E) AND (G), ACID WASTE SUMPS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium	
21-022(b)																																	
Vertical Borehole	1	0.0 - 5.0 R					X	X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E		E	
		5.0 - 10.0 R						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E		E	
		10.0 - 15.0 R									X	X	X	X	X	X	X					E	E	E	E		E	E	E	E		E	
		15.0 - 20.0 R									X	X	X	X	X	X	X					E	E	E	E		E	E	E	E		E	
		20.0 - 25.0 R									X	X	X	X	X	X	X					E	E	E	E		E	E	E	E		E	
		25.0 - 30.0 R									X	X	X	X	X	X	X					E	E	E	E		E	E	E	E		E	
		30.0 - 35.0 R									X	X	X	X	X	X	X					E	E	E	E		E	E	E	E		E	
		35.0 - 40.0 R									X	X	X	X	X	X	X					E	E	E	E		E	E	E	E		E	
		40.0 - 45.0 R									X	X	X	X	X	X	X					E	E	E	E		E	E	E	E		E	
Field Duplicate		45.0 - 50.0 R									X	X	X	X	X	X	X					E	E	E	E		E	E	E	E		E	
		50.0 - 55.0 R									X	X	X	X	X	X	X					E	E	E	E	X	E	E	E	E		E	
Rinsate Blank																										X							
Field Blank		55.0 - 60.0 R									X	X	X	X	X	X	X					E	E	E	E	X	E	E	E	E		E	
		60.0 - 65.0 R									X	X	X	X	X	X	X					E	E	E	E	X	E	E	E	E		E	
		65.0 - 70.0 R									X	X	X	X	X	X	X					E	E	E	E	X	E	E	E	E		E	
		70.0 - 75.0 R									X	X	X	X	X	X	X					E	E	E	E	X	E	E	E	E		E	
		75.0 - 80.0 R									X	X	X	X	X	X	X					E	E	E	E	X	E	E	E	E		E	
Trip Blank																										X							
21-022(c)																																	
Vertical Borehole	2	0.0 - 5.0 R					X	X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E		E	
		5.0 - 10.0 R						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E		E	
		10.0 - 15.0 R									X	X	X	X	X	X	X					E	E	E	E		E	E	E	E		E	

Table 18.8-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-022(B)-(E) AND (G), ACID WASTE SUMPS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys					Field Screening						Field Laboratory Measurements									Laboratory Analysis									
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey		Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging		Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture				Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium
Rinsate Blank																																	
Field Blank																																	
Trip Blank																																	
21-022(d)																																	
Vertical Borehole	3	0.0 - 5.0 ft					X		X	X		X	X	X		X	X	X	X					E	E	E	E	E	E	E	E	E	E	E
		5.0 - 10.0 ft							X	X		X	X	X		X	X	X	X					E	E	E	E	E	E	E	E	E	E	E
		10.0 - 15.0 ft							X	X		X	X	X		X	X	X	X					E	E	E	E	E	E	E	E	E	E	E
		15.0 - 20.0 ft		X					X	X		X	X	X		X	X	X	X					E	E	E	E	E	E	E	E	E	E	E
		20.0 - 25.0 ft		X					X	X		X	X	X		X	X	X	X					E	E	E	E	E	E	E	E	E	E	E
		25.0 - 30.0 ft		X					X	X		X	X	X		X	X	X	X					E	E	E	E	E	E	E	E	E	E	E
		30.0 - 35.0 ft		X					X	X		X	X	X		X	X	X	X					E	E	E	E	E	E	E	E	E	E	E
		35.0 - 40.0 ft		X					X	X		X	X	X		X	X	X	X					E	E	E	E	E	E	E	E	E	E	E
		40.0 - 45.0 ft		X					X	X		X	X	X		X	X	X	X					E	E	E	E	E	E	E	E	E	E	E
		45.0 - 50.0 ft		X					X	X		X	X	X		X	X	X	X					E	E	E	E	E	E	E	E	E	E	E
		50.0 - 55.0 ft		X					X	X		X	X	X		X	X	X	X					X	X	X	X	X	X	X	X	X	X	X

Table 18.8-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-022(B)-(E) AND (G), ACID WASTE SUMPS.

Sample Identification	Sampling Location	Interval	Sample Type	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture		Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium
		40.0 - 45.0 R						X	X		X	X		X	X		X				E	E	E		E					X
		45.0 - 50.0 R						X	X		X	X		X	X		X				E	E	E		E					
		50.0 - 55.0 R						X	X		X	X		X	X		X				E	E	E		E					
		55.0 - 60.0 R																													
Rinsate Blank																															
Field Blank		60.0 - 65.0 R						X	X		X	X		X	X		X				E	E	E		E					
		65.0 - 70.0 R						X	X		X	X		X	X		X				E	E	E		E					
		70.0 - 75.0 R						X	X		X	X		X	X		X				E	E	E		E					
Field Duplicate		75.0 - 80.0 R						X	X		X	X		X	X		X				E	E	E		E					
Trip Blank		0.0 - 5.0 R						X			X	X		X	X		X				E	E	E		E					
21-022(e) Vertical Borehole	4	5.0 - 10.0 R						X			X	X		X	X		X				E	E	E		E					
		10.0 - 15.0 R						X			X	X		X	X		X				E	E	E		E					
		15.0 - 20.0 R						X			X	X		X	X		X				E	E	E		E					
		20.0 - 25.0 R						X			X	X		X	X		X				E	E	E		E					
		25.0 - 30.0 R						X			X	X		X	X		X				E	E	E		E					
		30.0 - 35.0 R						X			X	X		X	X		X				E	E	E		E					
		35.0 - 40.0 R						X			X	X		X	X		X				E	E	E		E					
		40.0 - 45.0 R						X			X	X		X	X		X				E	E	E		E					
		45.0 - 50.0 R						X			X	X		X	X		X				E	E	E		E					
		50.0 - 55.0 R						X			X	X		X	X		X				E	E	E		E					

Table 18.8-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-022(B)-(E) AND (G), ACID WASTE SUMPS.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals	Laboratory Analysis: Isotopic Thorium
		65.0 – 70.0 ft		X				X	X	X	X	X	X	X	X	X			E	E	E			E	E	E	E			X
		70.0 – 75.0 ft		X				X	X	X	X	X	X	X	X	X			X	X	X			X	X	X	X			
Rinsate Blank																														
Field Blank																														
		75.0 – 80.0 ft		X				X	X	X	X	X	X	X	X	X			C	C	C			C	C	C	C			C
		80.0 – 85.0 ft		C				C	C	C	C	C	C	C	C	C			C	C	C			C	C	C	C			
		85.0 – 90.0 ft		C				C	C	C	C	C	C	C	C	C			C	C	C			C	C	C	C			C
		90.0 – 95.0 ft		C				C	C	C	C	C	C	C	C	C			C	C	C			C	C	C	C			
		95.0 – 100.0 ft		C				C	C	C	C	C	C	C	C	C			C	C	C			C	C	C	C			C
		100.0 – 105.0 ft		C				C	C	C	C	C	C	C	C	C			C	C	C			C	C	C	C			
		105.0 – 110.0 ft		C				C	C	C	C	C	C	C	C	C			C	C	C			C	C	C	C			C
		110.0 – 115.0 ft		C				C	C	C	C	C	C	C	C	C										X				
		115.0 – 120.0 ft		C				C	C	C	C	C	C	C	C	C														
Trip Blank																														
21-022(g)																			E	E	E			E	E	E	E			E
Vertical Borehole	5	0.0 – 5.0 ft		X				X	X	X	X	X	X	X	X	X														
		5.0 – 10.0 ft		X				X	X	X	X	X	X	X	X	X			E	E	E			E	E	E	E			E
		10.0 – 15.0 ft		X				X	X	X	X	X	X	X	X	X														
		15.0 – 20.0 ft		X				X	X	X	X	X	X	X	X	X			E	E	E			E	E	E	E			E
		20.0 – 25.0 ft		X				X	X	X	X	X	X	X	X	X														
		25.0 – 30.0 ft		X				X	X	X	X	X	X	X	X	X			E	E	E			E	E	E	E			E
		30.0 – 35.0 ft		X				X	X	X	X	X	X	X	X	X														
		35.0 – 40.0 ft		X				X	X	X	X	X	X	X	X	X			E	E	E			E	E	E	E			E
		40.0 – 45.0 ft		X				X	X	X	X	X	X	X	X	X														
		45.0 – 50.0 ft		X				X	X	X	X	X	X	X	X	X			X	X	X			X	X	X	X			X
Rinsate Blank																														

Table 18.8-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-022(B)-(E) AND (G), ACID WASTE SUMPS.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium	
Field Blank																												X	X	X				
		50.0 - 55.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			E	
		55.0 - 60.0 ft						X	X		X	X	X	X	X	X	X																	
		60.0 - 65.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			E	
		65.0 - 70.0 ft						X	X		X	X	X	X	X	X	X																	
		70.0 - 75.0 ft						X	X		X	X	X	X	X	X	X					E	E	E	E		E	E	E	E			E	
Field Duplicate																						E	E	E	E		E	E	E	E			E	
		75.0 - 80.0 ft						X	X		X	X	X	X	X	X	X																	
		80.0 - 85.0 ft						C	C		C	C	C	C	C	C	C					C	C	C	C		C	C	C	C			C	
		85.0 - 90.0 ft						C	C		C	C	C	C	C	C	C																	
		90.0 - 95.0 ft						C	C		C	C	C	C	C	C	C					C	C	C	C		C	C	C	C			C	
		95.0 - 100.0 ft						C	C		C	C	C	C	C	C	C																	
		100.0 - 105.0 ft						C	C		C	C	C	C	C	C	C					C	C	C	C		C	C	C	C			C	
		105.0 - 110.0 ft						C	C		C	C	C	C	C	C	C																	
		110.0 - 115.0 ft						C	C		C	C	C	C	C	C	C					C	C	C	C		C	C	C	C			C	
		115.0 - 120.0 ft						C	C		C	C	C	C	C	C	C																	
Rinsate Blank																						C	C	C	C		C	C	C	C			C	
Field Blank																												C	C	C				
Trip Blank																												X						

18.9. South Side of Plutonium-Processing Complex

18.9.1 Site Description

Three SWMUs (21-022(h)–(j)) are located along the south side of the plutonium-processing complex as indicated in Fig. 18.9-1. These SWMUs do not have the same potential for significant environmental releases as were documented for the five acid waste sumps described in Sec. 18.8. However, the known locations and accessibility of these SWMUs make them reasonable choices for investigations to address the potential for environmental releases on the south side of the plutonium-processing complex. As for the investigations addressed in Sec. 18.8, investigations at these SWMUs are to document and bound the extent of existing contamination prior to the time D&D can be implemented.

For SWMUs 21-022(h)–(j), deep contaminant releases are not expected as they were for the SWMUs discussed in Sec. 18.8. Therefore, the focus of the investigations will be on bounding the lateral extent of subsurface contamination on the south side of the plutonium-processing complex.

18.9.1.1. Site History

SWMU 21-022(h), sump TA-21-202 and its associated drain line, is located off the southeast corner of TA-21-150 (Fig. 18.9-1). This sump is an acid industrial waste manhole constructed in 1961–62 (LANL no date) from 36-in.-diameter, corrugated metal pipe. It received drainage from the basement floor drains and roof drains in building TA-21-150 (LASL 1961). The drain from the sump is 6 in. in diameter and discharges south into Los Alamos Canyon as NPDES outfall EPA 03A032 (see Sec. 15.4). This outfall reportedly drains cooling water overflow from TA-21-150 (EPA 1987).

SWMU 21-022(i) is a sump pump located in the equipment room at the southeast corner of TA-21-2 (LANL 1990; LASL 1945, 1966) (Fig. 18.9-2). This room housed air compressors and evaporative coolers, and no contamination is expected (Walker 1979). The bottom of the sump is estimated to be 14 ft below ground level (LASL 1945b) and may have a capacity of 1000 gal. per hour (LASL 1945d). It is not clear where effluent from this sump was pumped to, and no drain lines south of the equipment room have been identified.

SWMU 21-022(j) is described as a sump pump in the south end of Building TA-21-3 (LANL 1990). It is believed this refers to equipment room 3 on the southeast corner of TA-21-3. This

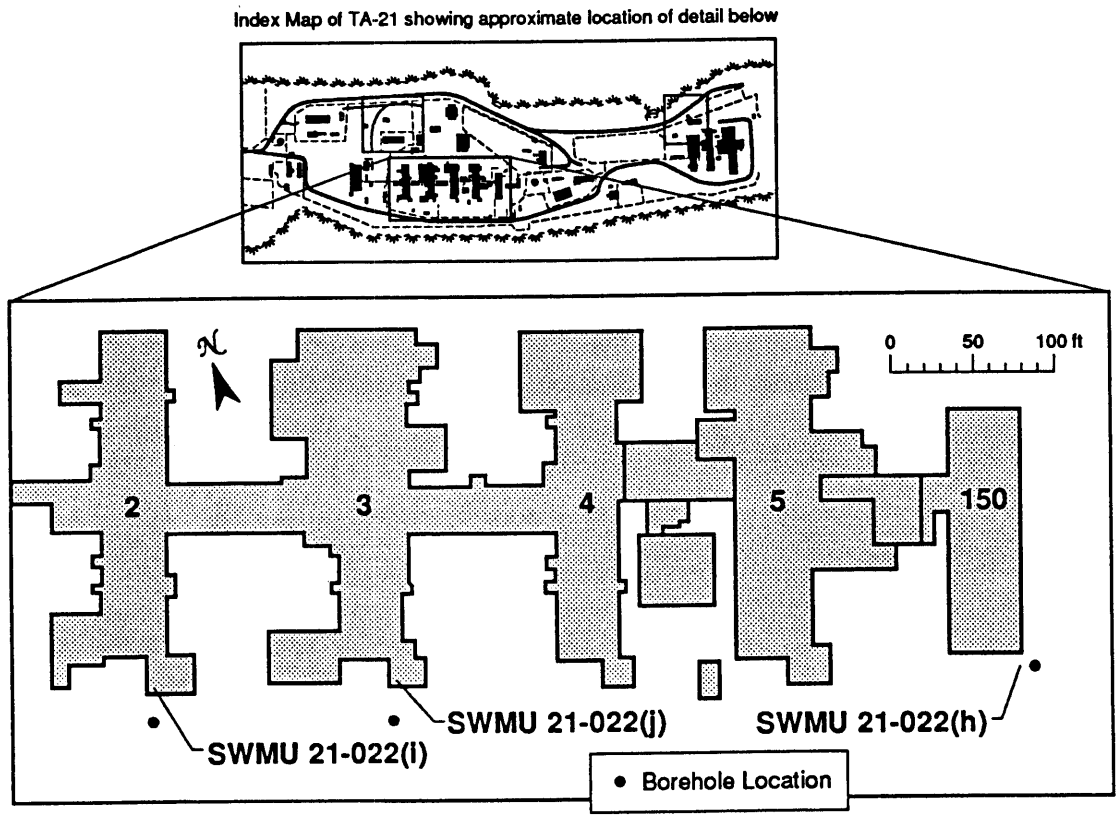


Fig. 18.9-1 Location of boreholes and SWMUs 21-022(h)–(j).

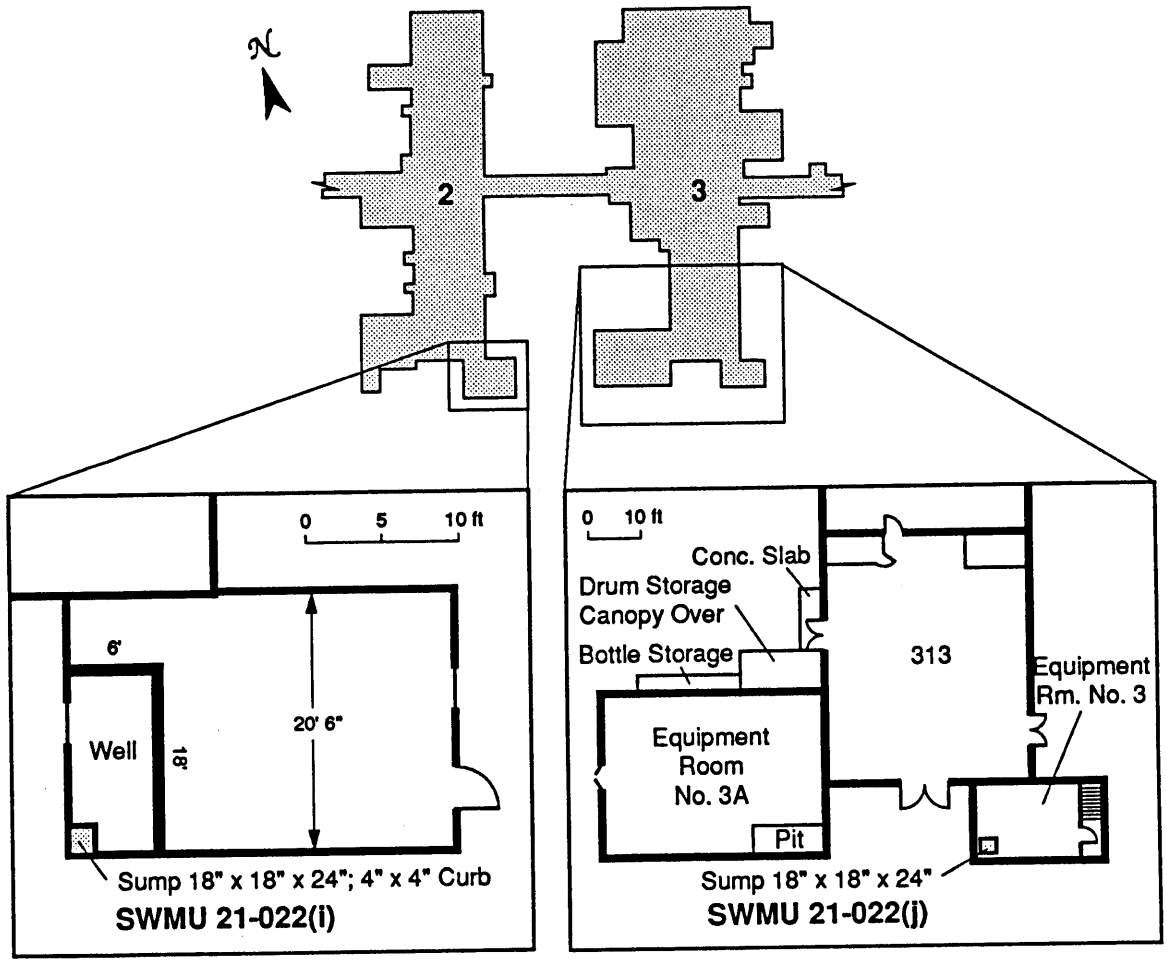


Fig. 18.9-2 Location of SWMU 21-022(i) on the south end of Building 2, and SWMU 21-022(j) on the south end of Building 3. (LASL 1945b, d; 1966)

room is similar to the sump in the equipment room on the southeast side of TA-21-2 discussed above. Fig. 18.9-3 shows the sump location and its dimensions. It is estimated that the bottom of the sump is 8 ft below ground level (LASL 1945d). No drain lines have been identified.

There also is an equipment room 3A on the southwest corner of TA-21-3. This room contains a trench that could be misidentified as a sump (Fig. 18.9-2). The trench is drained by two 3-in. lines that join a 4-in. line and discharge to a storm drain on the southwest corner of the building. This storm drain is the upper end of SWMU 21-027(a) described in Sec. 15.5, and equipment room 3A should be considered part of that SWMU.

18.9.1.2. Existing Information

SWMU 21-022(h)–(j). No sample analysis results or other quantitative information are available regarding the presence of contaminants in any of these SWMUs.

18.9.1.3. Source Term

SWMU 21-022(h)–(j). No information is available regarding whether any of these units contain radioactive or hazardous constituents. Likely contaminants are plutonium, uranium, mercury, lead, organics, and various acids that were associated with the plutonium purification process at TA-21.

18.9.2. Objectives and Data Needs

The objective of this investigation is to determine if contaminants have entered the environment from SWMUs 21-022(h)–(j) and from other SWMUs along the southern side of the plutonium-processing complex. By meeting this objective, the lateral extent of potential contamination from the plutonium-processing complex will be bounded. The area investigated may include contaminants released from SWMUs 21-006, 21-023, and 21-028 discussed previously in this chapter. The primary data needs are

- subsurface soil samples from boreholes along the southern side of the plutonium-processing complex with
    - Level II/III field laboratory data to guide the drilling and selection of samples for subsequent Level III/IV analyses; and
    - Level III/IV data for a selected subset of the borehole samples to identify contaminant species or to confirm the absence of contaminants.

18.9.3. Sampling/Investigation Rationale

Boreholes will be drilled along the south ends of Buildings TA-21-2, -3, and -150 to determine potential contamination from SWMUs 21-022(h)–(j).

Boreholes will be located close to the buildings and will be drilled sufficiently deep (50 ft) to document the absence of deep contaminant plumes. The absence of detectable contaminants in field laboratory analyses will be used to guide the decision to terminate the drilling of each hole. If contaminants are detected at depth, drilling will continue to document the nature and depth of the identified contaminant plume.

It is expected that any contaminants that may be detected on the south side of the complex will be at fairly shallow depths (less than 20 ft). If this is borne out by the initial sampling results, no additional investigations to bound the extent of contamination prior to D&D will be needed.

Field laboratory analysis of samples will be used to guide the depth of borehole sampling and to aid in the selection of samples to be submitted to an analytical laboratory. For this investigation, the identification of the presence of contaminants is critical; thus the selection of samples for laboratory analysis will focus first on those in which contaminants were detected in the field laboratory. A secondary focus will be to confirm the absence of contaminants in samples in which no contaminants were identified in the field laboratory. This secondary focus will be more intensive for any samples that might be construed to be close to the edge of a contaminant plume and less intensive for samples further away from any detected plume.

It is assumed that 50% of the total number of samples collected will be submitted to the analytical laboratory. The selection of samples will be biased as noted above. If no information is found in the field laboratory to allow biased selection of the samples, then a nonbiased selection of 50% of the collected samples will be submitted. Given the purpose of the investigation and the supporting Level II/III information from the field laboratory analyses, a 50% submission to the analytical laboratory for Level III/IV data to identify specific contaminant species or to confirm the absence of contaminants is appropriate.

18.9.4. Sampling Plan

18.9.4.1. Initial Investigation

The sump locations will be determined by surveying prior to drilling. All boreholes will be drilled according to the method in Sec. 11.5.3.2, Vertical Split Barrel Core Samples. Table 18.9-I identifies the samples and analyses for the initial investigations.

SWMU 21-022(h). The sampling for contaminants released to the soil from TA-21-202 will be performed by drilling a borehole approximately 2 ft east of the wall of the sump (Fig. 18.9-1). The borehole will be drilled to a nominal depth of 50 ft, resulting in the collection of 10 samples (5-ft core interval). (Note: the outfall from this sump also will be sampled as part of the outfalls sampling effort, Sec. 15.4.)

SWMUs 21-022(i) and (j) will be sampled by drilling a borehole 20 ft south of the sumps in their respective equipment rooms (Fig. 18.9-1). The boreholes will be drilled to a nominal depth of 50 ft, resulting in the collection of a total of 20 samples (5-ft core interval).

Because the potential exists that deep contamination may be found in the vicinity of the plutonium complex, it is appropriate to allow a contingency for drilling two of the three boreholes planned above deeper than the specified nominal depth. These contingency samples are shown in Table 18.9-I as 20-ft additions to two of the boreholes. In the field, the contingency may be applied as needed to one or several of the holes.

18.9.4.2. Subsequent Investigations

No subsequent investigations are envisioned prior to the D&D of the buildings and waste lines. At that time, the D&D Program will remove all structures, chase all waste and utility lines, and remove associated contamination. The ER Program will integrate SWMU investigations with D&D Program cleanup efforts and will assess the need for additional remediation on the basis of any residual contamination remaining following D&D.

Table 18.9-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-022(H) - (J), SOUTH SIDE OF PLUTONIUM-PROCESSING COMPLEX.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha	Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture		Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium
21-022(h)																				E	E	E	E	E	E	E	E	E			E
Vertical Borehole	1	0.0 - 5.0 ft						X	X	X	C	X	X	C	X	X	C			C	C	C	C	C	C	C	C	C			C
		5.0 - 10.0 ft						X	X	X	C	X	X	C	X	X	C														
		10.0 - 15.0 ft						X	X	X	C	X	X	C	X	X	C														
		15.0 - 20.0 ft						X	X	X	C	X	X	C	X	X	C			C	C	C	C	C	C	X	C	C			C
		20.0 - 25.0 ft						X	X	X	C	X	X	C	X	X	C														
		25.0 - 30.0 ft						X	X	X	C	X	X	C	X	X	C														
		30.0 - 35.0 ft						X	X	X	C	X	X	C	X	X	C														
		35.0 - 40.0 ft						X	X	X	C	X	X	C	X	X	C			C	C	C	C	C	C	X	C	C			C
		40.0 - 45.0 ft						X	X	X	C	X	X	C	X	X	C														
Field Duplicate		45.0 - 50.0 ft						X	X	X	C	X	X	C	X	X	C														
		50.0 - 55.0 ft						C	C	C	C	X	X	C	X	X	C			C	C	C	C	C	C	X	C	C			C
Rinsate Blank																															
Field Blank		55.0 - 60.0 ft						C	C	C	C	X	X	C	X	X	C			C	C	C	C	C	C	X	C	C			C
		60.0 - 65.0 ft						C	C	C	C	X	X	C	X	X	C														
		65.0 - 70.0 ft						C	C	C	C	X	X	C	X	X	C														
Trip Blank																															
21-022(i and j)																				E	E	E	E	E	E	E	E	E			E
Vertical Borehole	1	0.0 - 5.0 ft						X	X	X	C	X	X	C	X	X	C														
		5.0 - 10.0 ft						X	X	X	C	X	X	C	X	X	C														
		10.0 - 15.0 ft						X	X	X	C	X	X	C	X	X	C			E	E	E	E	E	E	E	E	E			E
		15.0 - 20.0 ft						X	X	X	C	X	X	C	X	X	C														
		20.0 - 25.0 ft						X	X	X	C	X	X	C	X	X	C			E	E	E	E	E	E	E	E	E			E

Table 18.9-I

SCREENING AND ANALYSIS FOR INITIAL INVESTIGATIONS AT SWMU 21-022(H) - (J), SOUTH SIDE OF PLUTONIUM-PROCESSING COMPLEX.

				Field Surveys				Field Screening							Field Laboratory Measurements								Laboratory Analysis															
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging		Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Isotopic Thorium		
		25.0 - 30.0 ft						X	X		X	X	X		X	X	X	X																			
		30.0 - 35.0 ft						X	X		X	X	X		X	X	X	X					E	E	E	E		E	E	E	E			E			
		35.0 - 40.0 ft						X	X		X	X	X		X	X	X	X																			
		40.0 - 45.0 ft						X	X		X	X	X		X	X	X	X					E	E	E	E		E	E	E	E			E			
		45.0 - 50.0 ft						X	X		X	X	X		X	X	X	X																			
		50.0 - 55.0 ft						C	C		C	C	C		C	C	C	C					C	C	C	C		C	C	C	C			C			
Rinsate Blank																							X	X	X	X		X	X	X	X			X			
Field Blank																													X	X	X						
		55.0 - 60.0 ft						C	C		C	C	C		C	C	C	C																			
		60.0 - 65.0 ft						C	C		C	C	C		C	C	C	C					C	C	C	C		C	C	C	C			C			
		65.0 - 70.0 ft						C	C		C	C	C		C	C	C	C																			
Trip Blank																													X							
Vertical Borehole	2	0.0 - 5.0 ft						X	X		X	X	X		X	X	X	X					E	E	E	E		E	E	E	E			E			
		5.0 - 10.0 ft						X	X		X	X	X		X	X	X	X																			
		10.0 - 15.0 ft						X	X		X	X	X		X	X	X	X					E	E	E	E		E	E	E	E			E			
		15.0 - 20.0 ft						X	X		X	X	X		X	X	X	X																			
		20.0 - 25.0 ft						X	X		X	X	X		X	X	X	X					E	E	E	E		E	E	E	E			E			
		25.0 - 30.0 ft						X	X		X	X	X		X	X	X	X																			
		30.0 - 35.0 ft						X	X		X	X	X		X	X	X	X					E	E	E	E		E	E	E	E			E			
		35.0 - 40.0 ft						X	X		X	X	X		X	X	X	X																			
		40.0 - 45.0 ft						X	X		X	X	X		X	X	X	X					E	E	E	E		E	E	E	E			E			
		45.0 - 50.0 ft						X	X		X	X	X		X	X	X	X																			
Rinsate Blank																							X	X	X	X		X	X	X	X			X			
Field Blank																													X	X	X						
Trip Blank																													X							

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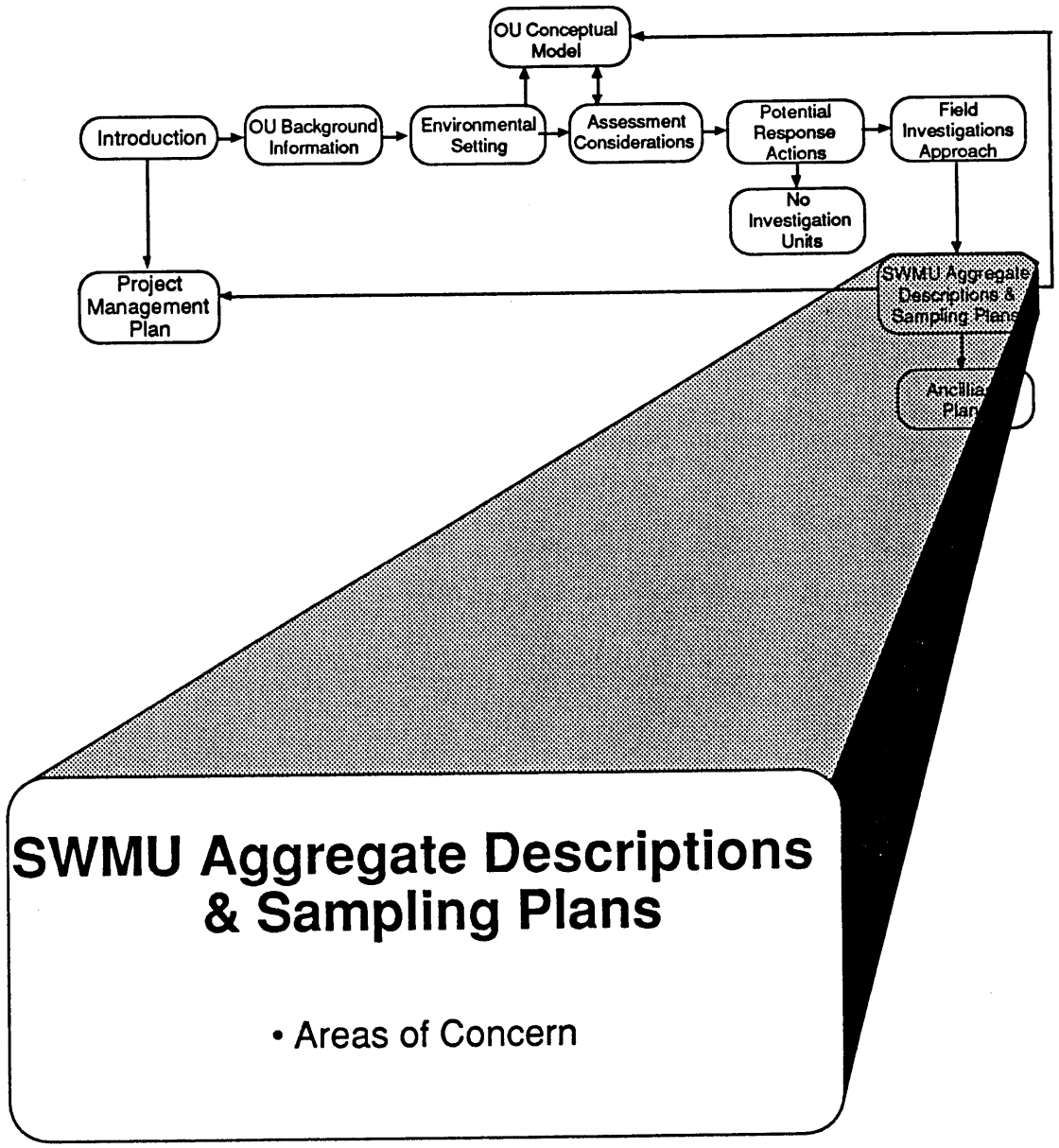
CHAPTER 19


OU Conceptual Model
Introduction
OU Background Information
Environmental Setting
Assessment Considerations
Potential Response Actions
Field Investigations Approach
No Investigation Units
Project Management Plan
SWMU Aggregate Descriptions & Sampling Plans
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SWMU Aggregate Descriptions & Sampling Plans
• Areas of Concern

19. AREAS OF CONCERN DESCRIPTION AND SAMPLING PLAN

The areas of concern consist of 33 sites identified in the SWMU Report (LANL 1990a) and documented as release sites having a C-prefix in the IWP (LANL 1990b), Appendix G. They are listed in Table 19-I and shown in Figs. 19-1 and 19-2. In addition, four areas of concern were added as part of the review of information about Building TA-21-35 (see Sec. 16.4). These areas consist of a miscellany of one-time spills or releases that were identified during the preparation of the SWMU Report. It was determined that these sites do not qualify as SWMUs. Available data on each of the areas of concern are presented in Table 19-I. No additional data are available. In the paragraphs that follow, the various areas of concern are organized into groups with common attributes and are discussed together (see Table 19-II).

19.1 Cleaned Up Sites

The first subdivision includes the sites for which cleanup reports exist. For those sites where records show that no documented releases have occurred, or that releases have occurred but cleanup has been conducted and documented, no further investigation will be pursued. The areas of concern in this category are C-21-002, -003, -004, -008, -010, -011, -014, -026, -028, -029, -030, -031 and -032. No sampling activities will be performed at these sites, and no further action in regard to these sites is warranted.

19.2 Sites Associated with other Structures or SWMUs

The second subdivision includes the sites with no documented cleanup. These sites consist of two types. The first are those that are located within existing structures. These sites require no action at this time; action will be deferred to the time when the buildings in which they are located are decommissioned. At the time of decommissioning, building materials may be sampled, underlying soil may be sampled, and residues will be removed. The sites in this category are C-21-001, -006, and -027.

The second type includes the sites that will be addressed as part of investigations at various SWMUs. Surface and subsurface sampling will be performed in these areas. The areas of concern in this category are: C-21-005; -007; -009; -012, -033, -034 through -037. No specific sampling activities will be performed at these sites under this plan, but these areas will be investigated along with the associated SWMUs (see Table 19-II).

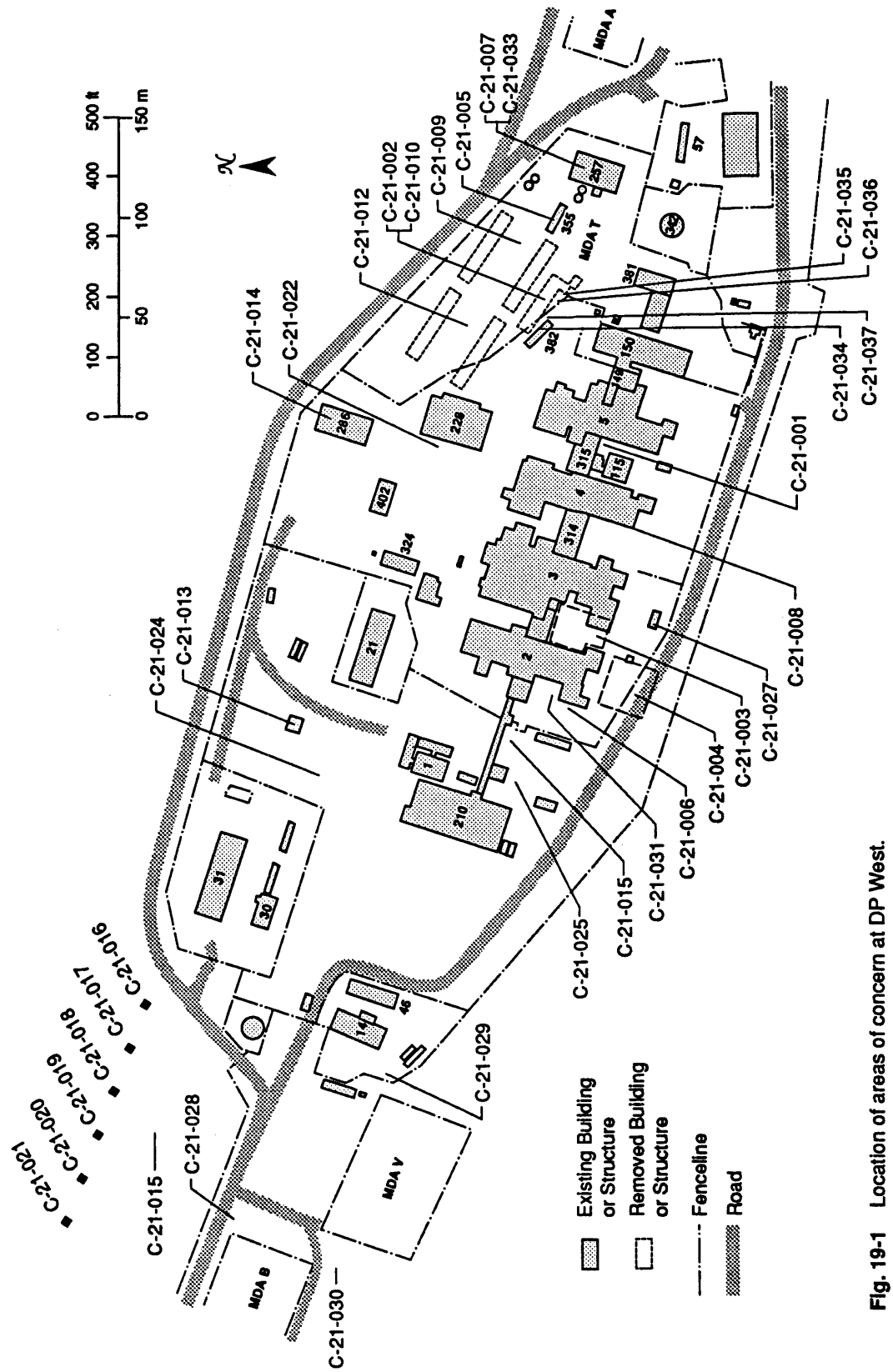

Fig. 19-1 Location of areas of concern at DP West.

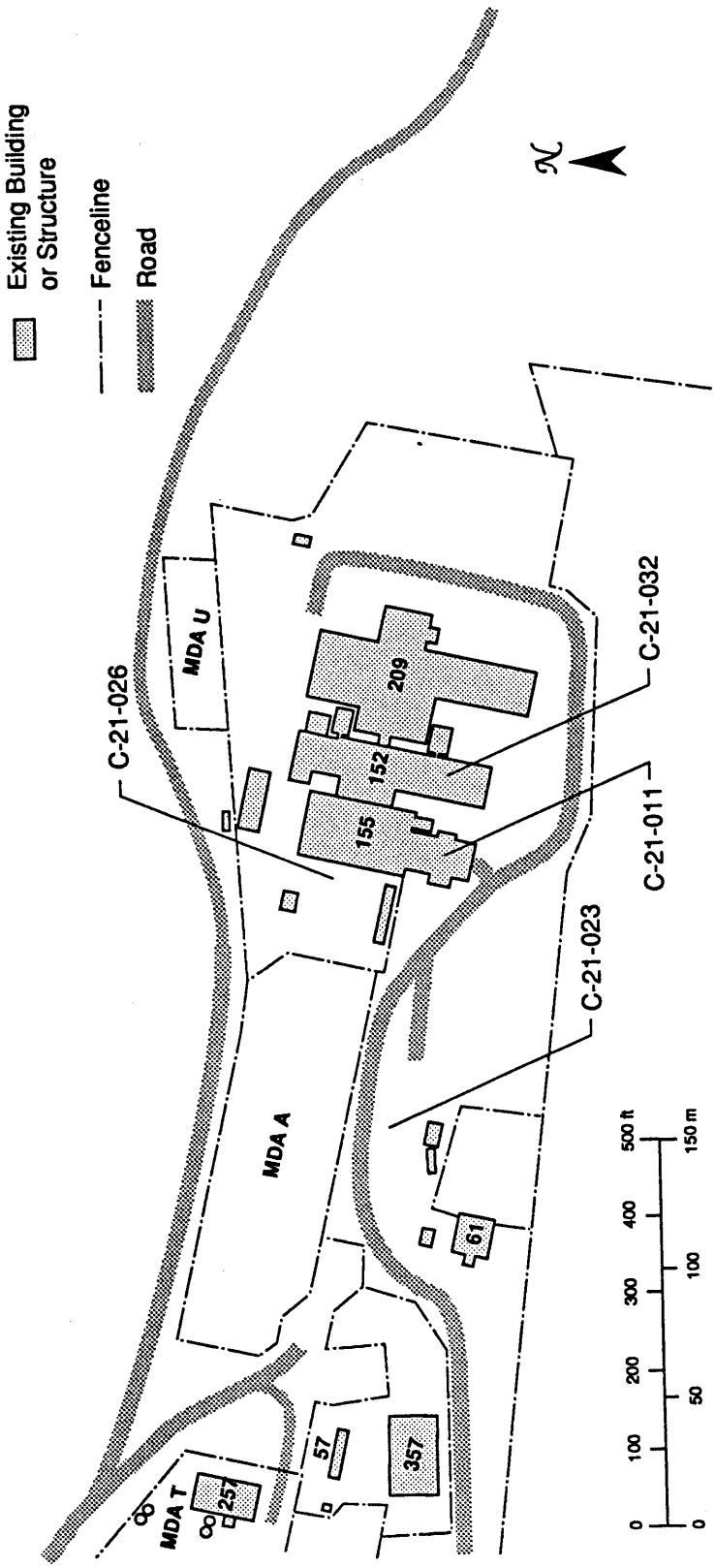

Fig. 19-2 Location of areas of concern at DP East.

TABLE 19-I
AREAS OF CONCERN AT THE TA-21 OPERABLE UNIT[a]

Site No.	Associated Structure	Description[b]
C-21-001	TA-21-17	A hydrogen flouride spill in a corridor of this building; (Task 10, Record 176).
C-21-002	TA-21-35	Leak of radionuclides from a waste storage tank to surrounding soil; soil was removed. (CEARP ID No. TA21-8-CA-I-RW/HW; Task 10, Record 177).
C-21-003	TA-21-2 and -3	Unknown releases to paved area between these two structures; area has been repaired. (CEARP ID No. TA21-8-CA-I-RW/HW; Task 10, Record 178).
C-21-004	TA-21-2	Possible radionuclide and hazardous waste release to asphalt driveways. Soil was removed and area was repaved. (CEARP ID No. TA21-8-CA-I-RW/HW; Task 10, Record 179).
C-21-005	TA-21-257	Release of ^{241}Am and plutonium on west side of building; soil was decontaminated. (RFA Unit 21.018, Task 10, Record 180). Addressed as part of 21-011.
C-21-006	TA-21-2	Release of ^{241}Am from a leaking transport trailer. The contaminated area was covered with asphalt. (CEARP ID No. TA21-8-CA-I-RW/HW; Task 10, Record 182).
C-21-007	TA-21-257	Release of plutonium, americium, and uranium from a tank vent. (CEARP ID No. TA21-8-CA-I-RW/HW; Task 10, Record 183). Addressed as part of 21-011.
C-21-008	TA-21-4	Release of radioactive material from a process exhaust line; soil was excavated. (Task 10, Record 184).
C-21-009	MDA T Shafts	Spill of ^{241}Am in a cement paste. Paste was removed, and the area was decontaminated. (Task 10, Record 185). Addressed as part of 21-016.
C-21-010	TA-21-35	Leak of ^{241}Am and plutonium from drums; area was decontaminated. (CEARP ID No. TA21-8-CA-I-RW/HW; Task 10, Record 186).
C-21-011	TA-21-155	In 1963, a plugged scrubber on the roof of Building 155 backed up, and spilled material containing Uranium-235; area was cleaned. (Task 10, Record 187).
C-21-012	MDA T	Spill of ^{241}Am and plutonium in a cement paste. (Task 10, Record 188). Addressed as part of 21-016.

TABLE 19-I (continued)

Site No.	Associated Structure	Description[b]
C-21-013	TA-21-331	A waste storage pit next to Building TA-21-212. It is possible that the pit was never built and therefore, the CEARP field team was unable to locate this pit. (CEARP ID No. TA21-2-SI-I-RW/HW).
C-21-014	TA-21-286	A currently operational equipment warehouse used by HSE-1, -6, -7. (Task 10, Record 154).
C-21-015	TA-21-45	A safety training building; building and soil were removed down to tuff. (Task 10, Record 157).
C-21-016	TA-21-23	A storage hutment removed in 1954. (Task 10, Record 158).
C-21-017	TA-21-24	A storage hutment removed in 1954. (Task 10, Record 159).
C-21-018	TA-21-25	A storage hutment removed in 1954. (Task 10, Record 160).
C-21-019	TA-21-26	A storage hutment removed in 1954. (Task 10, Record 161).
C-21-020	TA-21-27	A storage hutment removed in 1954. (Task 10, Record 162).
C-21-021	TA-21-28	A storage hutment removed in 1954. (Task 10, Record 163).
C-21-022	TA-21-34	A laboratory that was demolished and disposed of in TA-54, Area G. (Task 10, Record 164).
C-21-023	TA-21-54	Former location of a laboratory building and associated soil. Structure was demolished and disposed of in TA-54, Area G. (Task 10, Record 165).
C-21-024	TA-21-22	Former location of a warehouse and associated soil. Structure was demolished and disposed of in TA-54, Area G, Pit No. 4. (CEARP ID No. TA21-1-CA-I/A-RW/HW, Task 10, Record 166).
C-21-025	TA-21-19	Former location of a corridor contaminated with radionuclides; structure demolished in 1965. (Task 10, Record 167).
C-21-026	TA-21-151	Former location of an administrative building with shops; removed in 1966. (Task 10, Record 169).

TABLE 19-I (continued)

Site No.	Associated Structure	Description[b]
C-21-027	TA-21-143	A grilled water recirculator that is still active. (Task 10, Record 172).
C-21-028	TA-21-47	A 12,788 gal. aboveground fuel tank that was removed. (CEARP ID No. TA21-10-UST-A/I-RW/HW/PP, Task 9, Record 113).
C-21-029	TA-21-60	An aboveground 3,000 gal. steel oil tank that was removed. (CEARP ID No. TA21-10-UST-A/I-RW/HW/PP, Task 9, Record 119).
C-21-030	TA-21-64	A 320 gal. propane tank that was removed. (CEARP ID No. TA21-10-UST-A/I-RW/HW/PP, Task 9, Record 120).
C-21-031	TA-21-325	A 5,200 gal. stainless steel tank. This tank is described as half-buried. (CEARP ID No. TA21-10-UST-A/I-RW/HW/PP, Task 9, Record 115).
C-21-032	TA-21-152 Basement	A standby diesel generator served by a 300-gal. day tank and a 1000-gal. underground tank. (CEARP ID No. TA21-10-UST-A/I-RW/HW/PP).
C-21-033	TA-21-257	1976 TRU cement paste spill. (Task 10, Record 181). Addressed as part of 21-011.
C-21-034	TA-21-91	Former location of 1,000 gal. raffinate holding tank at southwest corner of TA-21-35. Addressed as part of 21-010.
C-21-035	TA-21-110	Former location of aboveground acid holding tank on south side of TA-21-35 before it was relocated to TA-21-257 where it is listed as SWMU 21-011(d). Addressed as part of 21-010.
C-21-036	TA-21-111	Former location of aboveground acid holding tank adjacent to TA-21-110 on south side of TA-21-35, before it was relocated to TA-21-257 where it is listed as SWMU 21-011(e). Addressed as part of 21-010.
C-21-037	TA-21-256	Former location of a 2,000 gal. aboveground acid tank at the southwest corner of Building TA-21-35, before it was relocated to TA-21-257 where it is listed as SWMU 21-011(h). Addressed as part of 21-010.

[a]LANL 1990 (Appendix C).
[b]Data source in parentheses is TA-21 Release Site Data Base [EES-15 (1989)].

TABLE 19-II
TA-21 AREA OF CONCERN AGGREGATIONS

Area of Concern Aggregation	Site Numbers Included	Document Section
Sites where records show either no documented release or cleanup to have occurred at time of release	C-21-002, 003, 004, 008, 010, 011, 015-026, 028, 029, 030, 031	Chapter 20
Sites for coordination with Building D&D	C-21-001, 006, ~~014~~, 027	Section 18.7
Sites being addressed as part of SWMUs	C-21-005, 007, 033	Addressed with SWMU 21-011 in Section 16.5
	C-21-009, 012	Addressed with SWMU 21-016 in Section 16.3
	C-21-034 to C-21-037	Addressed with SWMU 21-010 in Section 16.4
Site not constructed	C-21-013	Chapter 20

19.3 Area of Concern C-21-013, Possible Waste Storage Pit

The third subdivision includes a possible waste storage pit, TA-21-331, adjacent to Building TA-21-212. This area of concern is numbered C-21-013. This unit was intended to be a plywood test pit with an earthen floor and covered access, but engineering records indicate that construction of this pit was cancelled, and it is probable that this pit was never built. Subsequent reconnaissance investigations have failed to locate this pit. Therefore, this unit does not merit further investigation.

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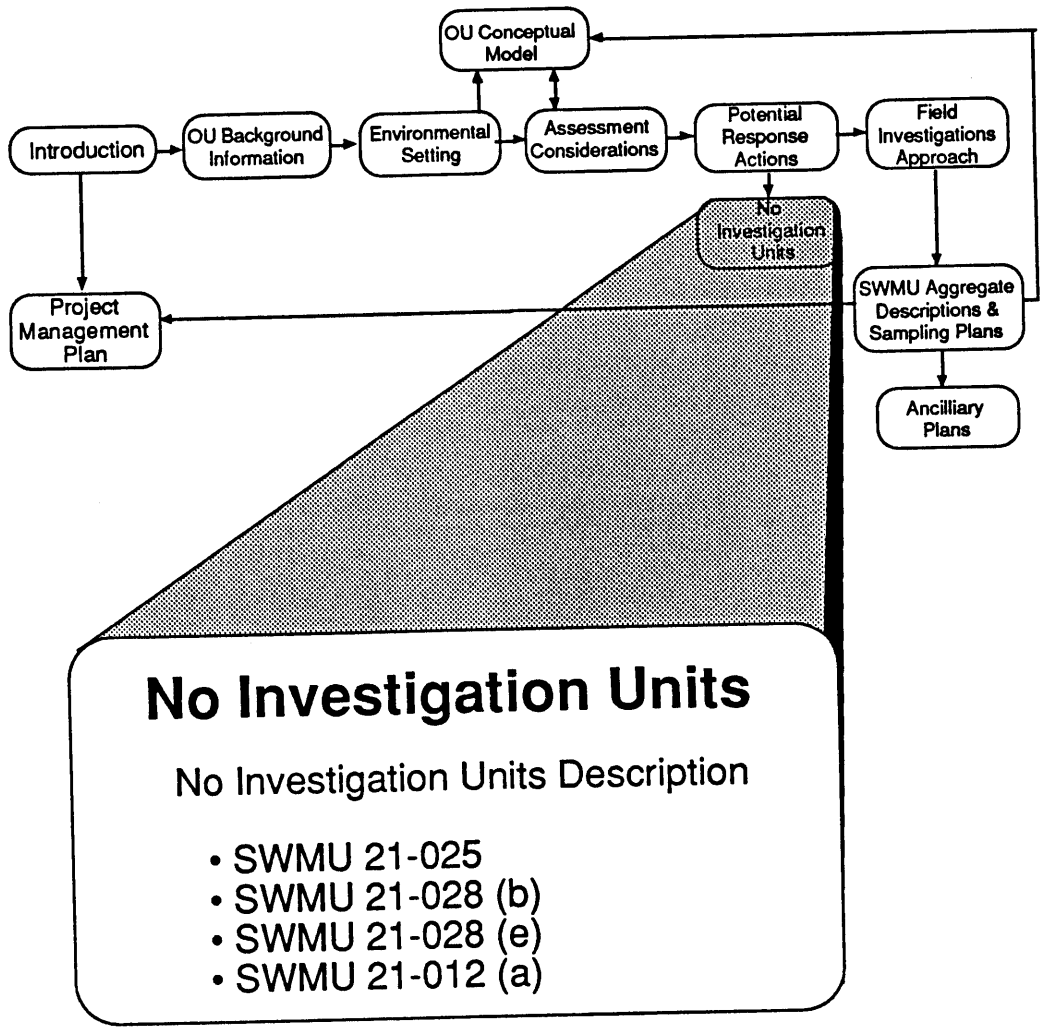
CHAPTER 20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Potential Response Actions
Field Investigations Approach
No Investigation Units
Project Management Plan
SWMU Aggregate Descriptions & Sampling Plans
Ancilliary Plans
No Investigation Units
No Investigation Units Description
• SWMU 21-025
• SWMU 21-028 (b)
• SWMU 21-028 (e)
• SWMU 21-012 (a)

20 NO-INVESTIGATION UNITS

20.1. SWMU 21-025 — Off-Gas System

20.1.1. Site Description

This section addresses two off-gas systems that have been identified as SWMU 21-025(a) and 025(b) at TA-21. These SWMUs are active systems that are monitored under routine operations at the Tritium Systems Test Assembly (TSTA) facility.

20.1.1.1. Existing Information

The first off-gas system is located in Building TA-21-155 (SWMU 21-025a), the TSTA facility, and the second is located in Building TA-21-209 (SWMU 21-025b), the high-temperature chemistry research facility. Building TA-21-155 was completed in 1982, and the first tritium operations began in 1984. Building TA-21-209 was built in 1965. The off-gas systems in both buildings are connected to exhaust stacks that are used to vent gas containing small amounts of tritiated water after treatment. The exhaust stack releases are identified as SWMU 21-019 and are discussed in Chapter 13.

The following is a description of the basic operating principle of the two off-gas systems (LANL 1990). They are designed to remove tritium from gaseous effluents prior to release to the environment. A tritium treatment train is in operation in both the TSTA facility (TA-21-155) and the high-temperature chemistry research facility (TA-21-209). On each train, gases that may contain tritium are stored in a tank until a given pressure is exceeded. When the pressure is exceeded, the gases are released from the tank and are passed through a catalyst bed operated at high temperatures in order to oxidize the tritium to tritiated water. The tritiated water is then collected in a series of molecular sieves. When a sieve is near breakthrough it is removed and hot nitrogen gas is used to strip the tritiated water from the sieve. The now- concentrated, tritiated water vapor is collected on a second series of molecular sieves. Just before breakthrough occurs in the second series of sieves, the sieves are removed and placed in asphalt-lined, 55-gal. drums for collection and disposal. After the off-gas streams are sufficiently detritiated, as determined by radiation monitoring, they are released to the exhaust stacks (see Chapter 13, SWMU 21-019). The entire off-gas treatment trains, including the tanks, are located entirely within the confines of Buildings TA-21-155 and TA-21-209.

20.1.1.2. Source Term

No known releases or contamination to the inside of the buildings that could have reached the environment as a result of the off-gas treatment trains have been documented.

20.1.2. Basis for Recommendation of No Further Action

It has been concluded that the two off-gas systems pose no threat to the environment and should not be investigated under field activities. It appears that the two off-gas systems have been incorrectly identified and should no longer be considered SWMUs. It has been recommended that no further action be taken in the investigation of the off-gas systems based on the following:

1. The two off-gas systems are considered to be separate from the building exhaust stacks. Any environmental contamination resulting from stack releases is not considered to be associated with the off-gas systems, but is associated with the stacks, and thus will be investigated under the TA-21 site-wide sampling plan (Chapter 12) and in relation to stack emissions, SWMU 21-019 (Chapter 13).

2. The two off-gas treatment trains, including the storage tanks, are located entirely within the confines of Buildings TA-21-155 and TA-21-209.

3. The two off-gas systems are currently in operation and are covered under routine Laboratory operations.

4. No environmental releases from inside of buildings to the environment have been documented from either TA-21-155 or TA-21-209.

20.2 SWMU 21-028(b) — Active Container Storage Areas

TA-21 contains five active container storage areas listed under SWMU 21-028(a)–(e) shown in Fig. 20.2-1. SWMU 21-028(a) is covered in Sec. 16.3 because it is located within MDA T. SWMU 21-028(c) is covered in Sec. 18.4 because it is an active container storage area located in a part of TA-21 that is scheduled for D&D. SWMU 21-028(d) and a portion of SWMU 21-028(e) are addressed in Chapter 14, Surface Units, because they are associated with buildings not currently planned for D&D. This section discusses SWMU 21-028(b), and the next section discusses the interior portions of SWMU 21-028(e). These are recommended for no further action.

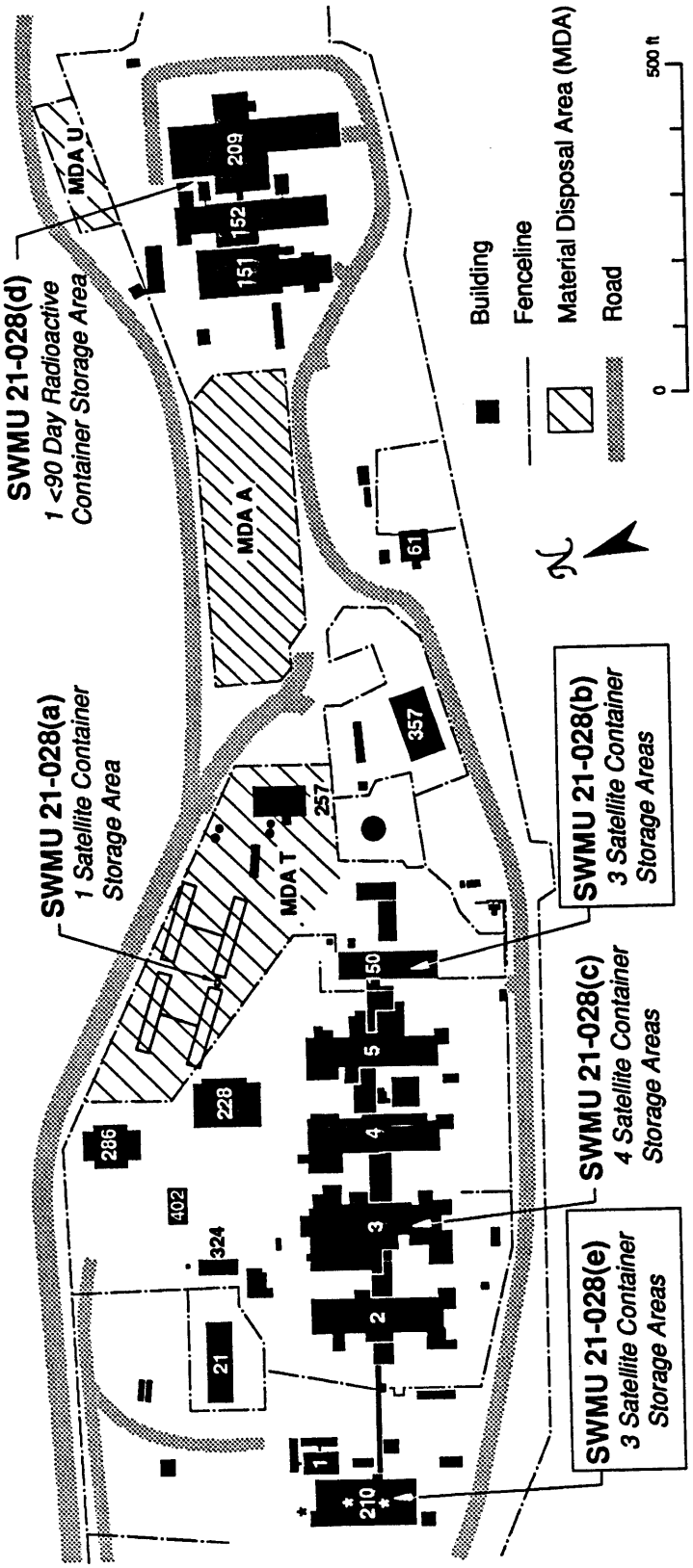


Fig. 20.2-1 Locations of the active container storage areas at TA-21 [SWMUs 21-018(a)–(e)].

20.2.1 Site Description

SWMU 21-028(b) consists of three satellite container storage areas located inside of Building TA-21-150 (Fig. 20.2-2). Generators at satellite storage sites may accumulate a total of 55 gal. of hazardous or mixed waste or up to one quart of acutely hazardous waste

20.2.1.1 Site History

The three satellite container storage areas are located under hoods within Rooms 603, 605, and 607. It is assumed that chemical waste storage at Building TA-21-150 began in 1963 when the building went into operation (Nyhan 1990).

20.2.1.2 Existing Information

No information regarding sampling and analysis in or around SWMU 21-028(b) is available.

20.2.1.3 Source Term

The types of materials that are stored under the hood in the chemistry research lab, Room 603, include

- halogenated organic chemicals—chloroform, methylene chloride, carbon tetrachloride, and alkyl halides; and
- nonhalogenated organic chemicals—acetone, toluene, tetrahydrofuran, benzene, ethanol, methanol, butanol, diethyl ether, and isopropanol.

These chemicals may be contaminated with thorium, depleted uranium, technetium, and other metals (LANL no date) .

The types of materials being stored in Room 605, the general chemistry lab, are

- liquids—acetone, dichloromethane, ether, tetrahydrofuran, hexane ethyl acetate, xylene, phenol, acetonitrile, n-butyl alcohol, benzyl alcohol, formalin, chloroform, methanol, ethanol, benzene, isopropanol, toluene, acetic anhydride, acetaldehyde, o-toluidine, pyridine, dioxane, propyl ether, t-butyl alcohol, dimethylformamide, and dimethylsulfoxide; and
- solid wastes—pipets, kimwipes, and gloves contaminated with the above-listed chemicals.

  The ethers (propyl ether, ethyl ether, and tetrahydrofuran) are stored separately in a chemical safety cabinet.

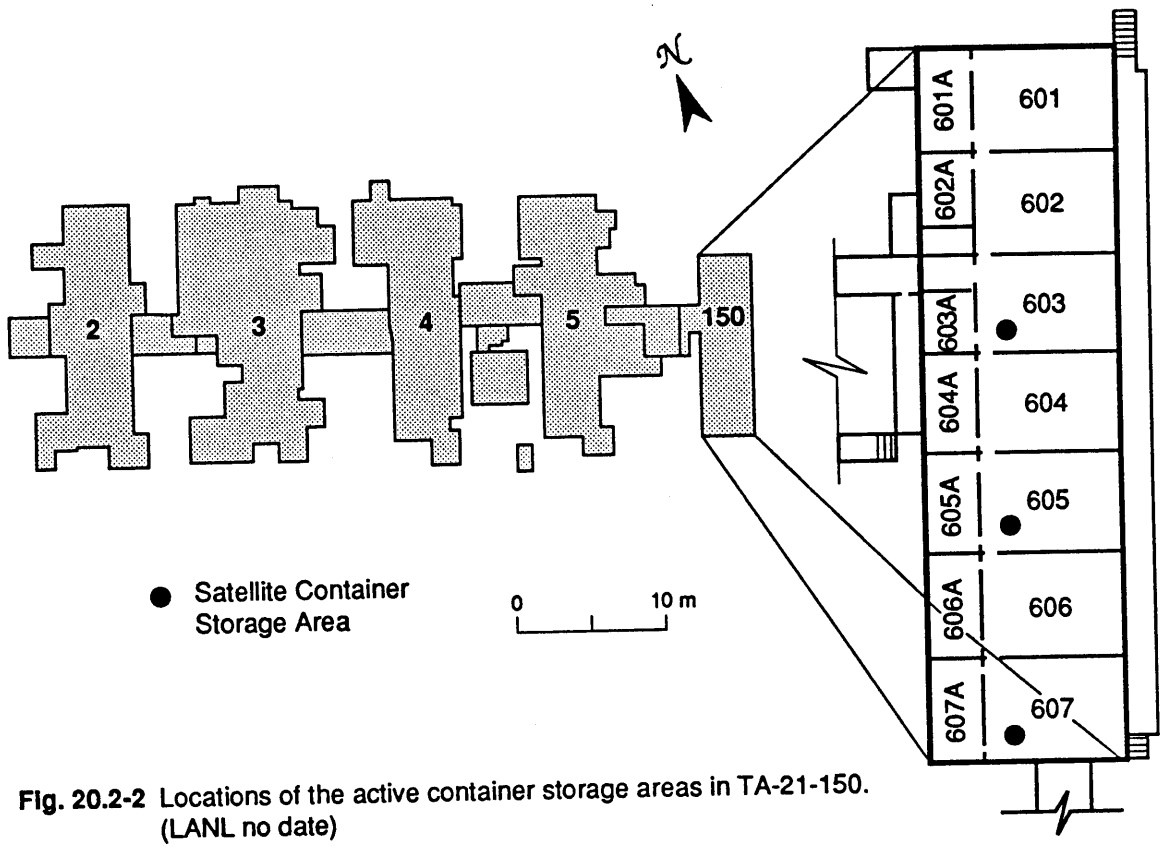


Fig. 20.2-2 Locations of the active container storage areas in TA-21-150. (LANL no date)

Mercury is also being temporarily stored under a hood in the room (LANL no date).

The types of materials being stored in Room 607, glassware cleaning room, are

- liquids — acetone, ethyl acetate, methanol, benzene, hexane, and n-butyl alcohol; and
- solid wastes — kimwipes, gloves, and pipets are contaminated with the above-listed chemicals.

Acetone and methanol are the primary reagents used (LANL no date).

20.2.2 Basis for Recommendation of No Further Action

It is recommended that no further action be taken in the investigation of the three satellite container storage areas located inside Building TA-21-150, based on the following:

1. These storage areas exhibit no evidence of routine releases.
2. No environmental releases from inside Building TA-21-150 to the environment have been documented.

20.3 SWMU 21-028(e) — Active Container Storage Areas

20.3.1 Site Description

This section addresses those parts of SWMU 21-028(e) inside Building 210. A portion of SWMU 21-028(e) is outside of the building, the north loading dock, and is covered in Sec. 14.4.

20.3.1.1 Site History

SWMU 21-028(e) consists of three satellite container storage areas located at TA-21-210. The areas are inside Room 128, inside the south lab in Room 120, and outside on the north loading dock. Only the areas inside Rooms 120 and 128 are considered here (see Fig. 20.2-1).

20.3.1.2 Existing Information

TA-21-210, Room 128, has been used periodically to store alcohol and solvents. Room 120 in Building 210 has been used to store waste oil from machines and wipes that have been used to absorb freon (LANL no date).

No information regarding sampling and analysis in or around SWMU 21-028(e), Rooms 120 and 128, is available.

20.3.2 Basis for Recommendation of No Further Action

It is recommended that no further action be taken in the investigation of the satellite storage areas located inside Building TA-21-210, Rooms 120 and 128, based on the following:

1. These storage areas exhibit no evidence of routine releases.
2. No environmental releases from inside Building TA-21-210 to the environment have been documented.

20.4 SWMU 21-012(a) — Dry Well Inside Steam Plant

20.4.1 Site Description

The SWMU Report (LANL 1990) states that "there is a dry well inside the steam plant (TA-21-357) that receives liquids from the steam plant."

20.4.1.1 Site History

The former steam plant (TA-21-9) was constructed in 1945 and was removed in 1985. A dry well associated with this steam plant is identified as SWMU 21-012(b) and is addressed in Sec. 17.4. The new steam plant, TA-21-357, was put on line in 1985.

20.4.1.2 Existing Information

Two site visits on May 11, 1990, and August 8, 1990 (Roy F. Weston 1990a, 1990b), verified that there is not a dry well associated with the new steam plant.

20.4.2 Basis for Recommendation of No Further Action

It is recommended that no further action be taken in the investigation of a dry well at the new steam plant because no dry well exists.

References

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

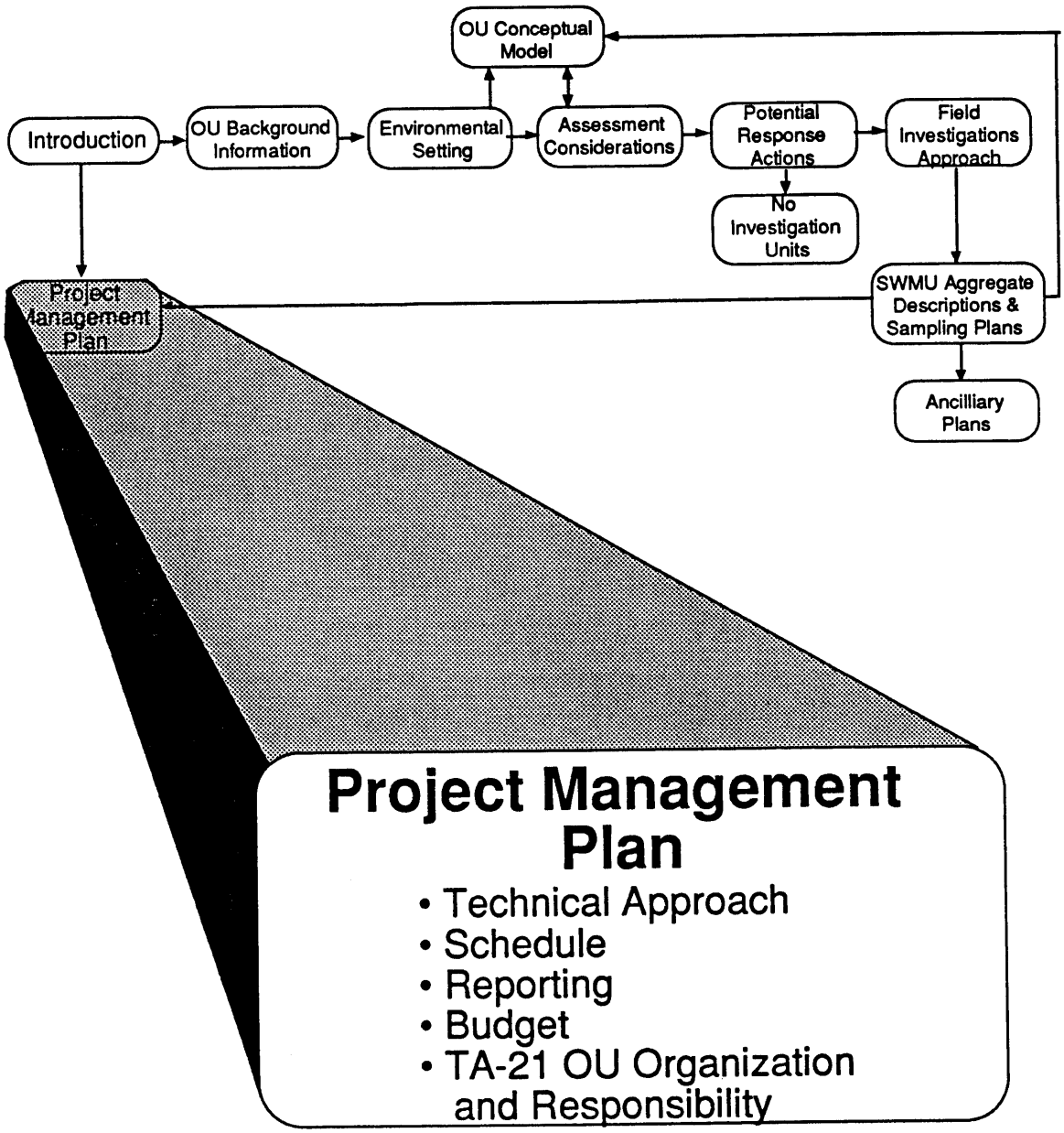
LANL (Los Alamos National Laboratory), no date. "LANL Container Storage Area Database," TA-59, Building OH-3, Room 119, Tony Grieggs, Los Alamos, New Mexico.

Nyhan, J. W., September 28, 1990. "RCRA Facility Investigation Task, SWMU Descriptions and Identifications of Data Needs: TA-21 Surface Units Aggregate at Los Alamos NM," Los Alamos National Laboratory, Los Alamos, New Mexico.

Roy F. Weston, Inc., May 1990. Site reconnaissance visit to TA-21, May 11, 1990, site recon-naissance performed in support of the Environmental Restoration Program, US Department of Energy, Albuquerque Operations Office, Albuquerque, New Mexico.

Roy F. Weston, Inc., May 1990. Site reconnaissance visit to TA-21, August 8, 1990, Roy F. Weston, Inc., site reconnaissance performed in support of the Environmental Restoration Program, US Department of Energy, Albuquerque Operations Office, Albuquerque, New Mexico.

CHAPTER 21


OU Conceptual Model
Introduction
OU Background Information
Environmental Setting
Assessment Considerations
Potential Response Actions
Field Investigations Approach
No Investigation Units
SWMU Aggregate Descriptions & Sampling Plans
Ancilliary Plans
Project Management Plan
Project Management Plan
• Technical Approach
• Schedule
• Reporting
• Budget
• TA-21 OU Organization and Responsibility

21. PROJECT MANAGEMENT PLAN

This chapter presents the technical approach, management structure, schedule, budget, and reporting milestones for implementation of the TA-21 OU RFI as set forth in this work plan. The project management plan for the TA-21 OU RFI is an extension of the ER Program project management plan given in Annex I of the IWP (ER 1990). This chapter addresses the project management plan requirements of the HSWA Module (Task II, E., p. 39) of the Laboratory's RCRA Part B Permit (EPA 1990).

21.1 Technical Approach

The technical approach employed for investigation of the TA-21 OU RFI is described in Sec. 2.3.1, Technical Approach. The approach used for TA-21 is based on the ER Program's overall technical approach to the RFI/CMS process as described in Chapter 3 of the IWP (LANL 1990). The following key features characterize the ER Program approach:

- use of action levels as criteria to trigger a corrective measures study (CMS);
- sampling approach to site characterization;
- decision analysis and cost effectiveness 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 general philosophy is to develop and iteratively refine the TA-21 OU conceptual model through carefully planned stages of investigation and data interpretation. An objective is to support interim corrective measures or a corrective measures study using the minimum data necessary.

The technical objectives of the TA-21 OU RFI are presented in Sec. 2.3.2, TA-21 Objectives and Approach. As detailed throughout this work plan, the objectives are

- Identify contaminants present at each SWMU
- Determine the vertical and lateral extent of the contamination at each SWMU
- Identify contaminant migration pathways
- Acquire sufficient information to allow quantitative migration pathway and risk assessment, as necessary

- Provide necessary data for the assessment of potential remedial alternatives
- Provide the basis for planning detailed corrective measures studies

21.1.1 Technical Implementation Rationale

The scheduling of the investigations at the TA-21 OU is based on the following rationale and priorities, as illustrated in Fig. 21.1-1.

Initial efforts are focused on obtaining OU-wide environmental data that form the basis for understanding contaminant transport processes. These investigations, described in Chapter 12, include

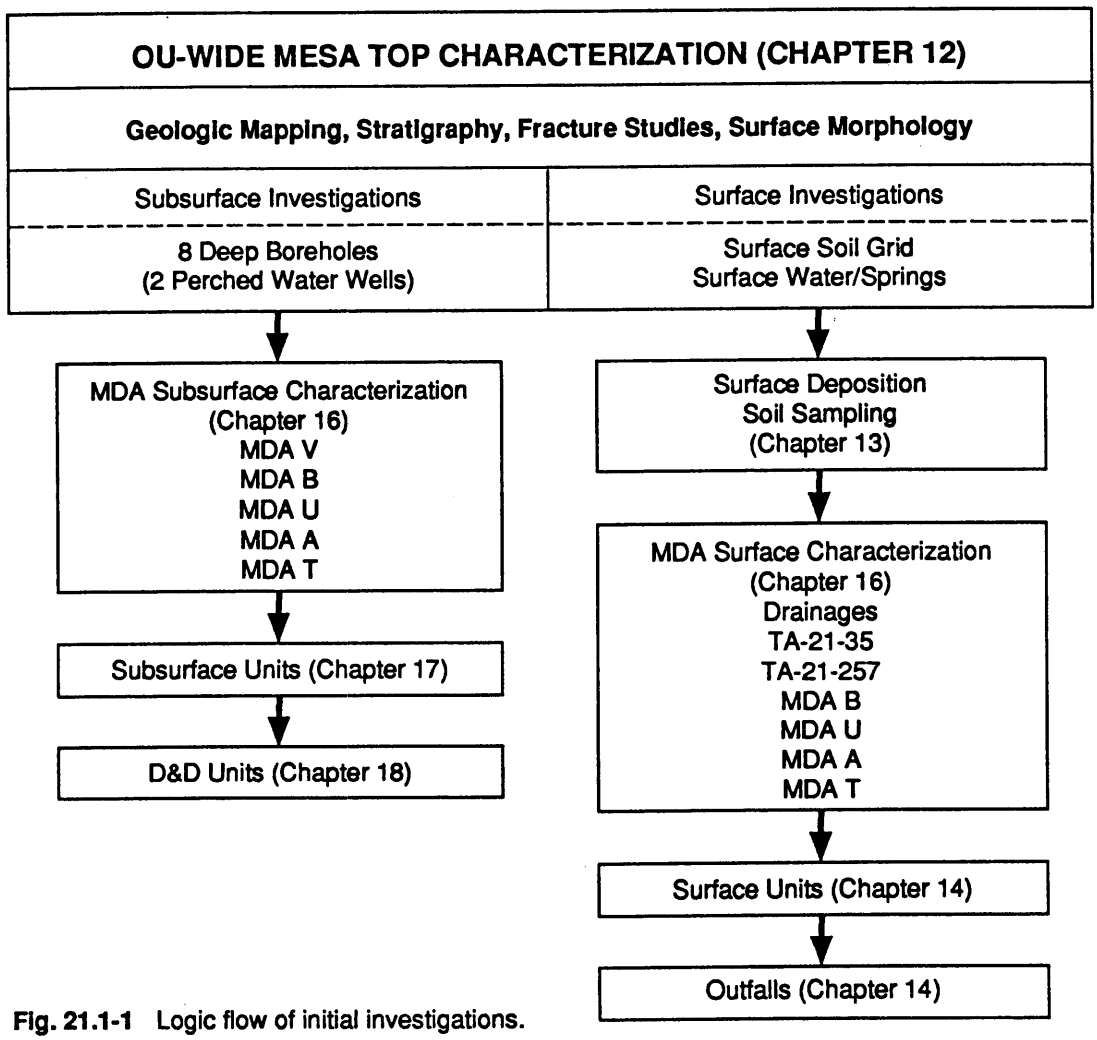


Fig. 21.1-1 Logic flow of initial investigations.

- development of a geologic base map, measuring stratigraphic sections, geomorphic characterization, and joint and fracture mapping;
- characterization of the hydrogeology of the vadose zone beneath the OU, focusing on parameters of importance in assessing the potential for subsurface migration; and
- measurement of contaminant levels in surface soils across the entire OU, as a basis for determining if low levels of contaminants detected at individual SWMUs are indicative of releases from individual SWMUs or only represent the presence of the OU-wide contamination.

Two relatively independent investigation paths are a part of the schedule logic and the investigation rationale. As shown in Fig. 21.1-1, subsurface investigations form one line of investigation, while surface investigations form another.

Surface investigations. The surface investigation path begins with the OU-wide surface soil characterization. The SWMU-specific surface investigations begin with investigation of contaminant deposition from stack releases and other airborne release SWMUs, as described in Chapter 13. This investigation is done at the same locations as the OU-wide surface investigation (Chapter 12) and at the same time. The difference between the two is the sample interval. The OU-wide characterization uses a 0- to 6-in. soil sample interval to provide data comparable to the soil sample data to be acquired at individual SWMUs. The contaminant deposition investigation focuses on a "deposition layer" (0- to 1-in.) sample to evaluate surficial deposits.

The surface investigation path continues with investigations of drainages in proximity to the five MDAs, and surface sampling in the immediate vicinity of the MDAs (Chapter 16). Subsequently, the investigations target SWMUs that have primarily surface or near-surface contamination (Chapters 14 and 15).

Subsurface investigations. The subsurface investigation path begins with the OU-wide investigation, which includes eight deep boreholes for characterizing the hydrogeology and the variability of the hydrogeology throughout the TA-21 OU (Chapter 12). Three of the holes are in close proximity to liquid waste MDAs. Two of the holes are targeted for identifying the presence of perched water beneath Los Alamos and DP Canyons.

The subsurface investigations continue at the MDAs. The rationale for the MDA investigations differs for liquid waste and solid waste MDAs. At the liquid MDAs, source term characterization and defining the depth of contaminant migration are priorities. The sequence of the investigations at MDAs V, U, and then T allows for knowledge gained at MDAs V and U to be applied to the investigation at MDA T, which is likely to have the largest source term and greatest extent of

contaminant migration.

At the solid waste MDAs (A and B), the focus is on confirming the absence of contaminant migration from the disposal pits. Only if evidence of migration is identified will consideration be deemed necessary for conducting source term characterization and more detailed investigations at those two MDAs.

The subsurface investigation path continues with SWMUs that have primarily subsurface releases, described in Chapters 17 and 18. Most of these units are related to the liquid waste handling system at TA-21. The investigation of these SWMUs occurs between the initial and subsequent investigations at the MDAs.

Priorities. The management priorities that generated the above described sequence of investigations have the following three primary aspects:

- Basic information and data obtained from the OU-wide characterization are needed as a basis for comparison and must be available before evaluations can be made of the SWMU-specific data.
- Investigations at the MDAs are the most likely to require extensive subsequent investigations and should be scheduled early to allow time for additional work.
- Existing assessments of exposure risks (Sec. 6.6, Current Risk Estimates) do not identify significant risks from surface contamination present at the OU. Thus characterization of surface contamination SWMUs can be secondary to the other priorities.

21.2 Schedule

The schedule for the entire RFI/CMS process at TA-21 was set in the IWP's Program Management Plan (Annex I, Table I-3) and detailed in the IWP's Appendix S, through the completion of the final CMS report. That schedule is provided here in Table 21.2-I.

A detailed schedule for the implementation of the TA-21 OU RFI is presented in Fig. 21.2-1. The schedule is organized by section of each sampling plan chapter (Chapters 12–18) and explicitly shows subsequent investigations where they are expected to be needed.

Implementation of RFI activities is contingent upon regulatory review and approval of this TA-21 OU Work Plan and upon available funding. The assumptions used to generate this schedule include the following:

TABLE 21.2-I

PROJECTED SCHEDULE FOR CORRECTIVE ACTION PROCESS[a]

Activity	Date
Start OU-1106 Draft RFI Work Plan	2 Oct 89
Finish OU-1106 Draft RFI Work Plan	22 May 91
Finish OU-1106 Final RFI Work Plan	16 Aug 91
Start OU-1106 RFI	29 Oct 91
Start OU-1106 Draft RFI Report	29 Jun 95
Finish OU-1106 RFI	11 Dec 96
Finish OU-1106 Draft RFI Report	11 Dec 96
Finish OU-1106 Final RFI Report	28 May 97
Start OU-1106 Draft CMS Plan	28 May 97
Finish OU-1106 Draft CMS Plan	21 Aug 97
Start OU-1106 CMS	21 Aug 97
Start OU-1106 Draft CMS Report	13 Jan 98
Finish OU-1106 Final CMS Plan	10 Feb 98
Finish OU-1106 CMS	12 Feb 99
Finish OU-1106 Draft CMS Report	12 Feb 99
Finish OU-1106 Final CMS Report	21 Jul 99

[a]IWP APPENDIX S, (EPA 1990).

FIGURE 21.2-1. TA-21 OU RFI SCHEDULE

Chapter and Section	Start Date	Duratn (Days)	End Date
12 INITIAL INVESTIGATION	15/Oct/91	467	20/Aug/93
12.3 GEOMORPHOLOGY	15/Oct/91	158	29/May/92
12.4 SURFACE SOIL CHARACT.	16/Dec/91	168	12/Aug/92
12.4 ROUND 2 SURFACE SOIL CHAR	15/Mar/93	113	20/Aug/93
12.5 VADOSE ZONE CHARACT.	25/Mar/92	258	2/Apr/93
12.6 YEAR 1: SPRING SAMPLING	15/Oct/91	287	3/Dec/92
12 SUBSEQUENT INVESTIGATIONS	20/Nov/92	997	8/Nov/96
12.5 VADOSE ZONE CHARACT.	20/Jul/94	186	17/Apr/95
12.6 YEAR 2: WATER SAMPLING	20/Nov/92	997	8/Nov/96
12.6 YEAR 3-5: WATER SAMPLING	29/Nov/93	742	8/Nov/96
13 INITIAL INVESTIGATION	12/Mar/92	387	22/Sep/93
13.2 AIRBORNE EMISSIONS	12/Mar/92	147	7/Oct/92
13.2 ROUND 2 AIRBORNE EMISSION	15/Jan/93	174	22/Sep/93
13 SUBSEQUENT INVESTIGATIONS	10/Jan/94	141	29/Jul/94
13.2 AIRBORNE EMISSIONS	10/Jan/94	141	29/Jul/94
14 INITIAL INVESTIGATION	10/Mar/94	106	8/Aug/94
14.2 PCB CTR STORAGE	24/Mar/94	59	15/Jun/94
14.3 ABOVE GROUND TANKS	31/Mar/94	61	24/Jun/94
14.4 ACTIVE CTR STORAGE	5/Apr/94	47	9/Jun/94
14.5 DP TANK FARM	5/Apr/94	68	11/Jul/94
14.6 INACTIVE CTR STORAGE	11/Apr/94	46	14/Jun/94
14.7 SURFACE DISP AREAS	10/Mar/94	106	8/Aug/94
14.8 SEWAGE TREATMENT PLANT	22/Apr/94	71	2/Aug/94
14 SUBSEQUENT INVESTIGATIONS	8/May/95	108	10/Oct/95
14.2 PCB CTR STORAGE	8/May/95	107	6/Oct/95
14.6 INACTIVE CTR STORAGE	13/Jul/95	56	29/Sep/95
14.7 SURFACE DISPOSAL AREAS	17/Jul/95	60	10/Oct/95
15 INITIAL INVESTIGATION	20/Apr/94	126	18/Oct/94
15.2 UNKNOWN LOCATIONS	20/Apr/94	85	18/Aug/94
15.3 SEPTIC SYSTEM	29/Apr/94	77	17/Aug/94
15.4 DIRECT DISCHARGE	11/May/94	56	29/Jul/94
15.5 DRNG S TA-21-3	17/May/94	61	11/Aug/94
15.6 SEPTIC TANKS	16/May/94	64	15/Aug/94
15.7 S T[illegible] 21-155	23/May/94	45	26/Jul/94
15.8 [illegible] 21-155	23/May/94	69	29/Aug/94
15.9 SPECIAL CASES	25/May/94	65	25/Aug/94
15.10 NPDES	31/May/94	98	18/Oct/94

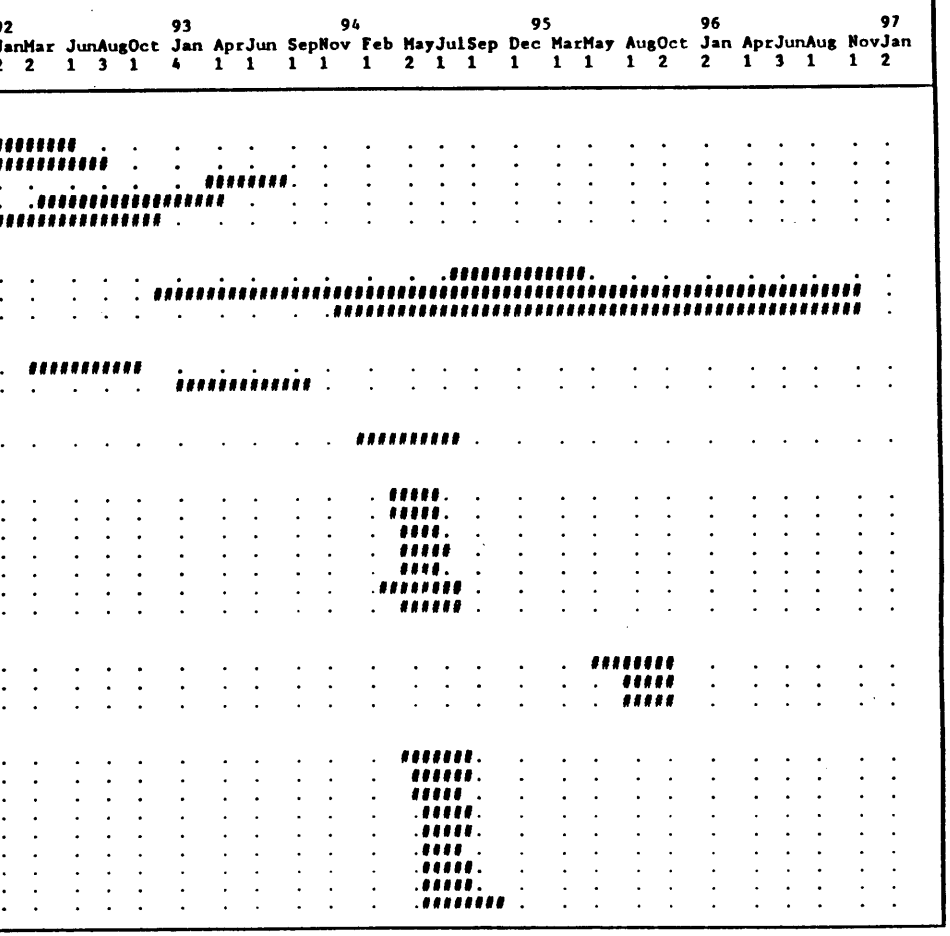
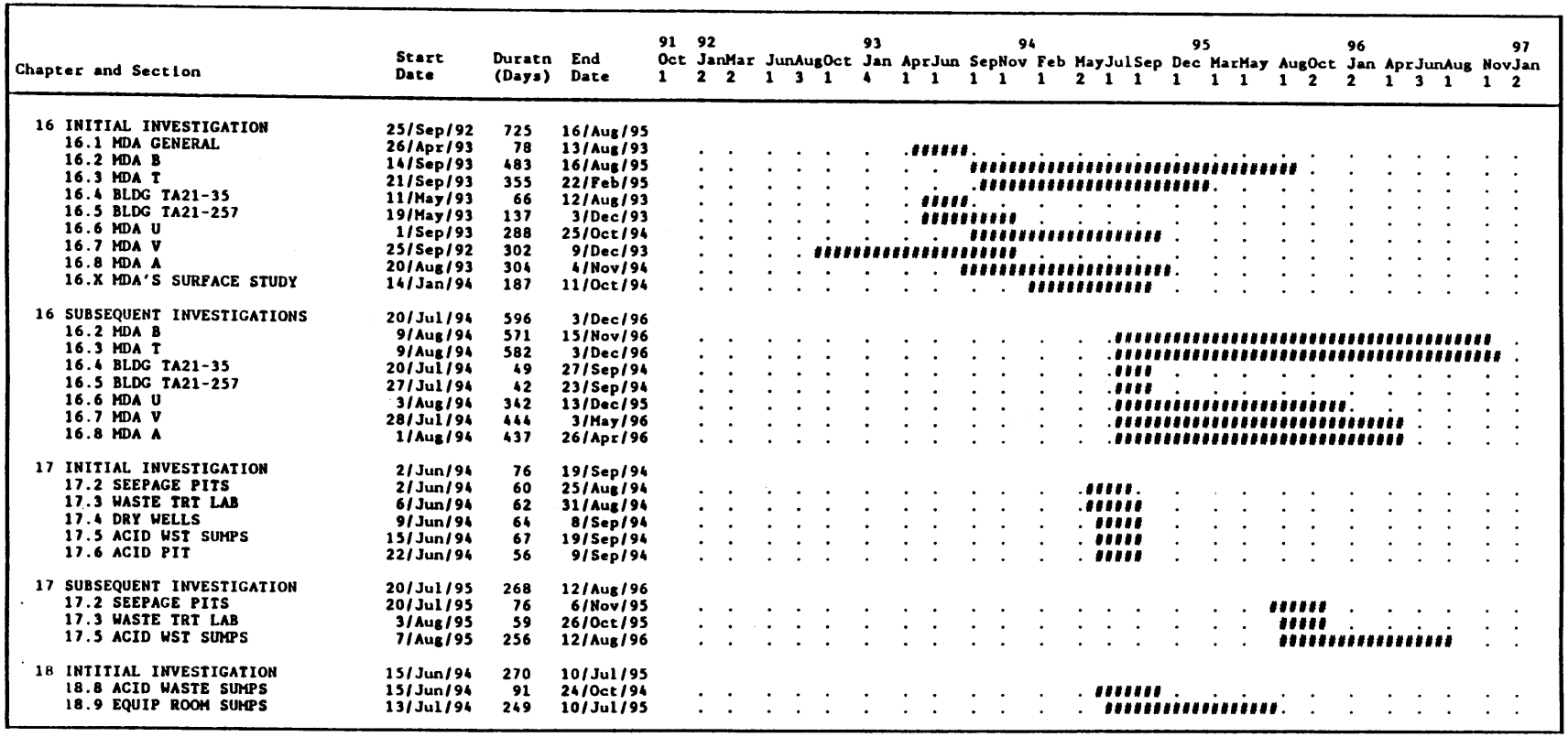


FIGURE 21.2-1. TA-21 OU RFI SCHEDULE (CONTINUED)



- Review and approval of the TA-21 OU RFI work plan, and supporting project plans, by regulatory agencies is scheduled to be completed by October 28, 1991 (see Table 21.2-I).
- Certain tasks (e.g., mesa top characterization) may be initiated before the regulatory agencies grant final approval of the work plan.
- The schedule assumes that an adequate number of support personnel (e.g., HSE technicians, trained drilling contractors) will be available for conducting necessary tasks.
- EPA approval of technical memoranda/work plan modifications (including EPA comments, Laboratory revision, and final EPA approval) is assumed to take 2.5 months, of which one month is allowed for EPA review and comment, and one and a half months for revisions.
- SWMUs expected to require subsequent investigations have been scheduled earlier in the RFI to allow time for data assessment and subsequent investigations.
- The work scheduled in the first two investigation years is constrained by planned DOE budgets for the TA-21 OU for fiscal years 1992 and 1993.
- Where possible, field work has not been scheduled between November 15 and March 15 each year, to allow for inclement weather.

21.3 Reporting

Results of RFI field work will be presented in three principal documents: quarterly technical progress reports, technical memoranda/work plan modifications, and the RFI Report. The purpose of each of these reports is detailed below. A schedule for submission of draft and final reports is presented in Table 21.3-I.

21.3.1 Quarterly Technical Progress Reports

As the TA-21 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.

21.3.2 Technical Memoranda/Work Plan Modifications

Technical memoranda/work plan modifications will be submitted for work conducted on aggregates of SWMUs or on individual SWMUs. These documents will function as interim reports on portions of the RFI effort because of both the large number of SWMUs addressed in this work plan and the five-year time frame 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).

The standard outline for a technical memorandum/work plan modification, is given in Table 21.3-II. This outline may be modified as needed for a given technical memorandum/work plan modification.

21.3.3 RFI Report

The RFI report will summarize all field work conducted during the five-year duration of the RFI. As required by the HSWA module of the Laboratory's RCRA Part B operating permit (Task V, D, page 46), the Laboratory will submit an RFI report within 60 days of completion of the RFI. As stated in the IWP Sec. 3.5.7 (LANL 1990), the RFI Report will describe the procedures, methods, and results of field investigations and will include information on the type and extent of contamination, sources and migration pathways, and actual and potential receptors. The report will also contain adequate information to support delisting of sites that require no further action and corrective action decisions.

21.4 Budget

The schedule presented above is based on fixed budgets for the first two years of the RFI. The fixed budgets in fiscal years 1992 and 1993 (FY 92 and FY 93) are based on expected DOE funding levels. DOE funding requests are set two years in advance; thus the first year in which the TA-21 OU RFI is not constrained by past budget estimates will be FY 94. Funding requests for FY 94 and beyond will reflect the cost and schedule that most efficiently complete the RFI plans. Table 21.4-I presents a summary cost estimate for the TA-21 RFI, with costs broken down by section for each sampling plan chapter (Chapters 12 –18). The cost estimates reflect DOE guidance regarding appropriate contingency assumptions.

TABLE 21.3-I REPORTS PLANNED FOR THE TA-21 OU RFI

	Report Type and Subject	Draft Date	Final Date
Quarterly Technical Progress Reports			
	Summary of Technical Activities/Data		15 Feb, Yearly 15 May, Yearly 15 Aug, Yearly 15 Nov, Yearly
Technical Memoranda/Work Plan Modifications			
1.	Subsurface Investigations Mesa Top and MDA V (Initial)[a]	20 Sep 93	10 Dec 93
2.	Surface Investigations Mesa Top and MDAs (Initial)	22 Jul 94	12 Oct 94
3.	Surface/Subsurface Investigations MDAs Surface (Subsequent)[b] All Non-MDA Units (Initial)	20 Apr 95	11 Jul 95
4.	Subsurface Investigations MDA A, MDA B (Initial)	30 May 95	17 Aug 95
5.	Surface/Subsurface Investigations Non-MDA Units (Subsequent)	3 May 96	24 Jul 96
6.	Subsurface Investigations MDA T, MDA U, MDA V (Initial and Subsequent)	12 Sep 96	4 Dec 96
7.	Subsurface Investigations MDA A, MDA B (if needed)	27 Aug 96	18 Nov 96
RFI Report			
	Final RFI Report	11 Dec 96	28 May 97

[a] Initial: Report of results from the planned initial investigation.

[b] Subsequent: Report of results from subsequent investigations, if any.

TABLE 21.3-I I OUTLINE OF TECHNICAL MEMORANDA/WORK PLAN MODIFICATION

1. Executive Summary
2. Introduction
3. SWMU Descriptions
4. Summary of Investigation
5. Methods and Procedures
5. Data Assessment
   - 5.1 Data Quality Summary
   - 5.2 Source Term
   - 5.3 Nature and Extent of Contamination
   - 5.4 Contaminant Migration
6. Subsequent Investigation Sampling Plans
7. Permit Modification

21.5 TA-21 OU Organization and Responsibility

The organizational structure for the ER Program is presented in Sec. 2.0 of the LANL ER Program Quality Program Plan (QPP) (Annex II of the IWP, LANL 1990). ER Program personnel are identified to the Technical Team Leader and OU Project Leader level in Fig. 11-1 of the QPP, which is reproduced here as Fig. 21.5-1. Section 2.0 of the QPP identifies line authority and personnel responsibilities for each position identified in the figure.

This section details the management organization for the TA-21 OU RFI, as shown in Fig. 21.5-2. Each person currently assigned to the positions shown in the figure is identified in Table 21.5-I. Records of qualifications and training of all personnel working on the TA-21 OU RFI field work will be kept as ER Records [see Appendix C, Records Management Plan (RMP)]. Contributors to the TA-21 OU RFI Work Plan are given in Appendix E.

The following are the responsibilities of the positions identified in Fig. 21.5-2:

TA-21 OU Project Leader

- oversees day-to-day operations, including planning, scheduling, and reporting technical and related administrative activities;
- ensures preparation of scientific investigation planning documents and procedures;
- prepares monthly and quarterly reports for the Project Manager (PM);
- oversees subcontractors, as appropriate;
- coordinates with technical team leaders;
- conducts technical reviews of the milestones and final reports;
- Interfaces with the ER Quality Program Project Leader (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.

TABLE 21.4-I TA-21 OU RFI ESTIMATED BUDGET

Chapter and Section	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
12 INITIAL INVESTIGATION						
12.3 GEOMORPHOLOGY	203,700					
12.4 SURFACE SOIL CHARACT.	378,735					
12.4 ROUND 2 SURFACE SOIL CH		330,055				
12.5 VADOSE ZONE CHARACT.	1,343,579	504,538				
12.6 YEAR 1: SPRING SAMPLIN	85,818	8,617				
	2,011,832	843,209				
12 SUBSEQUENT INVESTIGATIONS						
12.5 VADOSE ZONE CHARACT.			787,158	744,876		
12.6 YEAR 2: WATER SAMPLING		62,070	310,827	7,029	7,057	1,319
12.6 YEAR 3-5: WATER SAMPLIN			58,765	67,924	66,647	9,631
		62,070	1,156,750	819,830	73,704	10,950
13 INITIAL INVESTIGATION						
13.2 AIRBORNE EMISSIONS	281,804	3,373				
13.2 ROUND 2 AIRBORNE EMISSI		419,120				
	281,804	422,493				
13 SUBSEQUENT INVESTIGATIONS						
13.2 AIRBORNE EMISSIONS			326,751			
			326,751			
14 INITIAL INVESTIGATION						
14.2 PCB CTR STORAGE			110,534			
14.3 ABOVE GROUND TANKS			51,426			
14.4 ACTIVE CTR STORAGE			30,586			
14.5 DP TANK FARM			78,562			
14.6 INACTIVE CTR STORAGE			31,650			
14.7 SURFACE DISP AREAS			374,868			
14.8 SEWER TREATMENT PLANT			123,936			
			801,562			
14 SUBSEQUENT INVESTIGATIONS						
14.2 PCB CTR STORAGE				43,968	4,256	
14.6 INACTIVE CTR STORAGE				29,154		
14.7 SURFACE DISPOSAL AREAS				49,834	4,256	
				122,956	8,512	
15 INITIAL INVESTIGATION						
15.2 UNKNOWN LOCATIONS			229,546			
15.3 SEPTIC SYSTEM			188,542			
15.4 DIRECT DISCHARGE			120,438			
15.5 DRNG S TA-21-3			78,486			
15.6 SEPTIC TANKS			71,088			
15.7 S TA-21-155			28,490			
15.8 N TA-21-155			111,218			
15.9 SPECIAL CASES			91,586			
15.10 NPDES			276,266	59,360		
			1,195,660	59,360		

TABLE 21.4-I TA-21 OU RFI ESTIMATED BUDGET (CONTINUED)

	FY 92	FY 93	FY 94	FY 95	FY 96	FY 97
16 INITIAL INVESTIGATION						
16.1 MDA GENERAL		163,560				
16.2 MDA B		60,523	1,141,946	731,307		
16.3 MDA T		11,865	785,447	289,880		
16.4 BLDG TA21-35		90,592				
16.5 BLDG TA21-257		126,274	87,016			
16.6 MDA U		47,489	559,489	86,452		
16.7 MDA V	37,219	1,139,389	44,520			
16.8 MDA A		94,929	858,948	129,679		
16.X MDO'S SURFACE DATA			511,305	8,095		
	37,219	1,734,622	3,988,672	1,245,413		
16 SUBSEQUENT INVESTIGATIONS						
16.2 MDA B			84,029	10,640	965,998	43,171
16.3 MDA T			91,686	1,557,820	1,380,375	44,520
16.4 BLDG TA21-35			80,230			
16.5 BLDG TA21-257			94,665			
16.6 MDA U			86,883	474,913	243,824	
16.7 MDA V			90,377	1,128,201	515,312	
16.8 MDA A			85,808		661,206	
			613,678	3,171,574	3,766,715	87,691
17 INITIAL INVESTIGATION						
17.2 SEEPAGE PITS			43,398			
17.3 WASTE TRT LAB			40,502			
17.4 DRY WELLS			54,986			
17.5 ACID WST SUMPS			128,036			
17.6 ACID PIT			17,686			
			284,608			
17 SUBSEQUENT INVESTIGATION						
17.2 SEEPAGE PITS				181,660	14,364	
17.3 WASTE TRT LAB				33,448	2,394	
17.5 ACID WST SUMPS				264,353	318,935	
				479,461	335,693	
18 INITIAL INVESTIGATION						
18.8 ACID WASTE SUMPS			261,586	15,960		
18.9 EQUIP ROOM SUMPS			102,200	527,114		
			363,786	543,074		
TOTAL	2,330,855	3,062,394	8,731,467	6,441,668	4,184,624	98,641
CONTINGENCY (25%)	582,714	765,599	2,182,867	1,610,417	1,046,156	24,660
Management & MDA Pilot Study	970,000	970,000	970,000	970,000	970,000	
TOTAL ESTIMATE	3,883,569	4,797,993	11,884,334	9,022,085	6,200,780	123,301

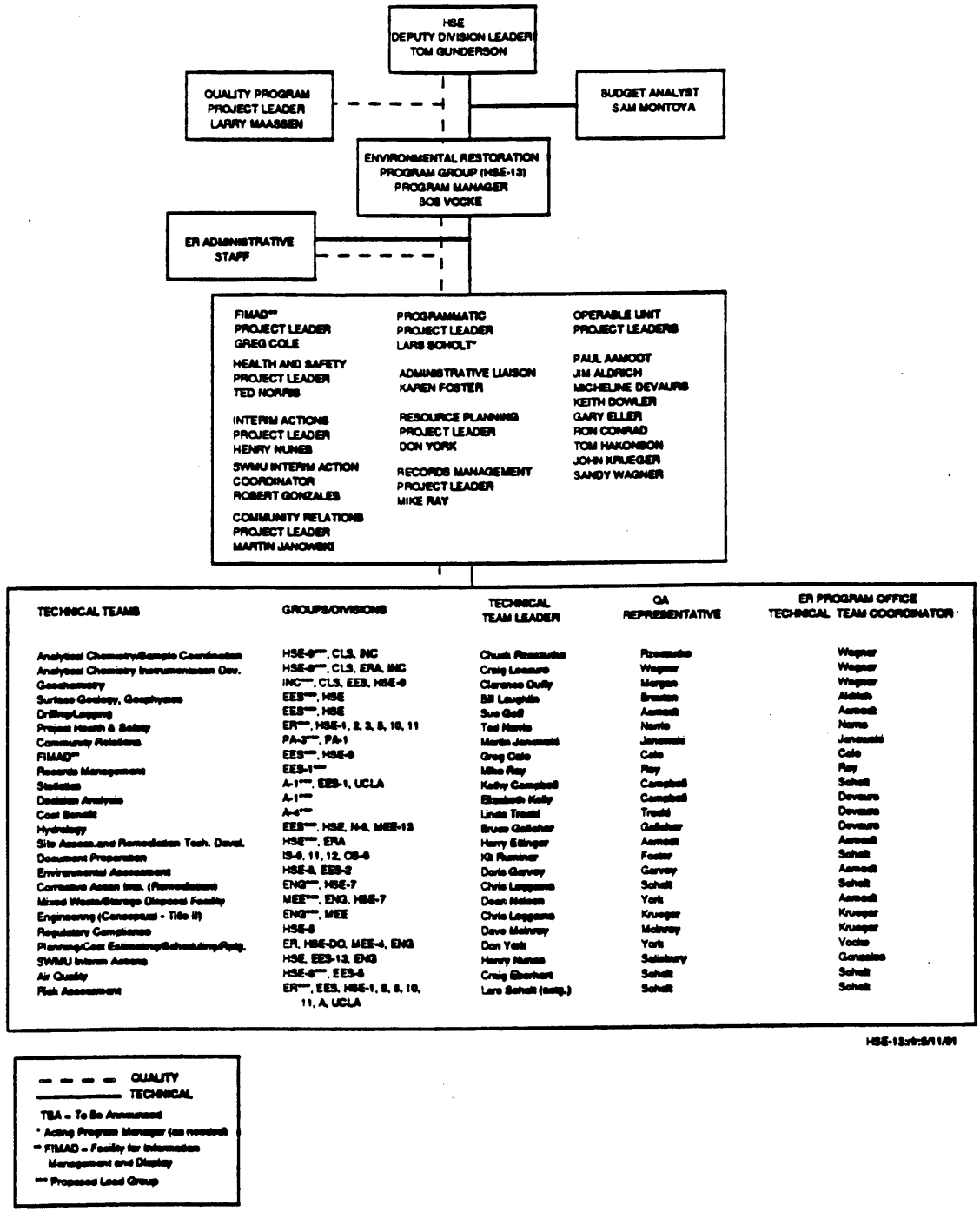


Fig. 21.5-1. Organization of the Environmental Restoration Program at Los Alamos National Laboratory.

TABLE 21.5-I TA-21 OU RFI PERSONNEL[a]

OPERABLE UNIT PROJECT LEADER	Micheline Devaurs, HSE-13
ASSISTANT TO OUPL	Karen West (Assistant), EES-1
FIELD TEAMS MANAGER	Ward Hawkins, EES-1
FIELD TEAM LEADERS	TBD[b]
FIELD TEAM MEMBERS	TBD[b]
TECHNICAL TEAM MEMBERS	Dave Broxton (geology), EES-1
	Elizabeth Kelly (statistics), EES-1
	W. John Smith (radiation ecology), R.F. Weston, Inc.
	TBD[b] (Hydrology)
	TBD[b] (Geochemistry)

[a]Current as of May 1, 1991. All personnel are located at the Laboratory, unless otherwise indicated. Note that additional laboratory and contractor personnel will be added as needed to implement the RFI.

[b]TBD - To be determined.

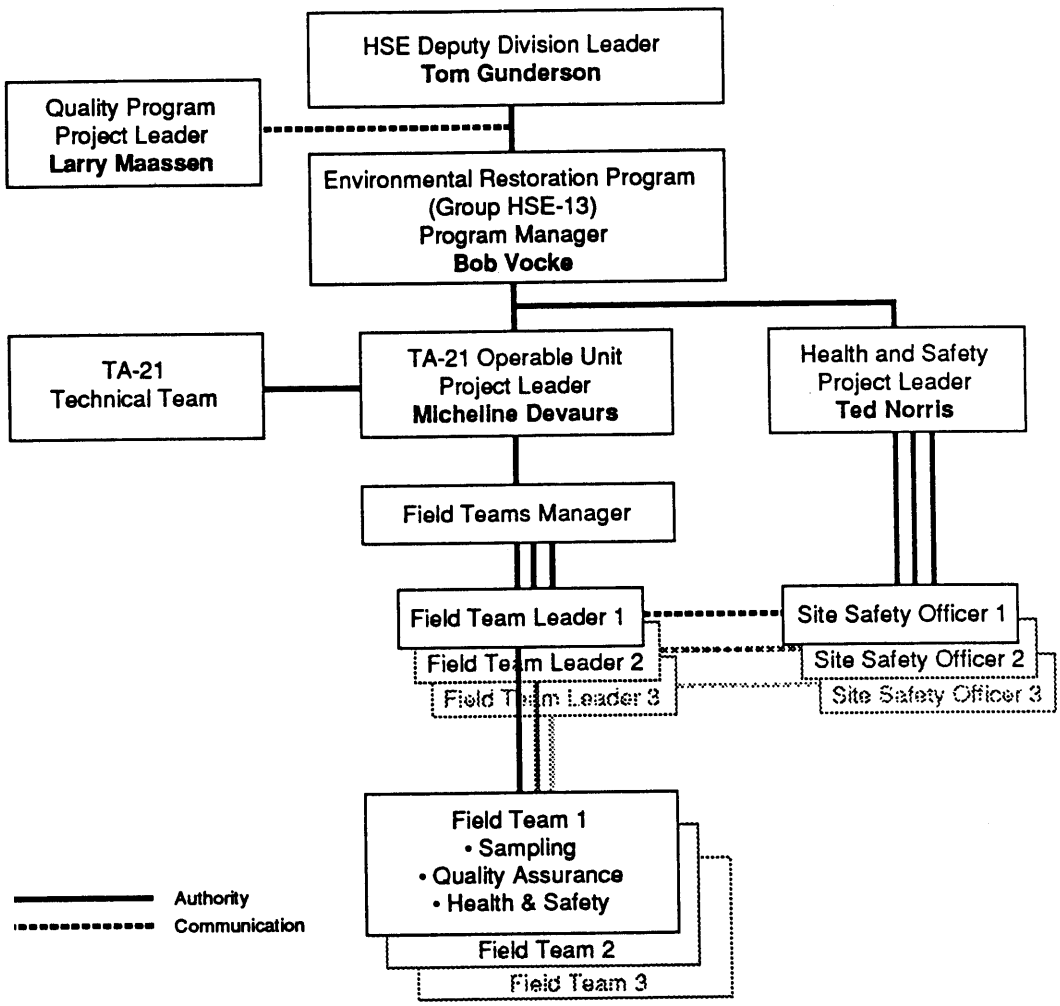


Fig. 21.5-2 TA-21 Operable Unit field work organization chart showing health and safety and quality assurance responsiblity.

Technical Team Members

Technical team members are responsible for providing technical input for their discipline throughout the RFI/CMS process. During the TA-21 OU RFI, they have participated in the development of this work plan and the individual field sampling plans and will 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-21 OU technical team are hydrogeology, statistics, geochemistry, and health physics. The composition of the technical team may change with time as the technical expertise needed to implement the TA-21 OU RFI changes.

TA-21 Field Teams Manager

- oversees day-to-day field operations;
- conducts planning and scheduling for the implementation of the RFI field activities detailed in Chapters 12 through 19; and
- manages field team members.

Field Team Leader

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 contractor personnel.

Field Team Member(s)

Field Team Members may include, as appropriate

- sampling personnel,
- site safety officer,
- geologists,
- hydrologists,
- health physicists, and
- other applicable disciplines.

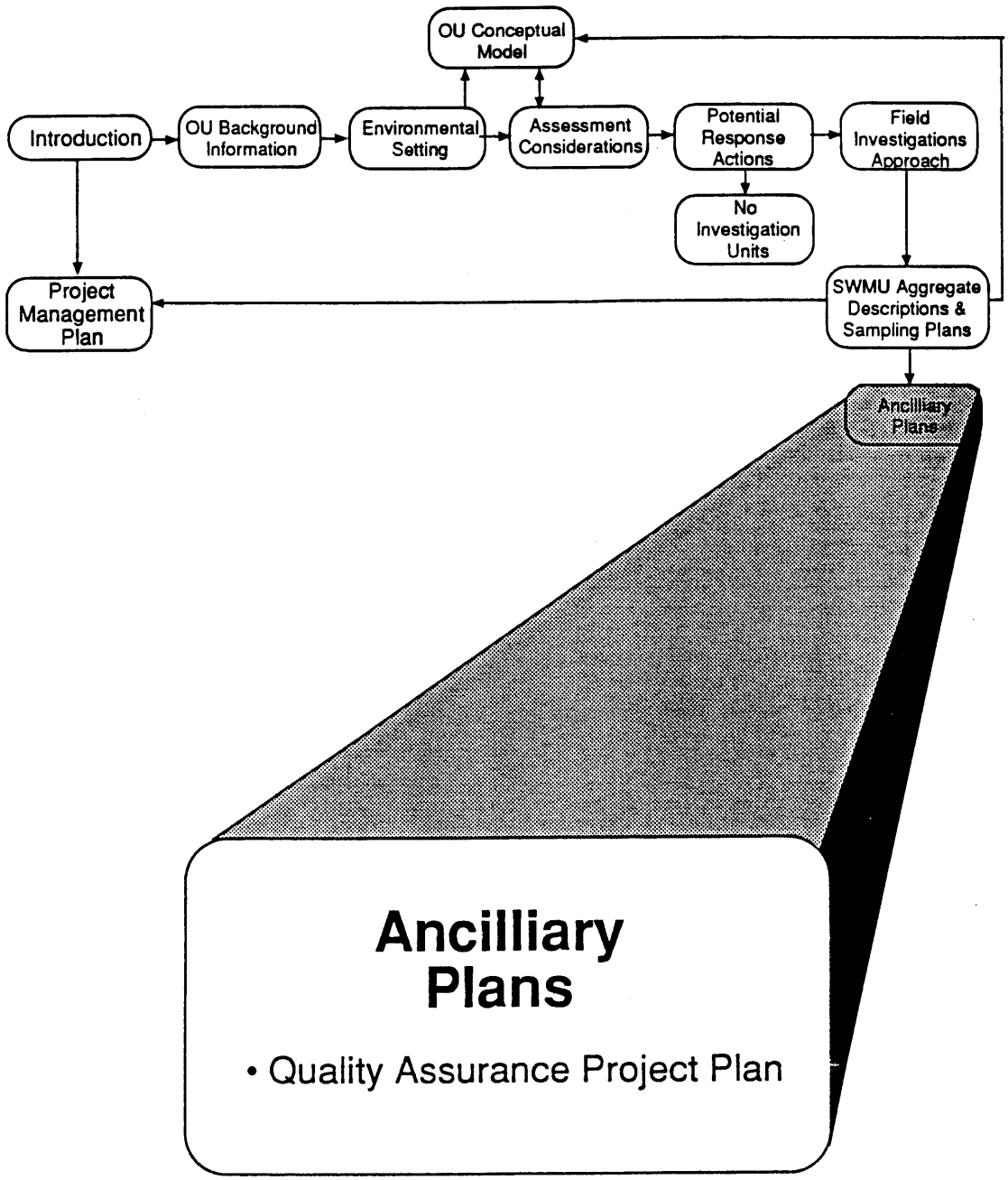
All teams will have, at a minimum, a site safety officer and a qualified field sampler. They are responsible for conducting the work detailed in field sampling plans, under the direction of the field team leader. Field team members may be contractor personnel.

References

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

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

APPENDIX A


OU Conceptual Model
Introduction
OU Background Information
Environmental Setting
Assessment Considerations
Potential Response Actions
Field Investigations Approach
No Investigation Units
Project Management Plan
SWMU Aggregate Descriptions & Sampling Plans
Ancilliary Plans
Ancilliary Plans
• Quality Assurance Project Plan

APPENDIX A

TECHNICAL AREA 21 Operable Unit
QUALITY ASSURANCE PROJECT PLAN

for the
LOS ALAMOS NATIONAL LABORATORY
ENVIRONMENTAL RESTORATION PROGRAM

I. APPROVAL FOR IMPLEMENTATION

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

   SIGNATURE:_____ DATE:_____

2. NAME: Larry Maassen
   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 (HSE-9)

   SIGNATURE:_____ DATE:_____

4. NAME: Margaret Gautier
   TITLE: Quality Assurance Officer, Health and Environmental Chemistry Group (HSE-9)

   SIGNATURE:_____ DATE:_____

5. NAME: Micheline Devaurs
   TITLE: Project Leader, Los Alamos National Laboratory

   SIGNATURE:_____ DATE:_____

6. NAME: Charles Ritchey
   TITLE: Acting Chief of Office of Quality Assurance, Region VI Environmental Protection Agency

   SIGNATURE:_____ DATE:_____

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

LIST OF ACRONYMS

AP	-	Administrative Procedure
ASA	-	American Society of Agronomy, Inc.
ASTM	-	American Society for Testing and Materials
COE	-	U.S. Army Corp of Engineers
DOE	-	U.S. Department of Energy
DQO	-	Data Quality Objective
EPA	-	U.S. Environmental Protection Agency
ER	-	Environmental Restoration
FIMAD	-	Facility for Information Management, Analysis and Display
H&S	-	Health and Safety
HSE	-	Health, Safety and Environment Division
ICPMS	-	Inductively Coupled Plasma Mass Spectroscopy
IWP	-	Installation Work Plan
LANL	-	Los Alamos National Laboratory
OU	-	Operable Unit
PCB	-	Polychlorinated biphenyl
PL	-	Project Leader
PM	-	Program Manager
QA	-	Quality Assurance
QAP	-	Quality Assurance Plan
QAPjP	-	Quality Assurance Project Plan
QA/QC	-	Quality Assurance/Quality Control
QC	-	Quality Control
QP	-	Quality Procedure
QPP	-	Quality Program Plan
QPPL	-	Quality Program Project Leader
RCRA	-	Resource Conservation and Recovery Act
RFI	-	RCRA Facility Investigation
RMP	-	Records Management Plan
SMF	-	Sample Management Facility
SOP	-	Standard Operating Procedure
SSSA	-	Soil Science Society of America, Inc.
SW	-	Solid Waste
SWMU	-	Solid Waste Management Unit
USATHAMA	-	U.S. Army Toxic and Hazardous Materials Agency

3.0. Project Description

3.1. Introduction

This Technical Area (TA)-21 RFI [Resource Conservation and Recovery Act (RCRA) Facility Investigation] Operable Unit (OU) Quality Assurance Project Plan (QAPjP) is tiered to the Los Alamos National Laboratory (LANL) Environmental Restoration (ER) Program Generic QAPjP (LANL 1991b). Information that is specific to the TA-21 OU RFI QAPjP is presented in detail in this document. Information that is covered by the LANL ER Program Generic QAPjP, or is presented elsewhere, has been referenced to that specific document chapter.

This TA-21 OU RFI QAPjP integrates the U.S. Environmental Protection Agency (EPA) 16-point QAMS-005/80 guidance (EPA 1980), as well as the ASME NQA-1-1989 edition of "Quality Assurance Program Requirements for Nuclear Facilities (ASME 1989) (as specified in DOE Order 5700.6B). The integration is described in Sec. 3, Quality Assurance Program, of the LANL ER Quality Program Plan (QPP),which was published as Annex II of the Laboratory's Installation Work Plan (IWP) (LANL 1990).

A description of the TA-21 OU RFI and tasks is presented in Chapter 2 of the TA-21-OU Work Plan.

3.2. Facility Description

A facility description of Los Alamos National Laboratory is presented in Sec. 2.0 of the LANL Installation Work Plan (IWP)(LANL 1990). Additional historical information on TA-21 is presented in Chapter 3 of the TA-21 OU RFI Work Plan.

3.3. Environmental Restoration Program

A description of the ER Program is presented in Sec. 3.0 of the LANL IWP (LANL 1990).

3.4. Project Description

3.4.1. Project Objectives

Information regarding the TA-21 OU RFI project objectives is presented in Sec. 2.3.2 and Tables 9.1-I and 9.1-II in Chapter 9 of the TA-21 OU RFI Work Plan.

3.4.2. Project Schedule

Project activity dates are presented in Sec. 21.2 of the TA-21 OU RFI Work Plan.

3.4.3. Project Scope

This information is presented in Sec. 2.2 of the TA-21 OU RFI Work Plan.

3.4.4. Background Information

This information is presented in various sections of Chapter 3 of the TA-21 OU RFI Work Plan.

3.4.5. Data Usage

Information regarding data usage and data users is presented in Chapter 9 and Tables 9.1-I and 9.1-II of the TA-21 OU RFI Work Plan. Data collected during the RFI at the TA-21 OU will be used to define the presence or absence of contamination at Solid Waste Management Units (SWMUs) or SWMU aggregates, as detailed in the field sampling plans in Chapters 12 through 19 of the TA-21 OU RFI Work Plan. Section 11.9 of the TA-21 OU RFI Work Plan provides an overview of important aspects of data analysis for the TA-21 OU. Data collected during the RFI will be input into the Facility for Information Management, Analysis and Display (FIMAD) following the ER Records Management Procedure [see TA-21 OU RFI Work Plan, Appendix C, Records Management Plan (RMP)], and analyzed, as appropriate, using statistical techniques, kriging, 2- and 3-dimensional modeling or other appropriate methods (see IWP Annex IV (LANL 1990) and IWP updates for additional detail as FIMAD develops).

4.0. Project Organization and Responsibility

The overall organizational structure of the ER Program is presented in Sec. 2.0 of the LANL ER Program QPP (IWP Annex II, LANL 1990). Therein, ER program personnel are identified down to the technical team leader and operable unit project leader level, and personnel responsibilities and line authority are detailed. In addition, the Quality Assurance (QA) organizational structure is presented, and personnel qualifications are detailed.

Detailed information pertinent to the management organization for TA-21 OU RFI is provided in Chapter 21 of the TA-21 OU RFI Work Plan. Records of qualifications and training of all personnel working on the TA-21 OU RFI field work will be kept as ER Records (see Appendix C, RMP) of the TA-21 OU RFI Work Plan). Additional information on general responsibilities of personnel is also in the Management Plan, Chapter 21 of the TA-21 OU RFI Work Plan.

The following details QA responsibilities of personnel:

TA-21 Operable Unit Project Leader

- oversees day-to-day operations, including planning, scheduling, and reporting technical and related administrative activities;
- ensures preparation of scientific investigation planning documents and procedures;
- prepares monthly and quarterly reports for the Project Manager (PM);
- oversees subcontractors, as appropriate;
- coordinates with technical team leaders;
- conducts technical reviews of the milestones and final reports;
- interfaces with the ER Quality Program Project Leader (QPPL) to resolve quality concerns and to coordinate with the QA staff for audits;
- complies with the LANL ER Program health and safety, records management, and community relations procedures;
- 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.

TA-21 Field Teams Manager

- oversees day-to-day field operations, including planning, scheduling and implementation of RFI field activities detailed in Chapters 12-19 of the TA-21 OU RFI Work Plan; and
- manages field team members.

Field Team Member(s)

Field team members will include, depending upon the sampling activity being conducted, sampling personnel, a site safety officer, and staff members with technical knowledge of geology, hydrology, statistics, or other applicable disciplines.

The TA-21 OU RFI project management is presented in Chapter 21 of the TA-21 OU RFI Work Plan.

5.0. Quality Assurance Objectives for Measurement Data in terms of Precision, Accuracy, Representativeness, Completeness, and Comparability

5.1. Level of Quality Control

5.1.1. Field Sampling

A discussion of quality control samples for the ER Program is presented in Sec. 6.1 of the LANL ER Program Generic QAPjP (LANL 1991b). The frequency and type of field quality control samples identified in the LANL ER Program Generic QAPjP will be followed for chemical analyses of samples during the TA-21 OU RFI. The TA-21 OU RFI exception to the LANL ER Program Generic QAPjP level of field quality control samples is reagent blanks. Reagent blanks, both for soil and water sampling activities, will not be collected.

Soil samples for geotechnical analyses will be collected during the TA-21 OU RFI. These analyses will use either conventional laboratory procedures [e.g., American Society for Testing and Materials (ASTM)] or SOPs. In contrast to samples submitted for chemical analyses, field quality control samples are not routinely associated with geotechnical samples. Quality control for geotechnical sample analysis results is prescribed in the specific laboratory procedure. An additional measure of quality control for geotechnical samples is achieved by the collection and submittal to the laboratory of a sufficient volume of sample. A large sample volume may provide for reanalysis of an individual sample in the event results from the initial aliquot did not meet specific method requirements.

5.1.2. Field Measurements

The quality control level of effort for field measurements performed during the TA-21 OU RFI will follow the recommendations presented in Table V.1 in Sec. 5.1.2 of the LANL ER Program Generic QAPjP (LANL 1991b).

5.1.3. Analytical Laboratory

The analytical laboratory quality control level of effort for the TA-21 OU RFI will follow the recommendations specified in the U.S. EPA methods or the frequency presented in Table V.2 of Sec. 5.1.3 of the LANL ER Program Generic QAPjP (LANL 1991b).

5.2. Precision, Accuracy, and Sensitivity of Analyses

The analytical laboratory quality control acceptance criteria for precision, accuracy, and sensitivity of analyses for the TA-21 OU RFI will use the methods and detection limits specified for the U.S. EPA and U.S. Department of Energy (DOE) methods presented in Sec. 5.2 of the LANL ER Program Generic QAPjP (LANL 1991b). Specifically, the following will be used (or excluded from use) at the TA-21 OU:

- Table V.3 for volatile organic compounds
- Table V.4 for semivolatiles
- Tables V.5 and V.6 for polychlorinated biphenyls (PCBs) except that organochlorine pesticides are not included in the work at the TA-21 OU
- Table V.7 for inorganics
- Table V.8 for radionuclides
- Table V.9 for miscellaneous analytes
- Table V.10, for high explosives, is excluded from the work planned at the TA-21 OU

Any specific analyte identified in the tables listed above may be included in the RFI investigations at the TA-21 OU. Broad categories not included for work at the TA-21 OU are the pesticides (included in Tables V.5 and V.6), and high explosives (Table V.10), as noted above.

The analytical laboratory quality control acceptance criteria for precision, accuracy, and sensitivity of analyses that are to be used are not specific to the TA-21 OU RFI. The table numbers cited in the sections below correspond to the table numbers in the LANL ER Program Generic QAPjP (LANL 1991b), and include the analytes specific to TA-21.

5.3. Quality Assurance Objectives for Precision

The quality assurance objectives for precision of laboratory analyses for TA-21 OU RFI samples will follow the U.S. EPA guidance specified in Sec. 5.3 and Table V.11 of the LANL ER Program Generic QAPjP (LANL 1991b).

5.4. Quality Assurance Objectives for Accuracy

The quality assurance objectives for accuracy of laboratory analyses for TA-21 OU RFI samples will follow the U.S. EPA guidance specified in Sec. 5.4 and Tables V.11 and V.12 of the LANL ER Program Generic QAPjP (LANL 1991b).

5.5. Representativeness, Completeness, and Comparability

The field sampling plans in Chapters 12 through 19 of the TA-21 OU RFI Work Plan were developed to meet the sample representativeness criteria described in Sec. 14.3 of the ER Program Generic QAPjP (LANL 1991b).

Completeness of analytical data from the TA-21 OU RFI will be calculated according to the formula presented in Sec. 14.4 of the ER Program Generic QAPjP (LANL 1991b). The quality assurance objective for analytical data completeness for the LANL ER Program is 90%, which is also the objective for the TA-21 OU RFI.

Data comparability for the TA-21 OU RFI will be achieved through the use of standard sampling and analytical techniques. Sampling will be performed according to LANL ER Program Standard Operating Procedures (SOPs) (LANL 1991a). Sample analyses will be performed according to analytical methods referenced in the LANL ER Program Generic QAPjP (LANL 1991b) or this TA-21 OU RFI QAPjP. Data results will be reported in appropriate units consistent with existing site data and applicable regulatory levels.

5.6. Field Measurements

Field laboratory measurements for the TA-21 OU RFI will be performed according to Quality Assurance/Quality Control (QA/QC) procedures described in LANL ER Program SOPs (LANL 1991a). Adherence to the LANL ER Program SOPs will ensure the accuracy, precision, and completeness of the field measurement data.

5.7. Data Quality Objectives

All Data Quality Objective (DQO) elements are covered in various sections of the TA-21 OU RFI Work Plan and the LANL ER Program Generic QAPjP (LANL 1991b).

DQOs and the development process for the TA-21 OU RFI are described in Chapter 9 of the TA-21 OU RFI Work Plan. Tables 9.1-I and 9.1-II in Chapter 9 of the TA-21 OU RFI Work Plan

present specific objectives for each investigation unit. Each sampling plan chapter (Chapters 12–19 of the TA-21 OU RFI Work Plan) also contains a list of data needs, location figures, and sampling and analytical requirement tables that are specific to each SWMU.

Data analysis, interpretation, statistical representativeness, and applicability to the conceptual model are discussed in Chapters 6, 9, and 11 of the TA-21 OU RFI Work Plan.

TA-21 OU RFI budget and schedule information relative to anticipated field and laboratory activities is presented in Secs. 21.2 and 21.3 of the TA-21 OU RFI Work Plan.

6.0. Sampling Procedures

Procedures for collecting soil and aqueous samples will be selected, as appropriate, from the LANL ER Program SOPs (LANL 1991a). A general description of all types of field investigations is also presented in Chapter 11 of the TA-21 OU RFI Work Plan.

Information on required sample containers, volume, preservation, and holding times is presented in LANL ER Program SOP, "Containers, Sampling and Preservation" (LANL 1991a) and in Sec. 6 of the LANL ER Program Generic QAPjP (LANL 1991b).

Sample coordination is described in Sec. 6.0 of the LANL ER Program Generic QAPjP (LANL 1991b). Instructions for handling, packaging, and shipping of samples are described in general in Sec. 6.0 and Sec. 7.5 of the LANL ER Program Generic QAPjP and in detail in LANL ER Program SOP, "Guide to Handling, Packaging and Shipping of Samples" (LANL 1991a).

6.1. Quality Control Samples

A discussion of quality control samples for the ER Program is presented in Sec. 6.1 of the LANL ER Program Generic QAPjP (LANL 1991b). The frequency and type of field quality control samples identified in the LANL ER Program Generic QAPjP will be followed for chemical analyses of samples during the TA-21 OU RFI.

Soil samples for geotechnical analyses will be collected during the TA-21 OU RFI. In contrast to samples submitted for chemical analyses, field quality control samples are not routinely associated with geotechnical samples. Quality control for geotechnical sample analysis results is prescribed in the specific laboratory procedure. An additional measure of quality control for geotechnical samples is achieved by the collection and submittal to the laboratory of a sufficient volume of sample. A large sample volume may provide for reanalysis of an individual sample in the event results from the initial aliquot did not meet specific method requirements.

6.2. Sample Preservation During Shipment

Information on sample preservation during shipment is presented in LANL ER Program SOP, "Containers, Sampling and Preservation" (LANL 1991a) and in Sec. 6.2 of the LANL ER Program Generic QAPjP (LANL 1991b).

6.3. Equipment Decontamination

Equipment decontamination is described in Sec. 6.3 of the LANL ER Program Generic QAPjP (LANL 1991b), and in LANL ER Program SOP, "General Equipment Decontamination" (LANL 1991a). LANL ER Program SOP, "RFI Generated Waste Management" (LANL 1991a), provides information for proper handling and disposition of wash water and other materials generated during equipment decontamination.

6.4. Sample Designation

Samples will be assigned a unique alphanumeric identifier to provide chain of custody control during the transfer of samples from the time of collection through analysis and reporting. This information is detailed in LANL ER Program SOP "Sample Control and Documentation" (LANL 1991a).

7.0. SAMPLE CUSTODY

7.1. Overview

Field and laboratory sample chain of custody procedures are described in Sec. 7 of the LANL ER Program Generic QAPjP (LANL 1991b). These procedures will be followed for sampling activities conducted during the TA-21 OU RFI. The LANL ER Program SOP, "Sample Control and Documentation" (LANL 1991a), also provides the guidance for chain of custody procedures, including example chain of custody records and tags.

7.2. Field Documentation

A sample numbering system developed for the LANL ER Program uniquely identifies each boring location, monitor well, and sample collected. The LANL ER Program numbering system, including standard sample identifiers, identifiers for quality control samples, and the code system to be used is detailed in LANL ER Program SOP, "Sample Control and Documentation" (LANL 1991a).

Section 7.2 of the LANL ER Program Generic QAPjP (LANL 1991b) provides sample documentation guidance for field personnel involved with sample collection activities. The LANL ER program numbering system will be followed for all sampling activities conducted during the TA-21 OU RFI. All field data collection forms will be reviewed by the TA-21 Field Teams Manager, or a technical reviewer designee, before being submitted to the LANL ER Records Processing Facility. Incorrect entries will be crossed out with a single line and signed and dated by the person originating the entry and the TA-21 field teams manager or a technical reviewer designee.

7.3. Sample Management Facility

Section 7.3 of the LANL ER Program Generic QAPjP (LANL 1991b) provides a discussion of the ER Program activities coordinated by the LANL ER Program Sample Management Facility (SMF). The activities described will be accomplished for the TA-21 OU RFI effort.

7.4. Laboratory Documentation

Laboratory custody procedures associated with sample receipt, storage, preparation, analysis, and general security are described in Sec. 7.4 of the LANL ER Program Generic QAPjP (LANL 1991b). These procedures will be followed by all laboratories participating in chemical analysis of samples generated during the TA-21 OU RFI.

Laboratories providing radiological and geotechnical analyses of TA-21 OU RFI samples also will follow chain-of-custody and record-keeping procedures as described in Sec. 7.4 of the LANL ER Program Generic QAPjP (LANL 1991b). Sample storage for these samples will be according to requirements described in the analysis procedure or in the QA Plan of the laboratory. Sample tracking of these samples will be according to requirements described in the QA Plan of the laboratory.

Acquisition of appropriate QA manuals for all TA-21 OU RFI participating laboratories, including LANL HSE-9, is the responsibility of the LANL SMF.

7.5 Sample Handling, Packaging, and Shipping

Sample handling, packaging, and shipping procedures are described in Sec. 7.5 of the LANL ER Program Generic QAPjP (LANL 1991b) and in LANL ER Program SOP, "Guide to Handling, Packaging and Shipping of Samples" (LANL 1991a).

7.6 Final Evidence File Documentation

Final evidence file documentation is described in Sec. 7.6 of the LANL ER Program Generic QAPjP (LANL 1991b) and in the Records Management Plan, Annex IV of the IWP (LANL 1990).

TA-21 OU RFI activities will follow these ER Program-wide procedures. SOPs will be developed, reviewed, and approved if needed.

8.0. Calibration Procedures and Frequency

8.1. Overview

Section 8 of the ER Program Generic QAPjP (LANL 1991b) contains information on the calibration procedures and frequency of calibration for both field and laboratory equipment. As appropriate, additional information is also referenced to the ER Program SOPs (LANL 1991a) and the manufacturer's equipment manual.

8.2. Field Equipment

Field equipment that will be used during the TA-21 OU RFI includes those instruments described in Chapter 11 of the TA-21 OU RFI Work Plan. Specific information regarding calibration procedures and frequency of calibration for field equipment is presented in the applicable LANL ER Program SOPs (LANL 1991a) and the manufacturer's equipment manual.

8.3. Laboratory Equipment

Section 8.3 of the ER Program Generic QAPjP (LANL 1991b) contains general information on the calibration procedures and frequency of calibration for laboratory equipment. Specific instrument calibration procedures for various analytical instruments are described in detail in the QA manuals of the participating laboratories. Acquisition of appropriate QA manuals for all TA-21 OU RFI participating laboratories, including LANL HSE-9, is the responsibility of the LANL SMF.

The LANL ER Program SOPs (LANL 1991a) have been provided to U.S. EPA Region VI under separate submittal and are not attached to this TA-21 OU RFI QAPjP.

9.0. Analytical Procedures

9.1. Overview

Field and laboratory analytical measurements for TA-21 OU RFI samples will be performed according to LANL ER Program SOPs (LANL 1991a).

9.2. Field Testing and Screening

Field testing and screening of samples during the TA-21 OU RFI will follow LANL ER Program SOPs (LANL 1991a).

9.3. Laboratory Methods

The analytical methods to be used for the TA-21 OU RFI for aqueous and soil/sediment samples are those presented in Sec. 9.3 of the ER Program Generic QAPjP (LANL 1991b). All of the analytical methods presented there are applicable to the TA-21 OU RFI with the exceptions noted in Sec. 5.2 above; pesticides will not be analytes in this investigation and analyses for high explosives are not required for this investigation. Where those analytes appear in Tables IX.1 and IX.2 of Sec. 9 of the LANL ER Program Generic QAPjP, they do not apply to the TA-21 OU RFI.

Additional QA/QC information for the methods applicable to this investigation is presented in Sec. 5 of this TA-21 OU RFI QAPjP.

10.0. Data Reduction, Validation, and Reporting

10.1. Data Reduction

Field and laboratory data reduction for the TA-21 OU RFI will follow the protocols described in Sec. 10.1 of the LANL ER Program Generic QAPjP (LANL 1991b).

10.2. Data Validation

Field and laboratory data validation for the TA-21 OU RFI will follow the protocols described in Sec. 10.2 of the LANL ER Program Generic QAPjP (LANL 1991b), except no reagent blanks are planned.

10.3. Data Reporting

Field and laboratory data reporting for the TA-21 OU RFI will be as described in Sec. 10.3 of the LANL ER Program Generic QAPjP (LANL 1991b).

11.0. Internal Quality Control Checks

11.1. Field Sampling Quality Control Checks

A discussion of field quality control samples for the ER Program is presented in Sec. 6.1 of the LANL ER Program Generic QAPjP (LANL 1991b). The frequency and type of field quality control samples identified in the LANL ER Program Generic QAPjP will be followed, in general, for chemical analyses of samples during the TA-21 OU RFI.

11.2. Laboratory Analytical Activities

The types and frequency of internal quality control samples that apply to TA-21 OU RFI laboratory activities will follow those that are presented in Sec. 11.2 of the ER Program Generic QAPjP (LANL 1991b).

12.0. Peformance and System Audits

Performance and system audits for field and laboratory operations will be conducted during the TA-21 OU RFI. These audits will be performed as identified and referenced in Sec. 12 of the LANL ER Program Generic QAPjP (LANL 1991b).

13.0. Preventive Maintenance

13.1. Field Equipment

Preventive maintenance requirements for TA-21 OU RFI field equipment will follow specifications described in Sec. 13.1 of the LANL ER Program Generic QAPjP (LANL 1991b). Additional information is detailed in the ER Program SOPs (LANL 1991a), which define the required equipment checks for each type of field equipment. LANL ER Program SOPs have been provided to U.S. EPA Region VI under separate submittal and are not attached to this TA-21 OU RFI QAPjP.

13.2. Laboratory Equipment

TA-21 OU RFI preventive maintenance requirements for laboratory equipment will follow the specifications described in Sec. 13.2 of the LANL ER Program Generic QAPjP (LANL 1991b). The elements of the LANL HSE-9 Analytical Laboratory preventive maintenance program are discussed in Chapters 12 and 14 of the Health and Environmental Chemistry Laboratory Quality Assurance Program Plan (Gladney and Gautier 1991).

14.0. Specific Routine Procedures used to Assess Data Precision, Accuracy, Representatives, and Completeness

14.1. Precision

Analytical precision for TA-21 OU RFI data will be calculated according to the formula presented in Sec. 14.1 of the ER Program Generic QAPjP (LANL 1991b).

14.2. Accuracy

Analytical accuracy of TA-21 OU RFI data will be calculated according to the formula presented in Sec. 14.2 of the ER Program Generic QAPjP (LANL 1991b).

14.3. Sample Representativeness

The field sampling plans in Chapters 12 through 19 of the TA-21 OU RFI Work Plan were developed to meet the sample representativeness criteria described in Sec. 14.3 of the ER Program Generic QAPjP (LANL 1991b).

14.4. Completeness

Completeness of analytical data from the TA-21 OU RFI will be calculated according to the formula presented in Sec. 14.4 of the ER Program Generic QAPjP (LANL 1991b).

The quality assurance objective for analytical data completeness for the LANL ER Program is 90%, which will also be the objective for the TA-21 OU RFI.

15.0. Corrective Action

15.1. Overview

The procedures, reporting requirements, and authority for initiating corrective action during the TA-21 OU RFI will follow those defined in Sec. 15 of the ER Program Generic QAPjP (LANL 1991b) and in LANL-ER-QP-01.3Q, "Deficiency Reporting."

15.2. Field Corrective Action

Field corrective actions required during the TA-21 OU RFI will follow the process defined in Sec. 15.2 of the ER Program Generic QAPjP (LANL 1991b).

15.3. Laboratory Corrective Action

Laboratory corrective actions required during the TA-21 OU RFI will follow the process defined in Sec. 15.3 of the ER Program Generic QAPjP (LANL 1991b).

16.0. Quality Assurance Reports to Management

16.1. Field Quality Assurance Reports to Management

The TA-21 Field Teams Manager or a designee will provide a monthly field progress status report to the LANL ER Program Manager. This report will consist of the information identified in Sec. 16.1 of the ER Program Generic QAPjP (LANL 1991b).

16.2. Laboratory Quality Assurance Reports to Management

The laboratory QA reports identified in Sec. 16.2 of the ER Program Generic QAPjP (LANL 1991b) will be prepared during the TA-21 OU RFI.

16.3. Internal Management Quality Assurance Reports

The internal management QA reports identified in Sec. 16.3 of the ER Program Generic QAPjP (LANL 1991b) will be prepared during the TA-21 OU RFI.

Attachment A — Data Quality Objective —Example Scenario

Data Quality Objectives and the development process for the TA-21 OU RFI are described in Chapter 9 of the TA-21 OU RFI Work Plan. Tables 9.1-I and 9.1-II in Chapter 9 of the TA-21 OU RFI Work Plan also present specific objectives for each investigation unit. Each sampling plan chapter (Chapters 12–19 of the TA-21 OU RFI Work Plan) contains a list of data needs, location figures, and sampling and analytical requirement tables that are specific to each SWMU.

Data analysis, interpretation, statistical representativeness, and applicability to the conceptual model are discussed in Chapters 6, 9, and 11 of the TA-21 OU RFI Work Plan.

Attachment B —Quality Assurance/Quality Control Definitions

Quality Assurance/Quality Control definitions presented in Appendix B of the LANL ER Program Generic QAPjP (LANL 1991b) are applicable to activities described in this TA-21 OU RFI QAPjP.

References

ANSI/ASME (American National Standards Institute/American Society of Mechanical Engineers)1989. "Quality Assurance Requirements for Nuclear Facilities," NQA-1-1989, 345 East 47th Street, New York, New York.

EPA (US Environmental Protection Agency) 1980. "Interim Guidelines and Specifications for Preparing Quality Assurance Program Plans," QAMS-004/80, Washington, DC.

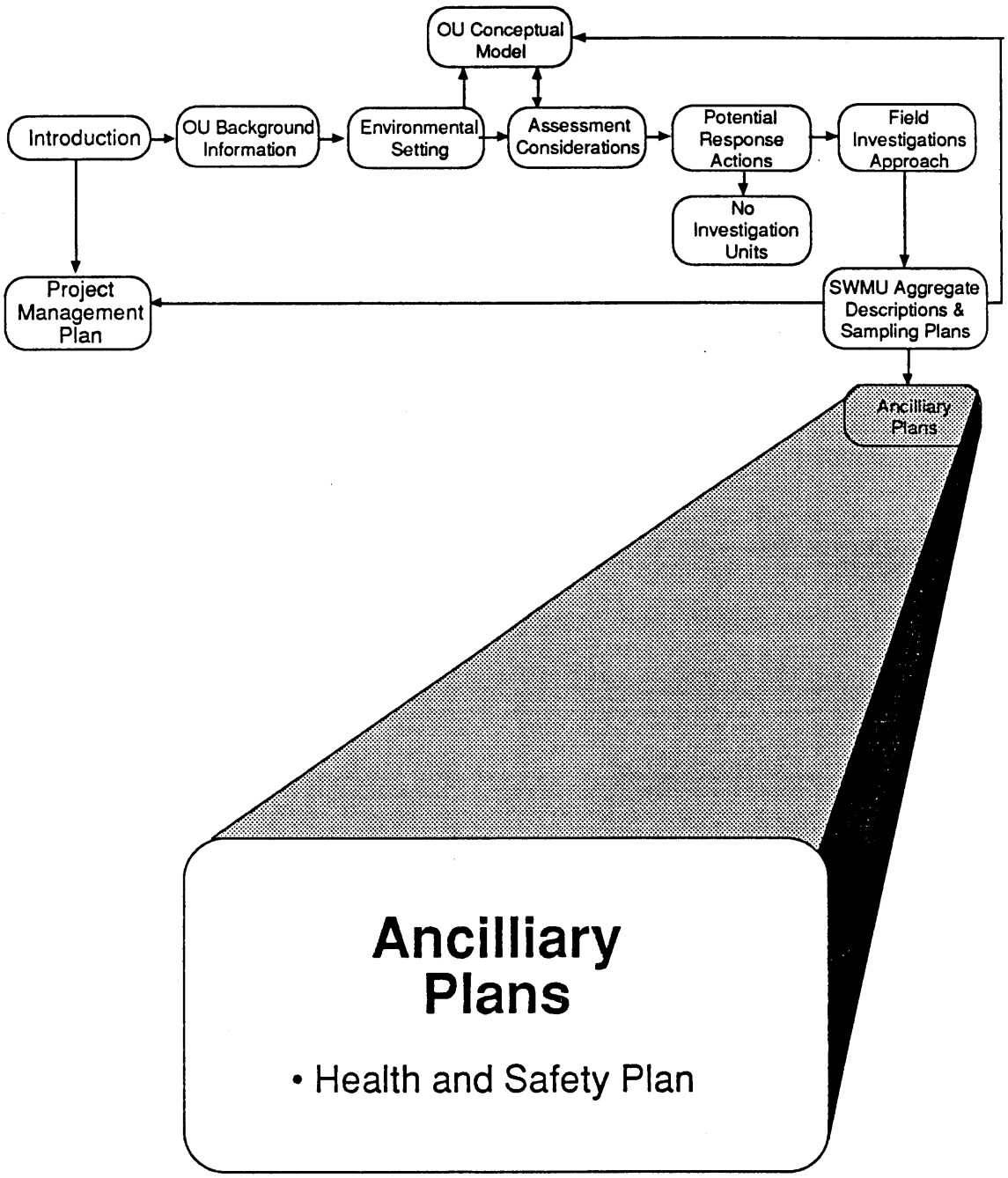
Gladney, E. S., and M. A. Gautier, January 1991. "Health and Environmental Chemistry Quality Assurance Program Plan," Los Alamos National Laboratory, Los Alamos, New Mexico.

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

LANL (Los Alamos National Laboratory), May 1991a. "Environmental Restoration Standard Operating Procedures," Vols. I, II, and III, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), May 1991b. "Generic Quality Assurance Project Plan," Rev. 0, Environmental Restoration Program, Los Alamos, New Mexico.

APPENDIX B


OU Conceptual Model
Introduction
OU Background Information
Environmental Setting
Assessment Considerations
Potential Response Actions
Field Investigations Approach
No Investigation Units
Project Management Plan
SWMU Aggregate Descriptions & Sampling Plans
Ancilliary Plans
Ancilliary Plans
• Health and Safety Plan

APPENDIX B – HEALTH AND SAFETY PLAN

1.0 Introduction

This OU-specific Health and Safety (H&S) Plan has been developed for the field investigations at TA-21. This plan includes an assessment of potential hazards, justification for personnel protection requirements, and site specific emergency response procedures. This document is tiered to the Installation Work Plan (IWP), Annex III, H&S Plan (LANL 1990). A copy of this plan must be kept on site at all times.

The specific purpose of this plan is to establish guidelines for field personnel involved in the OU-wide and SWMU-specific investigations at the TA-21 OU. This plan only applies to the field investigations associated with the TA-21 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, LANL 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. These standards and regulations have been established for the protection of workers on hazardous waste and radiation sites. The areas of concern at TA-21 are considered to have both hazardous waste and radioactively contaminated materials. Therefore, adherence to this plan is essential to the health and safety of workers as well as the general public.

The responsibilities of personnel with regard to the TA-21 OU health and safety as detailed herein do not distinguish whether Laboratory or contractor personnel are implementing this plan. If, at a later time, who implements this plan (i.e., contractor or Laboratory personnel) affects how it is implemented, this plan will be modified. EPA will be notified of any such modifications.

2.0 Site History

In 1945, plutonium purification operations were transferred to TA-21. The main purpose of DP West was to produce metal and alloys of plutonium and other transuranic elements from the nitrate solution feedstock provided by other national laboratories. Plutonium purification generated solid and liquid wastes principally disposed of in TA-21 MDAs. These plutonium-processing activities were transferred to TA-55 in 1977, and TA-21 buildings were remodeled for other uses.

DP East began operation in 1947. Facilities were used to process polonium and actinium and to produce initiators. In addition, a Tritium Systems Test Assembly is housed at DP East. Chapter 3 of the TA-21 work plan presents a more detailed operational history of TA-21. Additionally, specific historical information by SWMU is presented in field sampling plans in Chapters 13 through 20, as appropriate.

For a specific listing of the chemical and radiological contaminants, see Sec. 4 of this Appendix.

3.0 Policy and Standards

The following information describes policies and standards set forth in this plan. It includes: specific line of responsibility, standards and regulations, and requirements for audits and variances of health and safety policies.

3.1. General Responsibilities

The general responsibilities are contained in Sec. 5.0 of the IWP, Annex III, H&S Plan. Listed below are specific responsibilities for personnel involved in this OU investigation.

3.2. Individual Responsibilities

Within line management of the ER Program activities, there are certain employees and contractors with specific health and safety responsibilities. Listed in Fig. B-I is the field work organization chart showing the responsibilities of the line organization.

Los Alamos HSE Deputy Division Leader

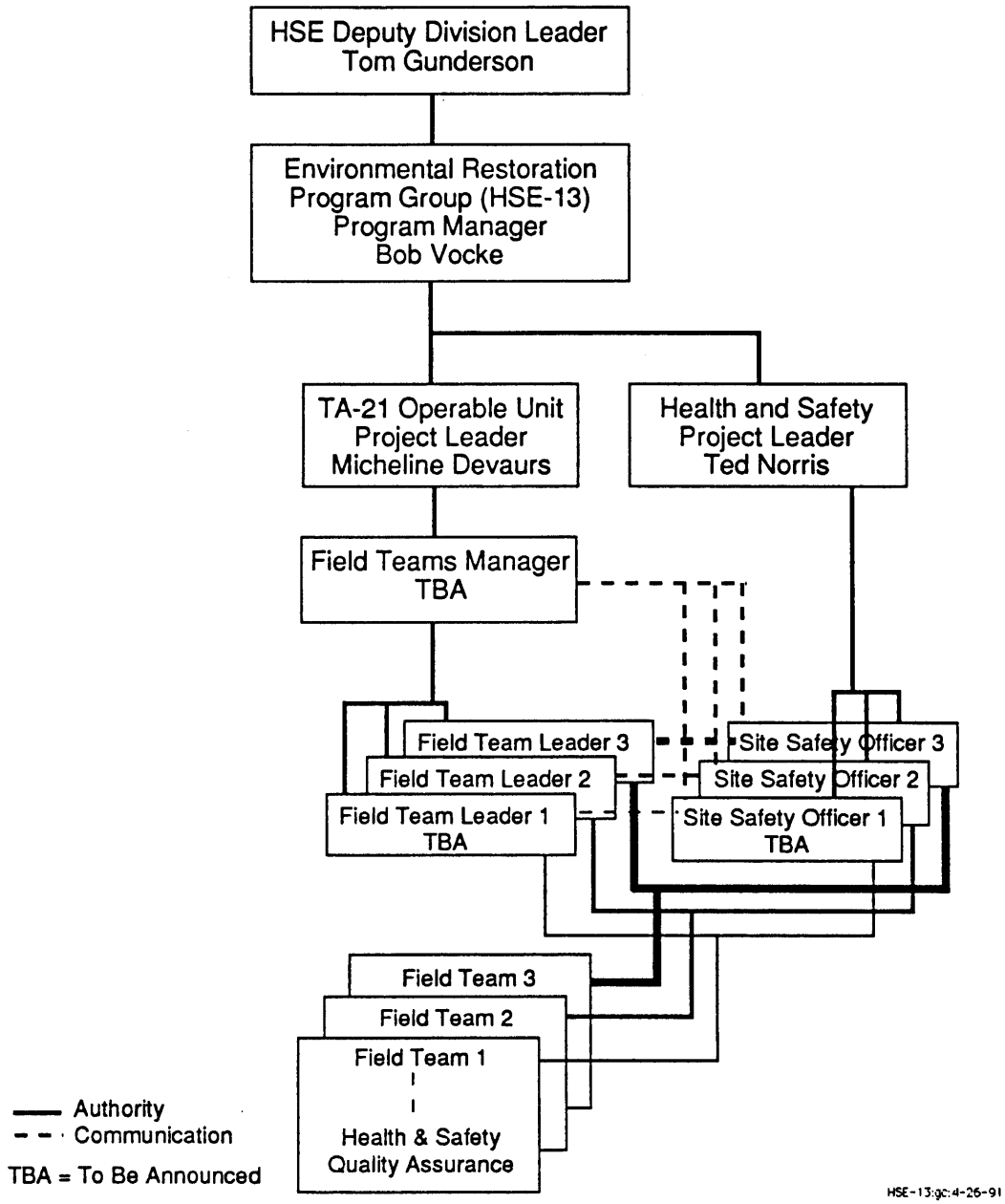
The Deputy Division Leaders are responsible for ensuring that programmatic health and safety concerns are addressed. They are also responsible for promoting a comprehensive health and safety program that will cover special fields such as radiation protection, occupational medicine, industrial safety, 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. He/she must ensure that the health and safety programs are established, implemented, and supported.

FIGURE B-1

TA-21 Operable Unit Field Work Organization, Showing Health and Safety Responsibility



Health and Safety Project Leader

The H&S Project Leader (PL) is responsible for updating and implementing the ER Program H&S Plan (LANL 1990) and for reviewing operable unit H&S Plans. He/she is also 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 OU PL is responsible for

- preparation, review, implementation, and revision of OU health and safety documents;
- interface with H&S PL to resolve health and safety concerns.

Field Teams Manager

The Field Teams Manager is responsible for

- compliance with the OU health and safety plan and responsibility for 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; and
- coordination of field activities with Laboratory personnel and contractors, as needed.

Field Team Leader

The Field Team Leader is responsible for

- 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.

Site Safety Officer

The following responsibilities apply to the Site Safety Officer:

- reading, complying, and enforcing this OU health and safety plan;
- performing and documenting initial inspections for all onsite equipment;
- evaluating the potential hazards at a site;
- 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 procedure 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 in the event of an emergency situation;
- ensuring all personnel have been trained in the appropriate safety procedures, have read and understood this OU health and safety plan, and that these requirements are followed during OU activities;
- conducting daily health and safety briefings for field team leaders and field team members; and

- having authority and requiring that field work be terminated if unsafe conditions develop or an imminent hazard is perceived.

Field Team Members

The specific responsibilities for Field Team Members may be found in Sec. 5.0 of the IWP Annex III, H&S Plan.

3.3 Health and Safety Audits

Health and safety audits will be performed during activities associated with this plan to ensure compliance. The frequency of these audits will be at least quarterly with a minimum of one audit during TA-21 remedial investigation. Audits will be conducted by the H&S PL, or a competent designee and documented in Health and Safety Audit Reports. The LANL HSE Deputy Division Leader, ER Program Manager, ER H&S PL, and OU PL will receive copies of this report. The individuals responsible for health and safety deficiencies noted in the audit findings will provide written responses describing corrective actions that have been implemented to resolve the findings.

The LANL HSE Division may also 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.

3.4. 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 Teams Manager and H&S PL. If the Field Teams Manager and H&S PL agree with the request, the request will be reviewed by the OU PL or his/her 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.

4.0 Hazard Assessment and Personnel Protection Requirements

The following section is designed to identify potential hazards associated with the field activities at the TA-21 OU. Due to the number of SWMUs involved in this RFI, hazards associated with all SWMUs will be listed first. The hazards unique to one or more areas of concern will be identified

by SWMU or building numbers. These areas of specific hazards will be reviewed again before work is performed at that particular location.

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 identifying the potential harm, the likelihood of occurrence, and measures to reduce the risk. It will then be written up 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 they have knowledge of the newly identified hazard.

4.1.1. 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 preventative measures, for this RFI.

Noise

The 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 (ACGIH 1990).

Many of the activities for this RFI have the ability to exceed these levels. Drill rigs and backhoes are a few examples of machinery that can produce noise levels above the established standards.

The following are standards established by ACGIH for noise exposure:

Duration/day in hours	Sound level 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 (National Safety Council 1971).

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. They 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 must 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 5 ft from the mesa edge; and marking trench and borehole boundaries.

Explosion/Fire/Oxygen Deficiency

The potential for flammable, or combustible, and oxygen deficient atmospheres is anticipated during drilling, trenching, and tank sampling. This would also include any unanticipated activity where flammable or combustible gases could collect in an enclosed area.

Flammable work 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. ER Program SOP, Health and Safety Monitoring of Combustible Gas Levels will also be followed.

Measurements of explosion potential will be made in the enclosed space or downhole for drilling using a combustible gas indicator (CGI)/oxygen meter. If the CGI indicator shows concentrations greater than 20 of the LEL (lower explosive limit), all activities in the 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 performed in enclosed or confined spaces and in areas that are not ventilated frequently. If oxygen levels fall below 19.5%, the area must be evacuated or supplied air respirators must be furnished to field personnel. 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.

CGI/O_2 readings will be performed according to ER Program SOP, Health and Safety Monitoring of Combustible Gas Levels.

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 by 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 occurring. Listed below are the physical reactions that can occur, ranging from mild to fatal.

Heat stress monitoring will be performed according to ER Program SOP, Heat Stress Monitoring.

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. This is where 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) + (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, causing death. 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, Cold Stress Monitoring.

Cold Related Illness

- Frost nip or incipient frostbite—characterized by a sudden whitening of the skin. If this occurs warm hands slowly and get person into warm dry clothes.
- Superficial frost bite—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 warmth as soon as possible, get them 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-21 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. In addition to the following requirements, ER Program SOPs Hollow Stem Auger and Trenching will be followed. Compliance with these requirements will significantly reduce the chance of personnel exposure to electrical shock.

1. Only qualified and licensed personnel will be allowed to operate this 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. 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 begins.

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.

4.1.2. Chemical Hazards

Chemical hazards that may arise at the Laboratory during the TA-21 RFI include inhalation, ingestion, or dermal absorption of heavy metals, PCBs, solvents, hydrocarbons, acids, beryllium, and other chemicals. Although field personnel should not have a need to enter buildings, asbestos may be present in some of the MDAs. This section is developed to identify and provide information on those specific chemical contaminants that are known to be present at TA-21. Information is presented for assistance in the identification of known contaminants via field-screening techniques. These same screening tools may identify some of the unknowns. When the unknowns are identified, they will be added to the plan's chemical contaminants of concern, Table B-I. The site safety officer will be responsible for adding chemicals to this table and for notifying field personnel as needed.

The information provided for the known contaminants will include the following: threshold limit value (TLV); immediately dangerous to life and health (IDLH) concentrations; exposure symptoms; ionization potential and relative response factor for commonly used instruments (note: this should be re-evaluated when the particular instrument is selected); and the best instrument for screening. The TLV (ACGIH) refers to a concentration of a chemical in which nearly all personnel may work for 40 hours/week over a lifetime without suffering any adverse health affects. Permissible exposure limits (PEL) are regulated standards by OSHA and are very similar to TLVs. The IDLH concentration is a concentration at which nearly all workers may be exposed for 30 minutes without suffering any irreversible health effects or escape impairing symptoms. The ionization

TABLE B-I
CHEMICAL CONTAMINANTS OF CONCERN

CONTAMINANT	EXPOSURE LIMIT	IDLH	SYMPTOMS OF EXPOSURE	ROUTE OF EXPOSURE	IP(eV)	MONITORING INSTRUMENT	RELATIVE RESPONSE
Polychlorinated Biphenols	0.2 ppm 1 mg/m^3	300 mg/m^3	Irritation of eyes; headache; nausea; fatigue; numb limbs; liver damage: chlor-acne	Inhalation Ingestion Contact	N/A	RAM[1]	Based on concentration in soil
Kerosene	N/A	N/A		Inhalation Ingestion Contact	N/A	PID FID	100% 150%
Benzene	1 ppm	Ca	Nose, eye, respiratory system irritation; giddy; headache; nausea; staggered gait, fatigue; anorexia; lassitude; dermatitis; abdominal pain	Inhalation Absorption Ingestion Contact	9.25	PID FID Dreager tube	100% 100%
Methanol	200 ppm	800 ppm	Eye irritation; headache; drowsy; light headed; nausea; vomiting; visual distortion; eyes burn; failure of vision	Inhalation Ingestion Contact	10.84	PID FID Dreager tube	10% 12%
Nitric acid	2 ppm	100 ppm	Mucous membrane, eye and	Inhalation	N/A	pH paper	

[1]Ca = Potential Human Carcinogens
PID = Photoionization Detector
RAM = Real Time Aerosol Monitor
FID = Flame Ionization Detector
IDLH = Immediately dangerous to life and health
IP = Ionization Potential in Electron Volts (eV)
N/A = Not Available

TABLE B-I
CHEMICAL CONTAMINANTS OF CONCERN

CONTAMINANT	EXPOSURE LIMIT	IDLH	SYMPTOMS OF EXPOSURE	ROUTE OF EXPOSURE	IP(eV)	MONITORING INSTRUMENT	RELATIVE RESPONSE
Nitric acid (continued)			skin irritation; delayed pulmonary edema; pneuitis; bronchitis; dental erosion	Ingestion Contact			
Ethyl benzene	100 ppm	2000 ppm	Eye, mucous membrane irritation; headache; dermatitis; narcosis coma	Inhalation Ingestion Contact	8.76	PID FID	100% 100%
Toluene	100 ppm	2000 ppm	Fatigue; weakness; confusion; euphoria; dizziness; headache; dilated pupils; lacrimation; nervous muscle fatigue; insomnia; dermatitis; photophobia	Inhalation Absorption Ingestion Contact	8.82	PID	100%
Xylene	100 ppm	10,000 ppm	Dizziness; excitement; eye, throat, nose irritation; corneal vacuolization; drowsiness; incoherence; anorexia; staggering gait; vomiting; abdominal pain; dermatitis	Inhalation Ingestion Contact	8.56 Absorption	PID	113% FID 114%
Acetone	250 ppm	20,000 ppm	Eye, nose, throat irritation; headache; dizziness; dermatitis	Inhalation Ingestion Contact	9.69	PID FID	63% 60%

TABLE B-I
CHEMICAL CONTAMINANTS OF CONCERN

CONTAMINANT	EXPOSURE LIMIT	IDLH	SYMPTOMS OF EXPOSURE	ROUTE OF EXPOSURE	IP(eV)	MONITORING INSTRUMENT	RELATIVE RESPONSE
1,1,2-Trichloro-ethane	10 ppm	Ca	Eye, nose irritation; CNS depression; liver and kidney damage	Inhalation Absorption Ingestion Contact	N/A	FID	85%
Trichloroethylene	50 ppm	Ca	Headache; vertigo; visual distortion; tremors; nausea; somnolence; vomiting; eye irritation; dermatitis; cardiac arrythmia	Inhalation Ingestion Contact	9.47	PID FID	89% 70%
Iodine	0.1 ppm	10 ppm	Eye, nose irritation; tight chest; lacrimation; headache skin burns; rash; vomiting; cutaneous hypersensitivity; burns mouth; abdominal pain; diarrhea		9.37	PID	45%
Tetrachloro-ethylene	50 ppm	Ca	Eye, nose, throat irritation; nausea; flush face and neck; vertigo; dizziness; incoherence; headache; somnolence; erythema	Inhalation Ingestion Contact	9.32	FID	100%
Sodium hydroxide	2 mg/m^3	250 mg/m^3	Eye irritation; pneumonitis; burns eyes and skin; temporary loss of hair	Inhalation Ingestion Contact	N/A	pH paper	

TABLE B-I
CHEMICAL CONTAMINANTS OF CONCERN

CONTAMINANT	EXPOSURE LIMIT	IDLH	SYMPTOMS OF EXPOSURE	ROUTE OF EXPOSURE	IP(eV)	MONITORING INSTRUMENT	RELATIVE RESPONSE
Cadmium	0.05 mg/m^3	Ca	Pulmonary edema; dyspnea; coughing; tight chest; chills; substernal pain; headache; muscle achne; nausea; diarrhea; anosmia; emphysema; proteinurea	Inhalation Ingestion	N/A	Miniram	
Lead	0.05 mg/m^3	Ca	Lassitude; insomnia; pallor; eye grounds; anorexia; low weight; malnutrition; anemia constipation; abdominal pain; hypotension; tremors	Inhalation Ingestion	N/A Contac	Miniram	
Chromium	1.0 mg/m^3	500 mg/m^3	Histologic fibrosis of lungs	Inhalation Ingestion	N/A	Miniram	
Beryllium	0.5 ug/m3	Ca	Respiratory systems; fatigue; weakness; weight loss		Inhalation		N/A Miniram
Mercury	0.1 mg/m^3	28 mg/m^3	Coughing; dyspnea; bronchial pneumonia; tremors; insomnia, irritability; indecision; fatigue; anorexia; weakness; stomatitis; low weight; salivation; eye and skin irritation; proteinurea	Inhalation Absorption	N/A Contac	Miniram	

TABLE B-I
CHEMICAL CONTAMINANTS OF CONCERN

CONTAMINANT	EXPOSURE LIMIT	IDLH	SYMPTOMS OF EXPOSURE	ROUTE OF EXPOSURE	IP(eV)	MONITORING INSTRUMENT	RELATIVE RESPONSE
Hydrofluoric acid	3 ppm	30 ppm	Eye, nose, and throat irritation; pulmonary edema; skin and eye burns	Inhalation Absorption, Ingestion Contact	NA	Air sampling	NA

potential is a characteristic of chemicals and is used in photoionization detectors to determine if the instrument may see the compound. The relative response factor reflects the percentage of the compound that an instrument will see. There are relative response factors for both photoionization and flame ionization detectors. The Site Safety Officer will be responsible for having available general reference (NIOSH 1985a) with chemical specific information for compounds that are discovered during the RFI.

Table B-II describes the suspected chemical(s) for each individual SWMU or groups of similar SWMUs and TA-21- OU-wide contaminants. Also listed in this table are the initial levels of protection. Figures B-2 to B-4 show the major features of the TA-21 OU and the associated SMWU locations.

4.1.3. Radiological Hazard

Radionuclides that might be present at TA-21 sites include ^{238}Pu, $^{239/240}Pu$, ^{238}U, tritium, ^{241}Am, curium, ^{227}Ac, and ^{90}Sr, $^{230/232}Th$; and others are suspected. There are three principal pathways where individuals may be exposed to radioactivity during field investigations as follows:

- inhalation or ingestion of radionuclide particulates or vapors;
- dermal absorption of radionuclide particulates or vapors through wounds; and
- exposure to direct gamma radiation from contaminated materials.

Soils will be screened in accordance with the SOP, Near Surface and Soil Sample Screening for Low Energy Gamma Radiation. The specific properties of the above radionuclides, including type of emission and half life, are provided in Table B-III. As concentrations of these radionuclides are determined, and as new radionuclides are discovered, Table B-III will be updated. The site safety officer will be responsible for adding radionuclides to this table and for notifying field personnel as needed. Table B-II describes the suspected radionuclides for each individual SWMU or groups of similar SWMUs and TA-21-OU-wide contaminants.

4.1.4. Biological Hazards

Biological hazards will likely be encountered in some of the areas of TA-21. Rattlesnakes may be encountered in the areas near the mesa in high grass. This includes the outfalls (see Chapter 15 of TA-21 work plan) and the sewage treatment plant (see Chapter 14 of the TA-21 work plan). If

TABLE B-II
SUSPECTED CHEMICAL AND RADIOLOGICAL CONTAMINANTS AT
TA-21 OU AND INDIVIDUALS SWMUS

SWMU Number	Suspected Chemical Contaminants	Suspected Radiological Contaminants	Activity	Initial Level of Protection
All DP West and DP East		Pu, U	1) Surface soil sampling 2) Drilling	Dependent upon SWMU location
DP West	Flourine, iodine, lead cadmium, beryllium, mercury, sodium, nitrates, chlorine, solvents such as: acetone TCE, TCA, xylene, toluene and benzene	Pu, U, Th, ^{3}H, Ac, Am, Sr, Cm, Ba	1) Surface soil sampling 2) Drilling	Dependent upon SWMU location
DP East	Metals such as: lead, cadmium, beryllium	Po, Ac	1) Surface soil sampling 2) Drilling	Dependent upon SWMU location
SWMU 001	Metals, solvents	Pu, U, ^{3}H, and other various radionuclides	1) Surface soil sampling 2) Near surface soil sampling	Level D Level D
SWMU 002	Solvents	^{3}H	1) Near surface sampling	Level D
SWMU 003	Kerosene, toluene xylene, PCBs, copper		1) Near surface 2) Surface 3) Drilling	Level D Level D Level D
SWMU 004 (intrusive)		Assorted radionuclides	1) Surface 2) Tank	Level D Level D (remote) Level B
SWMU 005 (intrusive)	Nitric acid		1) Drilling 2) Trenching	Level D Level D (remote) Level B
SWMU 006	Fluorine	Pu, U, and other radionuclides from DP West	1) Drilling	Level D
SWMU 007	Oils and fats (petroleum products)	Radionuclides from DP West could be any of them	1) Drilling	Level D
SWMU 008	Ethyl ether, fluorine, nitric acid, aluminum nitrate,sulfur hydroxide, tributyl phosphate	Assorted radionuclides from DP West	1) Drilling	Level D
SWMU 009	None	None		Level D

TABLE B-II (continued)

SWMU Number	Suspected Chemical Contaminants	Suspected Radiological Contaminants	Activity	Initial Level of Protection
SWMU 010 and 011	Fluorine, iodine, lead ethyl ether, nitric acid, cadmium, mercury, beryllium, sodium, nitrates, chlorine, solvents, petroleum residues, hydrocarbons	Pu, U, Th, ^{3}H, Ac, Am, Sr, Cm, Ba	1) Surface 2) Near surface 3) Drilling	Level D Level C Level C
SWMU 012	Chromium		1) Drilling	Level D
SWMU 013(d)	1,1,1, TCA and other solvents	Potential radioactive debris		Level D
SWMU 014	Metals (lead, beryllium), solvents (acetone, TCE), organics	Pu, Am, and Po	1) Surface 2) Near surface 3) Drilling	Level D Level D Level C
SWMU 015	Organics, solvents, perchlorates, ethers, corrosives	Pu, U, Am, Cm, and Ac	1) Surface 2) Near surface 3) Drilling	Level D Level D Level C
SWMU 016	Lead, mercury, flourine, cadmium, nitric acid, ammonium citrate, citric acid, chlorine, solvents	Pu, Am, transuranic waste, ^{3}H, and others suspected	1) Surface 2) Near surface 3) Drilling	Level D Level D Level C
SWMU 017	Beryllium, PCBs, oil, petroleum, organics, solvents	Ac, Pu, Am, Po, and others suspected	1) Surface 2) Near surface 3) Drilling	Level D Level D Level C
SWMU 018	Solvents such as TCE, acetone, TCA, and others suspected	^{89}Sr, ^{90}Sr, ^{140}Ba, ^{140}La, ^{239}Pu, ^{3}H, and U	1) Surface 2) Near surface 3) Drilling	Level D Level D Level D
SWMU 019	Metals	(a ,c) ^{235}U (b) Pu and mixed fission products (d,g,h,i,j,k,l,m) Pu (e,f) tritium gas, tritium oxide	1) Surface	Level D
SWMU 020	Hydrofloric acid	Pu and others suspected		Level D
SWMU 021	Metals	Pu and Sr	1) Surface	Level D
SWMU 022	Nitric acid and metals	Pu and ^{2}H	1) Drilling	Level D

TABLE B-II (continued)

SWMU Number	Suspected Chemical Contaminants	Suspected Radiological Contaminants	Activity	Initial Level of Protection
SWMU 023	Metals, solvents possible	Possible radioactive waste	1) Surface 2) Near surface	Level D
SWMU 024	(a)Sulfite, copper salts, fuels, lead, mercury, zinc, and copper	Pu, ^{3}H, and U	1) Surface 2) Near surface	Level D Level D
	(b) Lead	^{241}Am, ^{239}Pu, and ^{3}H	1) Surface 2) Near surface	Level D Level D
	(c) Chromium, copper, lead, mercury, oil and grease, dichloromethane	^{241}Am, ^{238}Pu, $^{239,240}Pu$, ^{3}H, $^{234,235}U$, ^{238}U	1) Surface 2) Near surface	Level D Level D
	(d) Lead, mercury, oils	^{241}Am, ^{238}Pu, $^{239,240}Pu$, and ^{3}H	1) Surface 2) Near surface	Level D Level D
	(e) Lead, mercury, zinc, and oils	^{3}H, and $^{234,235}U$, and ^{238}U	^{241}Am, ^{238}Pu, $^{239,240}Pu$, 2) Near surface	1) Surface Level D Level D
	(f) Solvents, mercury, and lead	^{239}Pu and ^{3}H	1) Surface 2) Near surface	Level D Level D
	(g) TCE and arsenic		1) Surface 2) Near surface	Level D Level D
	(h) Organics, inorganics Level D		^{3}H, ^{227}Ac, and ^{210}Po 2) Near surface	1) Surface Level D
	(i) Arsenic, barium, beryllium, copper, cadmium, lead, mercury, selenium, vanadium, zinc	^{239}Pu, ^{236}Ra, $^{234,235}U$, ^{238}U and ^{3}H	1) Surface 2) Near surface	Level D Level D
	(j) Organics, metals, solvents		1) Surface 2). Near surface	Level D Level D
	(k) Organics, metals, solvents		1) Surface 2) Near surface	Level D Level D
	(l) Zinc	^{241}Am, ^{239}Pu, ^{3}H, and U	1) Surface 2) Near surface	Level D Level D
	(m) Organics, inorganics Level D		Possible radionuclides 2) Near surface	1) Surface Lev el D

TABLE B-II (continued)

SWMU Number	Suspected Chemical Contaminants	Suspected Radiological Contaminants	Activity	Initial Level of Protection
	(n) Petroleum		1) Surface 2) Near surface	Level D Level D
	(o) PCBs, organics, lead, and solvents		1) Surface 2) Near surface	Level D Level D
SWMU 025		^{3}H and ^{2}H	1) Surface	Level D
SWMU 026	Nitrates, solvents, and possible organics	Pu, U, Am and ^{3}H	1) Surface 2) Near surface 3) Subsurface	Level D Level D Level D
SWMU 027	(a) None identified (b) Chromium (c) Metals and acids (d) Fuel oils and solvents (B,E,T,X)	Various radionuclides	1) Surface 1) Surface 1) Surface 1) Surface	Level D Level D Level D Level D
SWMU 028	Solvents	^{3}H	1) Surface 2) Near surface	Level D Level D
SWMU 029	Fuel oil, kerosene, diesel, (B,E,T,X)		1) Near surface 2) Drilling	Level D Level D
Building 3 (West Side)	Hydrofluoric acid[a]		1) Near surface 2) Drilling	Level D Level D

[a] Note: Exposure to hydrofluoric acid requires special medical procedures which are found in Sec. 5.2.2, Personnel Injuries.

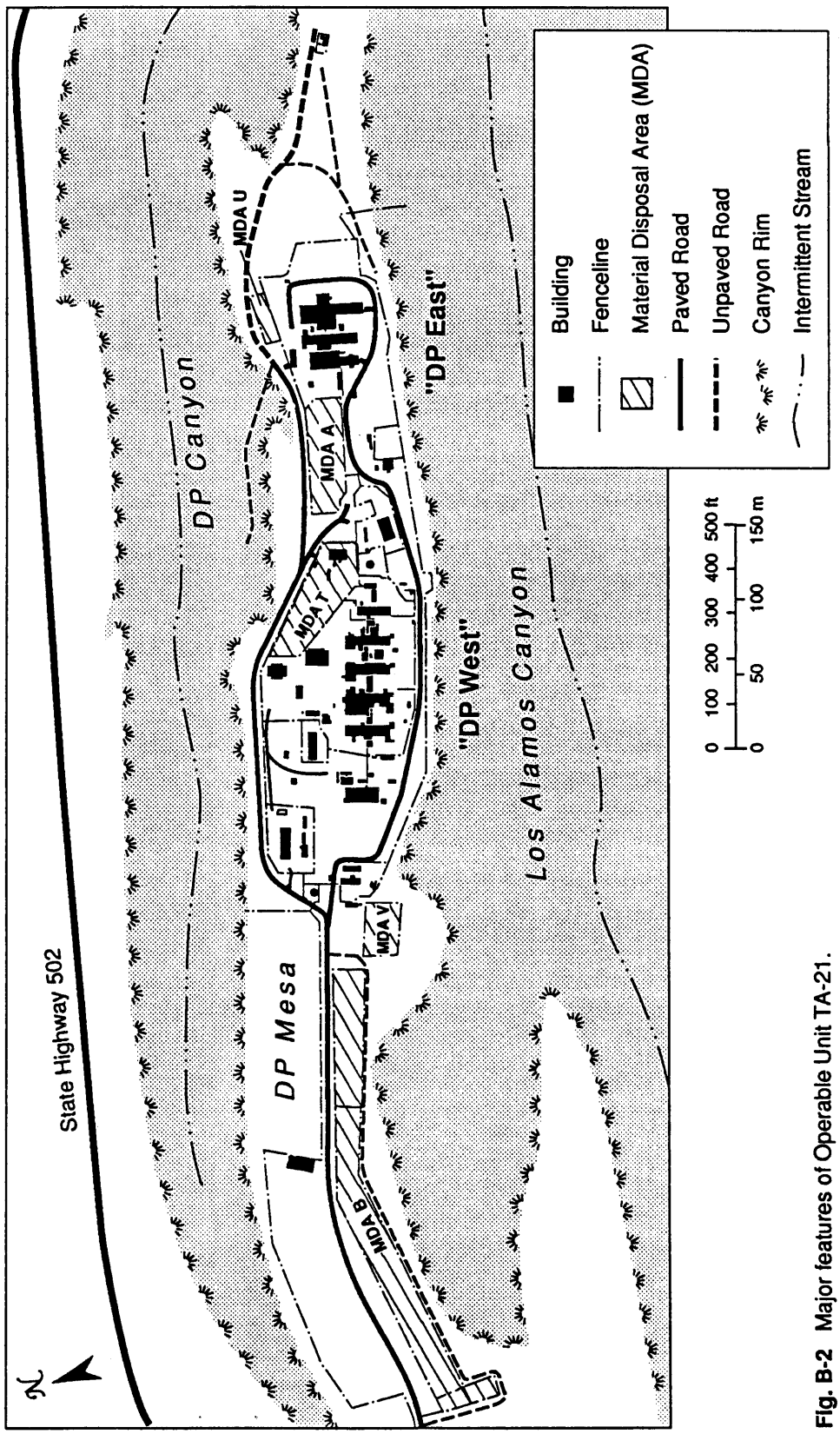


Fig. B-2 Major features of Operable Unit TA-21.

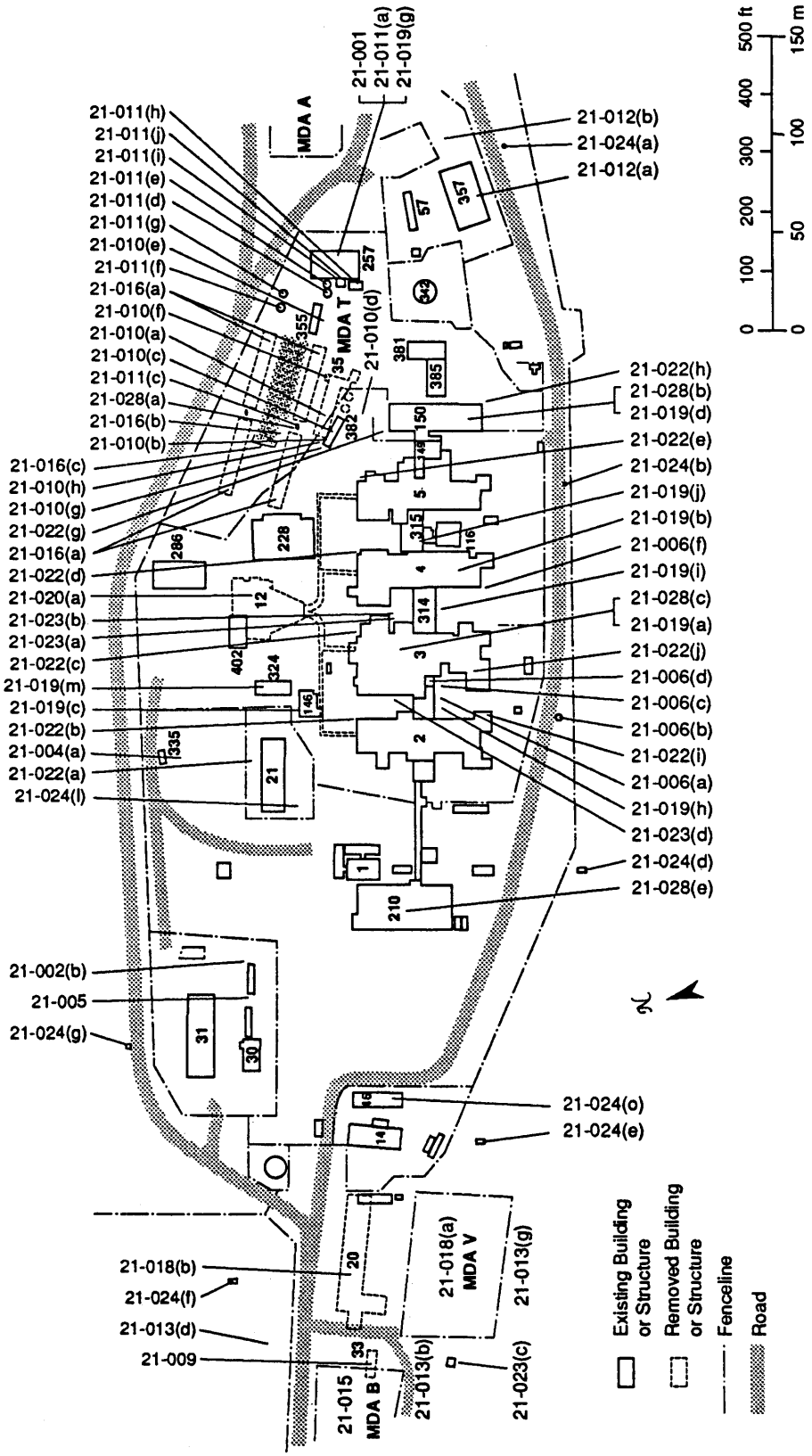


Fig. B-3 Location of SWMUs at DP West.

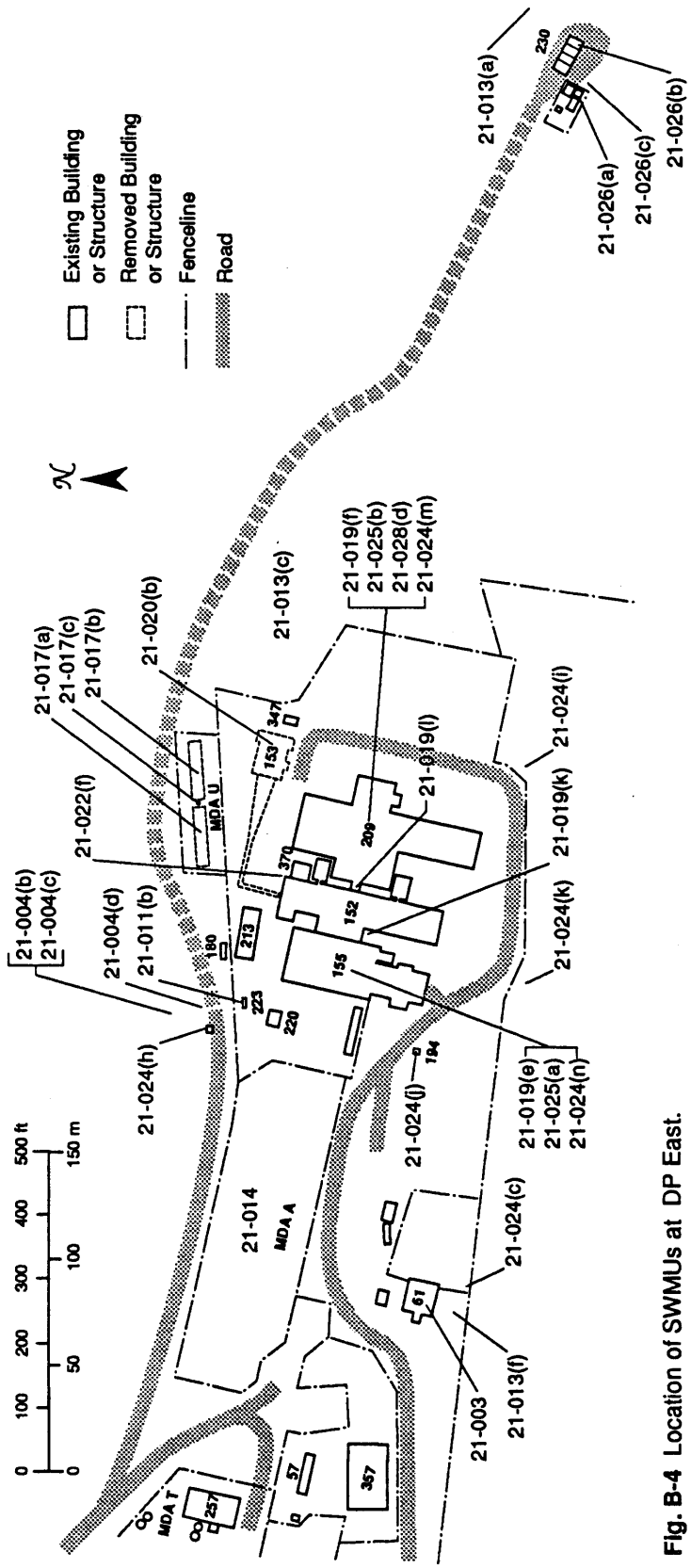


Fig. B-4 Location of SWMUs at DP East.

TABLE B-III. RADIONUCLIDES OF CONCERN

Radionuclide	Major Radiations	DAC (≤Ci/mL)	Critical Organ	Radioactive Half-Life	Monitoring Instrument
Plutonium-238	Alpha, gamma	3×10^{-12}	Bone	87.7 yrs	Alpha scintillometer FIDLER
Plutonium-239	Alpha, gamma	2×10^{-12}	Bone	2.4×10^{4} yrs	Alpha scintillometer FIDLER
Plutonium-240	Alpha, gamma	2×10^{-12}	Bone	6537 yrs	Alpha scintillometer FIDLER
Tritium	Beta	3×10^{-5}	Total body tissue	12.26 yrs	Liquid scintillation
Actinium-227	Beta, gamma	7×10^{-13}	Total body	21.6 yrs	GM, NaI
Thorium-229	Alpha, gamma	4×10^{-13}	Lung, bone	7340 yrs	Alpha scintillometer
Thorium-230	Alpha, gamma	3×10^{-12}	Lung, bone	8×10^{4} yrs	Alpha scintillometer
Thorium-232	Alpha, gamma	5×10^{-13}	Lung, bone	1.41×10^{10} yrs	Alpha scintillometer, NaI
Uranium-234	Alpha, gamma	2×10^{-11}	Lung, GI	2.47×10^{5} yrs	FIDLER, alpha scintillometer
Americium-241	Alpha	2×10^{-12}	Bone	432 yrs	Alpha scintillometer
Polonium-210	Alpha, gamma	3×10^{-10}	Total body	138.4 days	Alpha scintillometer
Curium-244	Alpha	4×10^{-12}	Bone	18.1 yrs	Alpha scintillometer
Barium-140	Beta, gamma	6×10^{-7}	Total body	12.79 days	GM
Strontium-90	Beta	8×10^{-9}	Bone	29 yrs	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.
GI - gastrointestinal tract
GM - Geiger-Müller detector
NaI - sodium iodide scintillometer

field personnel are in these areas, workers should wear snake leggings or have the grass mowed. If a snake bite does occur, the Emergency Medical System (EMS) should be notified immediately. The only first aid treatment that should be administered is that ice or a cold pack should be placed just above the affected area to slow blood flow.

In addition to snakes, mosquitoes, ticks, spiders, and rodents, including mice and rats, may be encountered. If workers are bitten by insects, first aid creams should be applied by the site safety office to ease the symptoms caused by the bite. If personnel are bit by a rodent, attempts should be made to obtain the animal, and medical assistance should be sought as soon as possible.

4.2. 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-21 OU. This section is designed to take each of the proposed tasks and identify which of the hazards apply and estimate the likelihood of exposure. Sections 4.3, 4.4, and 4.5 of this Appendix identify methods for eliminating or reducing the potential exposure to the hazards associated with these tasks.

Task: Drilling

Likelihood of Exposure: High

Associated Hazards: In drilling, there is a great possibility for 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 occur when drilling disturbs or penetrates a contaminated pocket of soil. This happens quite frequently during the drilling process. The rig will stir some dust and will generate heat, which will volatilize organics in the soil. These factors combine greatly to enhance the possibility of exposure to field personnel.

Task: Hand Augering

Likelihood of Exposure: Moderate

Associated Hazards: The hazards for hand augering are similar to that of drilling. The potential for contact with contaminated soils is enhanced, and this operation will have a tendency to stir more dust. Using a powered hand auger may still present the operator entanglement and pinch point hazards but to a lesser degree. With a nonpowered hand auger, the probability of physical injury is reduced greatly.

Task: Trenching

Likelihood of Exposure: High

Associated Hazards: The physical hazards associated with trenching operations are based on two main factors. The use of heavy equipment and potential excavation cave-ins on personnel in the trench. Operators of heavy equipment are trained to be aware of personnel around the area. However, sometimes the operator gets distracted or loses concentration. Therefore, personnel must be alert while the backhoe is 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. Physical injuries, as a result of cave-ins, range in severity with the most severe being death.

Chemical/radiological hazards are likely to be encountered while trenching is in progress. The hazards include inhalation of airborne dusts, volatiles, and alpha particles. Although these hazards may be present at all times, higher levels should be excepted at certain times. During the actual excavation of the trench, the most concentrated personnel exposure may occur from the stirring of dust and radioactive particles. Whereas, the accumulation of vapors inside the trench will conceivably occur after the trench has been completed. Monitoring of the hazards at these times is critical.

Task: Tank Sampling

Likelihood of Exposure: Moderate

Associated Hazards: The above-ground tanks that are proposed for sampling were designed for overflow collection. Background information indicates that these tanks have not been necessary and are empty. However, until the tanks have been opened, it must be assumed they contain contaminated material. Tanks that contain toxic or radioactive materials are a hazard to

the field team member tasked with the opening of the tanks. Tanks are considered confined spaces and allow for a build-up of dangerous levels of vapors and gasses.

There are also physical hazards that are associated with this activity. The most common injury related to tank sampling is from falling from the tank. The sampling crew should not climb or sit on a tank without the proper safety equipment and should be aware of unsecured permanent ladders and railings. Hand tools and tank covers may also cause injury if not properly handled.

4.3. 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 should be utilized, if possible, while working in the field.

Engineering Controls For Airborne Dust

Airborne dust can be a hazard in two situations: 1) nuisance dust for which standards have been established at 10 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. This has been effective in the past, however, these sprayers do not discharge a large amount of water and must be repeated often to maintain moist soils.

Where there are high winds in an area of little or no vegetation, and a large, dusty area, 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 will also require frequently repeated applications to be effective.

Engineering Controls For Airborne Volatiles

Drilling, trenching, soil and tank sampling 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. Even nature provides some engineering controls that may be utilized to assist in the dissipation of vapors. The wind can be used to remove toxic vapors from the work area. This can be accomplished by careful position of the equipment, such as a drill rig. The most effective means would be to establish a crosswind or position the rig where the wind is blowing towards the side of the rig. This allows the vapors to be blown away from personnel behind the rig and prevents them from collecting under the rig; and allows for an upwind approach of workers not performing duties directly related to the drilling (i.e., a geologist).

Another method is the use of ventilation by mechanical means. This may not be as effective as wind in open areas but may be more desirable 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, and they should be consulted for information on the most effective method for each situation.

Engineering Controls For Noise

Engineering controls for noise are difficult to design for an uncontrolled environment. 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 is covered, whereas the sides are left open to allow cooling of the engine. This demonstrates that barriers seem to work as effective noise reduction. If noise levels reach 90 dB, barriers should be utilized, if possible, to reduce excessive noise exposure.

4.3.4. 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. Benching will normally be found in very large excavations, such as surface mining operations. 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 principle theory is the same. The sides of the excavation are supported by some type of wall that is braced to prevent cave-ins. This method is used most often in deep, narrow trenches for installing water pipe or drainage systems and exploratory trenching. 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. There are administrative controls and personnel protective systems that are more desirable and realistic for the work at TA-21.

4.3.5. Engineering Controls For Drilling

Working with and around drill rigs presents workers with a great number of hazards. This is due to the number of moving parts and the power associated with the equipment. Engineering controls for this apparatus 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 periodically during the project.

4.3.6. Engineering Controls For Tank Sampling

One important aspect of tank sampling was discussed earlier in Engineering Controls for Airborne Volatiles. Removal of the potentially toxic environment in the tank's headspace is critical. In addition, lock-out/tag-out and other confine-space entry procedures should be followed to insure

zero energy is reached. Zero energy means that there is no potential for energizing or engaging any mechanical or electrical system that may potentially affect workers in the confined space. This is important even if there will be no personnel entry into that space. It has been proposed that all tank sampling be performed remotely (no personnel entry); however, workers will have to place a sampling tool inside the tanks that may be caught by mechanical devices inside the tank, such as mixers. Lock-out/tag-out and confined-space procedures will follow the Laboratory's administrative requirements (AR) 8-1_X and AR 8-6.

Personnel should also be aware that the potential for slip trip and fall hazards may exist. Ladders, railings, and walkways are a form of engineering controls. If these are not available, then Administrative controls or personnel protective equipment should be utilized.

4.4. 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. One example would be the amount of time or the proximity to a hazardous area a worker is allowed to remain. These may be instituted easily in most cases and are effective measures in decreasing personnel exposure.

4.4.1. 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, all nonessential personnel should only enter the contaminated zone when they are required. This not only lowers the exposure but complies with DOE's policy of exposures being 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.

4.4.2. 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 Sec. 4.1.1, noise is discussed, and the guidelines established by ACGIH are listed. In the table, you can see that ACGIH has formally established administrative controls. The basic idea is the louder the noise the more distance you must put between the noise and yourself or you must spend less time at the source. Although the principle of sound reduction by distance was not discused earlier, it is an effective method of reducing noise intensity. 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 person doubles the distance or is 20 ft from the source, the sound level drops to 94 dB; 30 ft, or triple the distance to the source, the sound level drops to 90 dB.

Distance is probably the better of the two methods for lowering the level of noise. If neither of these methods is possible, personnel protective equipment must be donned to protect workers.

4.4.3. Administrative Controls for Trenching

Administrative controls are the most effective method for reducing the hazards of the trench investigations proposed for TA-21. 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. Trenches less than 5-ft deep do not require protective systems (sloping, benching , or shoring). 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.

One important factor is that even though these standards are followed, accidents may still occur. Human error always plays a role in the causation of an accident. 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.

4.4.4. Administrative Controls for Tank Sampling

Chemical, radiological, and physical hazards may be encountered during tank sampling. The physical hazards are often ignored when obtaining this type of sample. The administrative controls for prevention of physical hazards during tank sampling include the following:

- make sure to check the tank's integrity;
- do not climb on a tank that does not have steps and hand rails;
- inspect stairs and hand rails for stability and condition before using them; and
- if sampling a tank with no stairs or handrails higher than 4 ft, ladders and personnel protective equipment (fall protection) are to be used.

The administrative control designed for chemical/radiological hazards associated with the proposed tank sampling is that sampling should be performed as remotely as possible. This places personnel at a distance from inhalation, ingestion, or direct contact with the sampled substance.

4.4.5. Administrative Controls for Working Near the Mesa Edge

Slip, trip, and fall hazards will exist around the mesa edge. These hazards may be avoided by good housekeeping around the work area near the edge of the mesa. Additionally, personnel working around the mesa will not get closer than 5 ft to the edge. If necessary, bannerguard will be used to delineate this restricted area. One exception to this requirement is for the outfall sampling. In that instance, the worker taking the sample will be required to be tied off before he/she is allowed to descend over the edge.

4.5. Personnel Protective Equipment and Systems

In the event 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 will discuss

the protective equipment or systems to be used in certain situations.

4.5.1. Protection Levels and Protective Clothing

The U.S. Environmental Protection Agency (EPA) has established four levels of protection for workers entering potentially hazardous sites. At many of the SWMUs at the TA-21 OU, the contaminants have been identified. Therefore, an assessment has been made based on each of the contaminants, investigation activities, and the areas to be investigated. The action levels for upgrades in levels of protection have been selected based on those factors and are given in Sec. 4.5.2, Action Levels for Upgrade in Protection.

The majority of site characterization will begin in modified level D protection. In certain cases, Levels C and B may be prescribed due to the amount or toxicity of the contaminants present. Personnel entering the contaminated zone 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 listed below.

Level B Protection will include the following:

- a full face, positive pressure, self-contained breathing apparatus (MSHA/ NIOSH-approved);
- chemical-resistant disposable clothing suitable for protection against the hazards of concern;
- inner glove (pvc, latex, or nitrile);
- rubber outer gloves providing the best 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.

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 the best 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-21 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.

4.5.2. 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. The action levels established below are based on the results obtained during SWMU-specific monitoring. In some instances, analytical lab screening with quick turn around and lab analysis will be necessary to determine the actual level of the specific chemical contaminant in air. For instance, there are no direct reading instruments for PCBs, but there is a real time aerosol monitor (RAM) that determines the amount of respirable dust present in the breathing zone. A PCB soil concentration will be obtained from the lab and plugged into a formula, which will determine the total PCB concentration in air, based on a total particulate reading from the RAM. This data may also be confirmed with air sampling. Air sampling will be used exclusively for determining alpha contamination in air. As of the writing of this plan, the organization implementing this plan has not been selected. The selected organization must 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)

A description of the PID may be found in Sec. 9.3 of the IWP, Annex III, H&S Plan.

Flame Ionization Detectors (FID)

Flame ionization detectors are also used to monitor total organic vapors. However, this instrument uses a flame to ionize the contaminant. It reads in ppm of methane, which is the calibration gas. The FID is more effective at reading lower-chain compounds.

Combustible Gas Indicator (CGI)

A description of the CGI may be found in Sec. 9.3 of the IWP, Annex III, H&S Plan.

Oxygen Meter

A description of the oxygen meter may be found in Sec. 9.3 of the IWP, Annex III, H&S Plan.

Real Time Aerosol Monitor

The real time aerosol monitor is designed to monitor respirable particulates (<10 microns). The instrument uses reflective light, which is converted to units of mg/m^3. This is useful if there are known concentrations in soil of alpha radiation, particulates, metals, and PCBs. Soil samples will be submitted to the lab, and the analysis will be used to determine action levels for the contaminants that are present.

Colormetric Detector Tubes

A description of the colormetric detector tubes may be found in Sec. 9.3 of the IWP, Annex III, H&S Plan.

High- and Low-Volume Air Samplers

A description of the high- and low-volume air samplers may be found in Sec. 9.3 of the IWP, Annex III, H&S Plan.

Radiation Survey Meters

A variety of radiation survey meters will be used in this OU specific investigation to determine the levels of radiation workers are exposed to. 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 exposure to field team members. In addition, Thermoluminescent Dosimeters (TLDs) will be worn by all personnel while at TA-21.

Action Levels

The following guidelines are to be used at each of the SWMU locations of the TA-21 OU. Readings are to be taken according to ER Program SOPs. They describe procedures and frequency of monitoring.

Volatiles

Contaminants at TA-21 are estimated from the historical information that has been gathered for the preparation of this plan. If present, most of these chemicals are expected to be at or near background levels. Therefore, the concentration ranges for each level of protection prescribed below are based on known contaminants.

Benzene has the most restrictive exposure limit of all the chemicals currently known to be present at TA-21. The limit for benzene is 1 ppm and is detected by the PID and the FID with a response factor of 100%. However, benzene does not have the adequate warning properties required for respirator use. Therefore, when PID or FID readings reach 1 unit (ppm as to methane) above background, benzene specific colormetric tubes will be used to determine benzene levels. If benzene levels are below 1 ppm, level D protective equipment is adequate. If benzene levels are above 1 ppm, Level B must be donned or personnel will be evacuated, and engineering controls will be implemented to reduce airborne concentrations. Work may be resumed when benzene levels return to background.

If benzene is determined not to be present, the action level for engineering controls, or level C protection is 8.5 units above background. This is based on the chemical with the second most restrictive exposure limit, which is 1,1,2-trichloroethane. The PEL for 1,1,2-trichloroethane is 10 ppm and has a PID relative response factor of 85%.

The maximum concentration for respirator use is 50 ppm. At this time, Level B will be donned or personnel will be evacuated, and engineering controls will be implemented to lower the concentration of airborne contamination.

Combustible Vapors

The CGI will be used to monitor for combustible atmospheres during drilling, trenching, and tank sampling. A one-minute downhole reading will be used for drilling, a one-minute reading at different levels will be used for trenching, and a one-minute reading inside the tanks will be used for tank sampling. This will give the instrument time to fully 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

A real-time aerosol monitor will be used in conjunction with lab data to determine the concentration of contaminants in air. A sample will be obtained to determine the amount of one or more of these contaminants in soil and an action level will be calculated for that particular work area.

4.5.3. 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-21.

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. The specific protective device utilized should be inspected for information on the effective noise reduction rating.

Trench protection—The one protection device that has been developed for trench operations where shoring, benching, and sloping are not feasible is the trench box or trench shield. 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 require certain specifications be met for the trench box to be safe. The trench box is placed in the trench and attached to the backhoe so that it may be pulled along as the workers progress. This type of system is used mostly in the installation of water systems. It would not be as useful to trench investigations because the walls of the trench may not be viewed from the box, and the protection is voided when workers leave the it.

Tank sampling—Aboveground tank sampling generally has to be performed from a sampling or filling cap on top of the tank. Therefore, some type of fall protection is required for personnel on a tank over 4-ft high. This would include a safety harness or belt and a teather line which is attached to the tank. If a fall were to occur the worker would not fall to the ground. These may also be used on permanent ladder and railing systems. Sampling from a bucket of a backhoe or from a forklift is not acceptable.

The same type of system will be used when hand augering is performed by the mesa edge.

In addition to these personnel protective devices, 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.

Fire extinguishers are classed by the type of fire it was designed to extinguish. However, they 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)

4.5.4. 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. They are listed in Sec. 9.4 of the IWP, Annex III, H&S Plan. In addition, the following measures will also 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.
- Regulated areas will be established according to the field activity and level of protection. This control zone will be at least 25 ft in diameter and will be established for safety considerations, as well as to control contamination.

The actual dimensions of the control zone should include the space required for any Laboratory security requirements.

- If dust persists during augering or drilling activities, water will be used for dust suppression. This action is for the protection of field personnel.

4.6. SITE-ACCESS CONTROL

4.6.1. 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 description of these zones may be found in Sec. 7.0 of the IWP, Annex III, H&S plan.

4.6.2. 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 migration of contaminants.

All vehicles and equipment that are suspected of being contaminated must be steam-cleaned using high-pressure washers. Vehicles and equipment suspected of being contaminated with alpha particles must be screened with an alpha scintillometer before being released from the site.

Personnel decontamination should be performed in all levels of protection. Disposable protective equipment need not be decontaminated but 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 have been established to guide the decontamination process. They are to be onsite and followed at all times. Decontamination of personnel will follow procedures outlined in ER SOP, Personnel Decontamination. Equipment decontamination will follow ER SOP, General Equipment Decontamination, and Radiological 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; 10.4, Polychlorinated Biphenyls; and 10.5, Transuranic Solid Waste.

In addition to the following, Sec. 10.0 of the IWP, Annex III, H&S Plan 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.

4.7. WORKER TRAINING

Worker training will follow the requirements set forth in Sec. 11.0 of the IWP, Annex III H&S Plan.

4.8. Employee Medical Program

In addition to the guidance provided in Sec. 12.0 of the IWP, Annex III H&S Plan, 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, and 6-4, Biological Monitoring for Hazardous Materials, and LANL Technical Bulletin 606, Biological Sample Monitoring, shall be followed.

4.9. Records and Reporting Requirements

The ER H&S PL, working the OU PL 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.

4.9.1. 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 Sec. 13.1 of the IWP, Annex III H&S Plan. 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 HSE-1 Radiation Protection Group.

4.9.2. Unusual Occurrence

All unusual occurrences must be reported by the site safety officer to the H&S PL, Field Teams Manager, TA-21 OU PL, and building managers in accordance with Sec. 13.2 of the IWP, Annex III, H&S Plan.

4.9.3. Accident/Incident Reports

The LANL principal investigator 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 are also reportable to DOE if

   - damage to a government vehicle not properly parked is greater than or equal to $250;
   - damage to DOE property is greater than or equal to $500 and the driver of a government vehicle is at fault;
   - damage to any private property or vehicle is greater than or equal to $250 and the driver of a government vehicle is at fault; and
   - any person is injured and the driver of a government vehicle is at fault.

4.10. 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 shall also be posted at the work site. Additionally, employees will be required to sign the form in Table B-IV prior to initiation of field work.

5. 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, was used in developing an emergency response plan.

5.1. Emergency Contacts

The names of persons and services to contact in case of emergencies are given in Table B-V. This emergency contact form will be copied and posted in prominent locations at the work site. Two-way radio communication will be maintained at remote sites when possible.

The emergency contact number at the Laboratory is 9-911. However, 911 will work but takes longer than dialing 9-911 on Laboratory phones.

5.2. 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. A copy of pre-existing TA-21 emergency response plans shall be available at the work site at all times, and all personnel working at the site shall be

TABLE B-IV
FIELD PERSONNEL SIGNATURE PAGE

I understand and have been informed of the contents of this Plan.

Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Name	Signature	Date

TABLE B-V

EMERGENCY CONTACTS

Site Safety Officer

Name TBD Call TBD

Environmental Restoration Health and Safety Project Leader

Name Ted Norris Call 665-5136

24-hr LANL Health/Safety Coordinator

Call 9-911

FIRE

Call 9-911

AMBULANCE

Call 9-911

POISON CENTER

Call 9-911

SECURITY

Call 9-911 OR 74673

POLICE

Call 9-911 OR 7-4437 (Protective Force) OR 9-662-8222

(City)

YOU ARE LOCATED AT

TBD

THE NEAREST TELEPHONE IS LOCATED AT

TBD

THE NEAREST EMERGENCY MEDICAL SERVICES ARE LOCATED AT

Los Alamos County Medical Center

3917 West Road, Los Alamos, NM

DIRECTIONS TO HOSPITAL: EXIT TA-21 THROUGH THE WEST GATE. FOLLOW TRINITY DRIVE TO THE INTERSECTION OF TRINITY DRIVE AND DIAMOND DRIVE. HOSPITAL IS ON THE RIGHT.

TRAVEL TIME FROM TA-21 OU (minutes): approx. 10

DISTANCE TO HOSPITAL (miles): 3

familiar with the plans. Evacuation plans and routes may be found in Sec. 5.2.3, Emergency Response Plan.

5.2.1. 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. 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.

5.2.2. Personnel Injuries

In case of serious injuries, the victim should be transported to a medical facility as soon as possible. The LANL Fire Department provides emergency transport services. Minor injuries may be treated by trained personnel in the work area. All injuries should be reported to HSE-2 Occupational Medicine Group. In the event that an injured person has been contaminated with chemicals, decontamination will be performed to prevent further exposure only if it will not aggravate the injury (as outlined in Subsec. 4.6.2). Treatment of life-threatening or serious injuries will always be undertaken first. If exposure occurs to hydrofluoric acid, special treatment is required. The hospital must be notified immediately and a special paste will be obtained and applied to the effected area. This paste is currently located at HSE-2.

5.2.3 Emergency Response Plan

For general emergencies that require evacuation (i.e., fire, medical, security, releases, etc.) an emergency response plan specific to TA-21 is required (OSHA 1986). This section will establish evacuation routes for personnel to follow in the event of an emergency. In a worst case, an evacuation of all personnel from TA-21 would be required; in most instances a safe distance may be established to protect personnel.

If a major fire or explosion were to occur, site personnel with fire extinguishers would be of no use. The signal for an evacuation will be two long blasts on an air horn. The crew would gather at a specified location (normally at the vehicles) and proceed away from the fire. 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 fire and toward the TA-21 exit. There is only one exit from TA-21, and that is the gate at the west end of DP West. At the gate, all personnel will wait until every person in the field crew has been accounted for. The site safety officer will determine the next course of action.

A major release or fire involving hazardous or radioactive materials may warrant a different approach. 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 to the exit or gate side and away from the plume (if visible). Once a safe distance is reached, all personnel are to be accounted for. The field team manager and the site safety officer will be responsible for this task. At that time, the site safety officer will determine the next course of action.

For a less severe accident, such as a minor release or small fire, a full evacuation may not be necessary. This will be signaled by one long blast. All personnel will meet at a designated area (i.e., the vehicles) and all personnel will be accounted for. The field team manager and the site safety officer will be responsible for this task, and will be given instructions by the site safety officer.

In the case of a security problem, one short blast will be sounded and personnel will stay in place and wait for instruction from a Laboratory guard.

These will be reviewed at least once per week to remind field personnel of the procedures and the signals. Listed below are the signals for easy reference. This page should also be posted at prominent locations at each work location.

- **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
- **Security problem**—one short blast on the air horn

5.2.4. 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 if the IWP, Annex III, H&S Plan.

5.3. Notification Requirements

The reporting of emergency situations will follow the flow diagram provided in Fig. B-1. Field team members will notify the health 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 HSE Division Office according to DOE Order 5500.2 and DOE-AL Order 5500.2B and 5000.3A. The LANL HSE 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

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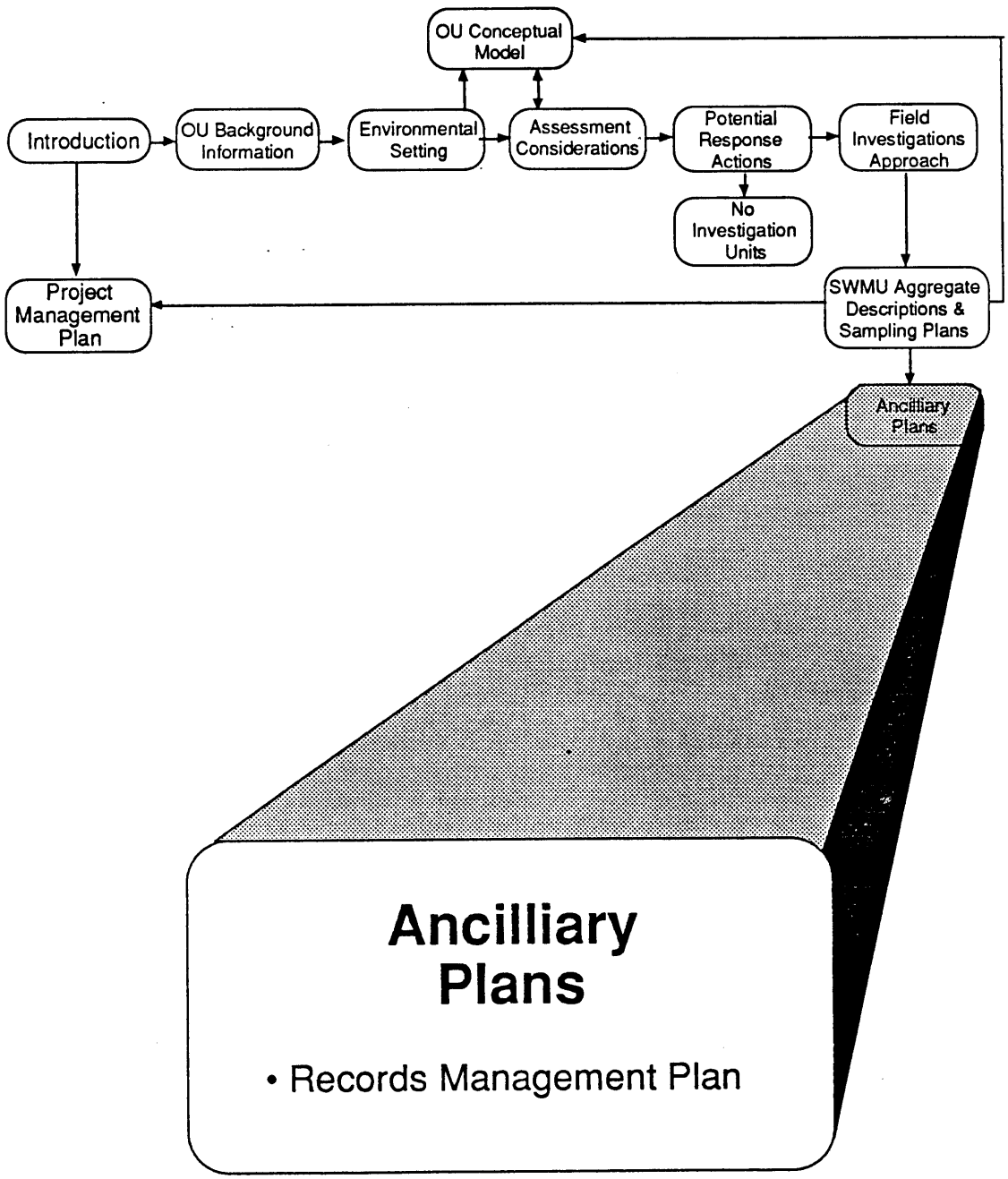
LANL (Los Alamos National Laboratory), November 1990. "Installation Work Plan for Environmental Restoration," Los Alamos National Laboratory Report LA-UR-90-3825, Los Alamos, New Mexico.

NIOSH (National Institute for Occupational Safety and Health), Occupational Safety and Health Administration, US Coast Guard, and US Environmental Protection Agency, October 1985. "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities," Report 85-115, Washington DC.

National Safety Council 1971. Fundamentals of Industrial Hygiene, Chicago, Illinois.

APPENDIX C


OU Conceptual Model
Introduction
OU Background Information
Environmental Setting
Assessment Considerations
Potential Response Actions
Field Investigations Approach
No Investigation Units
Project Management Plan
SWMU Aggregate Descriptions & Sampling Plans
Ancillary Plans
Ancilliary Plans
• Records Management Plan

APPENDIX C. RECORDS MANAGEMENT PLAN

The Records Management Plan (RMP) for the Environmental Restoration (ER) Program is described in Annex IV of the Installation Work Plan (IWP). The purposes of the RMP are to meet requirements for protecting and managing records (including technical data), to provide an ongoing tool to support the technical efforts of the Laboratory ER activities, and to function as a support system for management decisions throughout the life of the ER program. 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 at the Laboratory. The RMP will be implemented consistently to meet Quality Program requirements and provide an audited and legally defensible system for records management. The following statutory definition of a record will be used (44USC 3301):

> 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."

Section 2 of IWP Annex IV describes the implementation of the RMP. Activities at the TA-21 OU will follow those procedures, which are summarized briefly below. As the RMP is developed further to support OU needs, additional detail will be provided in annual updates to the IWP.

The RMP incorporates a threefold approach based on records control and commitment to Quality Program guidelines: a structured work flow for record packages, the use of approved procedures, and the compilation of a referable information base. ER record packages will consist of records that are specifically identified in QP, AP, SOP, or ER work plans; or records identified at the discretion of ER personnel as being essential to the program. Record packages are handled through a structured work flow and processing scheme. All stages of records management, including records identification, review, indexing, submittal, correction, retrieval, access, and retention, are governed by the records management procedure (LANL-ER-AP-02.1, R0). Additionally, the document control procedures exist (LANL-ER-AP-01.3, R0; LANL-ER-AP-01.4, R0; LANL-ER-AP-01.5, R0).

Record packages and data will be protected in, and accessed through, the referable information base. The referable information base is comprised of two parts as follows: the records processing facility (RPF) and the Facility for Information Management, Analysis, and Display (FIMAD). The RPF assigns record package identifiers upon request from the originator and serves as the

facility for receiving and processing ER Program record packages to prepare them for delivery to the FIMAD. The RPF also functions as an ER Program reference library for information that either is not feasible or not desirable to store in the FIMAD. The FIMAD will provide the hardware and software necessary for data capture, display, and analysis. Configuration management will be the means of accounting for, controlling, and reporting the planned and actual design components of the FIMAD. Specific details about the structure and use of the FIMAD are given in IWP Annex IV, Sec. 3.0.

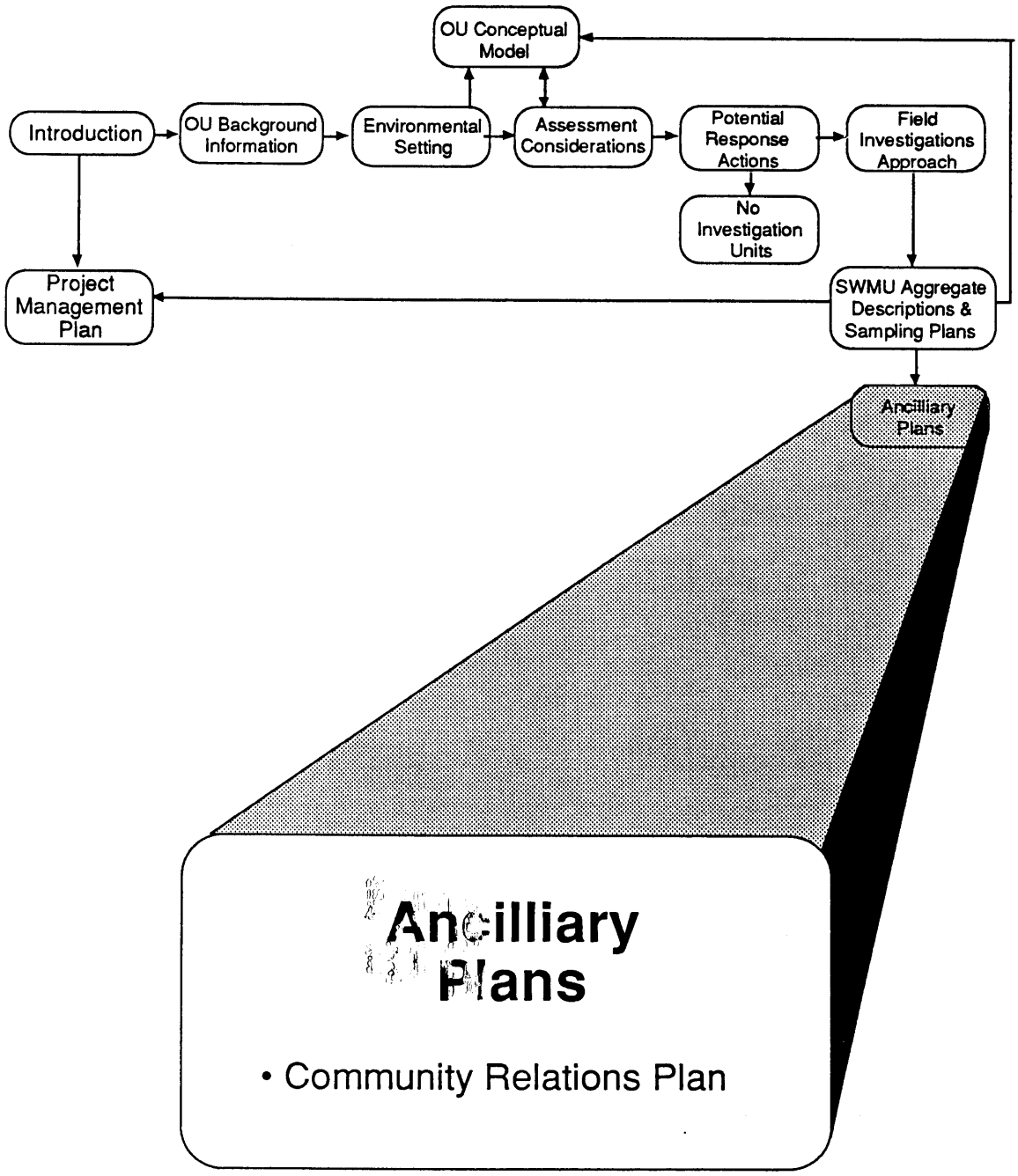
Records will be protected throughout all stages of the process, as described in Sec. 4.0 of IWP Annex IV and in LANL-ER-AP-02.1, R0. The originator is responsible for protecting records until they are submitted to the RPF. Protection by the originator will be commensurate with the value of the information contained in the record. Upon receipt of a record package, the RPF will store the original of the record package in 1-hour, fire-rated equipment and send a copy of the package to the FIMAD. The FIMAD will electronically capture the record package and return the copy of the record package to the RPF. The RPF will then send the original record package to a dual storage area for long-term storage.

Section 5.0 Of IWP Annex IV notes two exceptions to the records storage process. Because of their confidential nature, medical information will be maintained by the Laboratory's Occupational Medicine Group (HSE-2). For convenience, training records will be maintained by the Safety and Risk Assessment Group (HSE-3); the FIMAD will only contain information about the completion of training, the dates of required refresher training, and the location of training records.

Regulatory requirements for reporting, including data types and report frequency, will be delineated. A records retention schedule will also be developed.

RCRA requires that records be made available to the public. The following two complementary approaches are being implemented: hard copy and electronic access. Hard copies of relevant records will be retained in a reading room accessible to the public. A work station or optical reading device will also allow public access to the FIMAD data base.

APPENDIX D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Ancilliary Plans
• Community Relations Plan

APPENDIX D. COMMUNITY RELATIONS PLAN FOR THE TA-21 OPERABLE UNIT

1.0 Overview of Community Relations Plan

The Community Relations Plan specific to the TA-21 OU follows the directives, goals, and regulatory requirements set forth in the Community Relations Program Plan (Annex V, Volume I, IWP for ER). This appendix details the community relations activities for the TA-21 OU during the RFI. They are based on current knowledge of public information needs and resources available to the Laboratory's ER Program staff.

As shown in Fig. D-1, public participation is required by regulation during the CMS. However, the Laboratory will provide opportunities for public participation during the five-year RFI process as detailed in Fig. D-2 and in this Appendix.

All information concerning ER program activities at the TA-21 OU will originate with, or be provided to the public, through the Community Relations Project Leader as follows:

Martin J. Janowski
Community Relations Project Leader
Environmental Restoration Program
Los Alamos National Laboratory
P.O. Box 1663, MS M314
Los Alamos, New Mexico 87545
(505) 665-2127

2.0 Community Relations Activities

The following is a brief description of community relations activities to be conducted at TA-21 during RFI activities. Each activity can be expanded or diminished in response to public information needs.

2.1 Mailing List

Community Relations will enhance the ER Program mailing list to include residents and business owners near TA-21, as well as current and former workers at TA-21, to keep them informed of meetings, activities, and schedules pertaining to the TA-21 OU.

Figure D-1. Regulatorily Mandated Opportinities for Public Participation During the RCRA Corrective Action Process

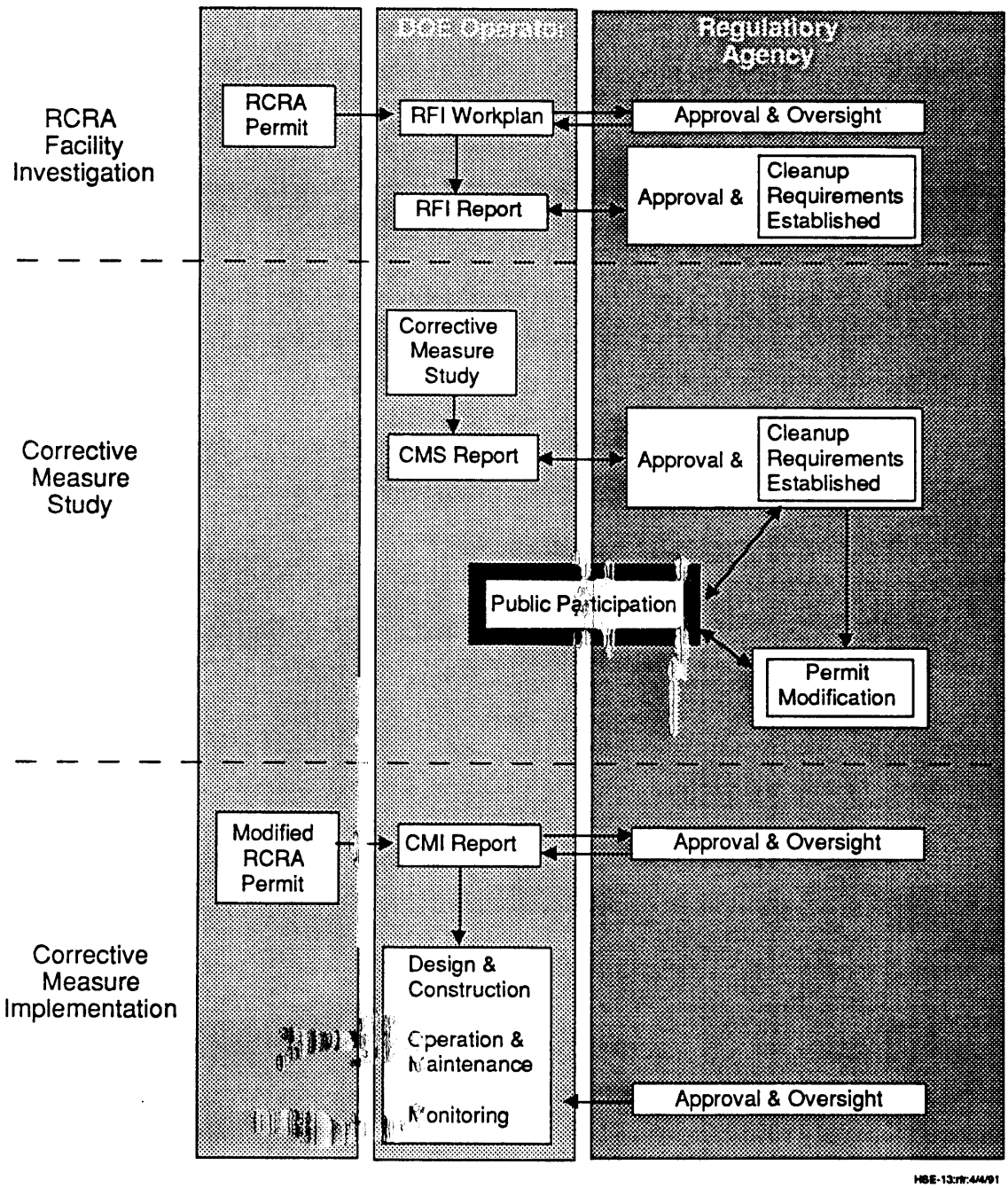
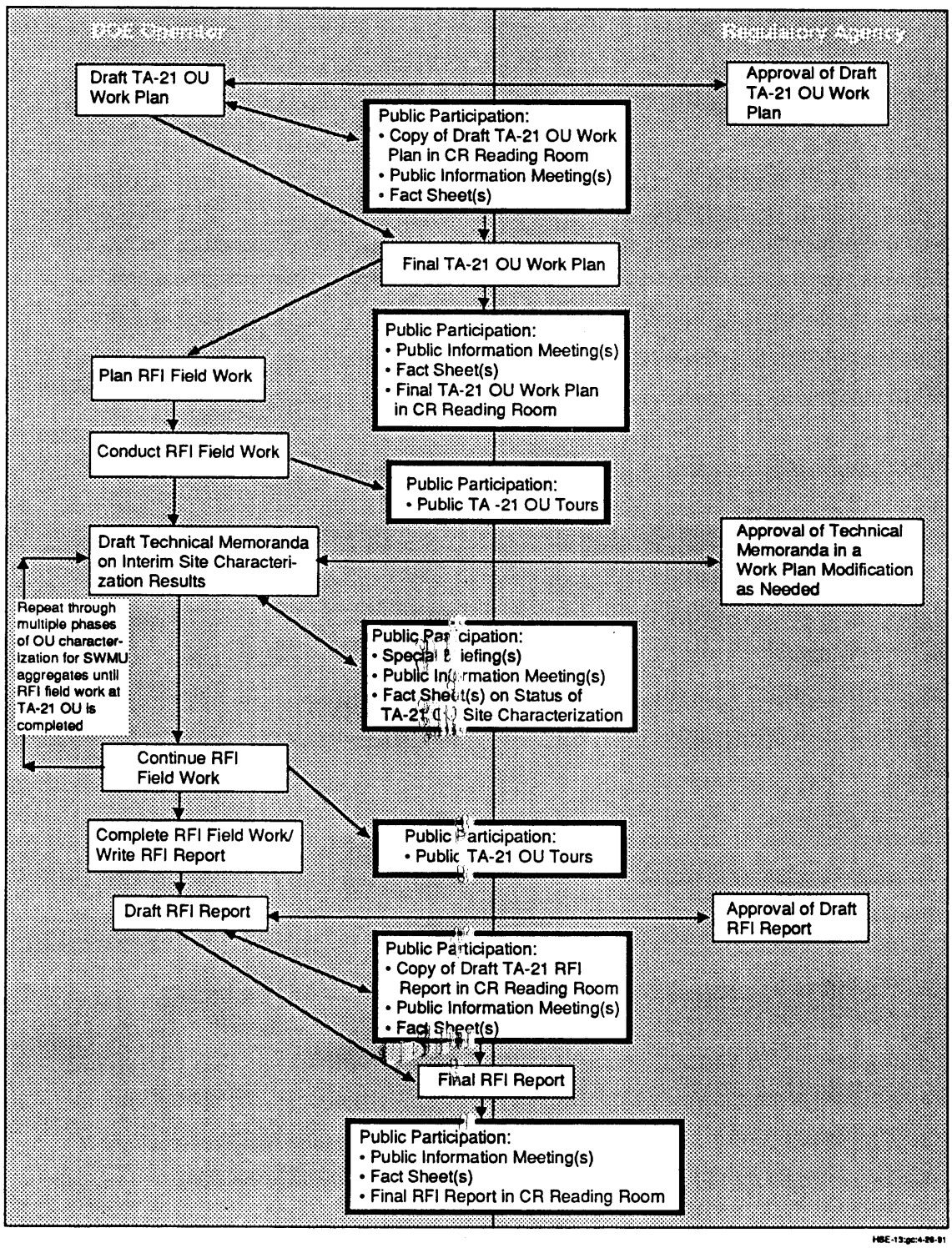


Figure D-2. Opportunities for Public Participation During the TA-21 OU RFI



2.2 Fact Sheets

Community Relations will develop a fact sheet with a simple map inset, which shows the boundaries of the site and summarizes site history and use, known contaminants of concern, and planned activities. The initial fact sheet will be available in June 1991. Additional fact sheets updating progress at TA-21 will be developed based on progress and public information needs.

2.3 Community Relations Reading Room

As they are developed, documents and data associated with the TA-21 OU, such as the TA-21 OU RFI Work Plan, technical memoranda, the RFI report, and other reports will be available to the public at the Community Reading Room located 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-21 OU RFI Draft Work Plan will be available at the Reading Room in June 1991.

2.4 Public Information Meetings/Briefings/Response to Inquiries

Once initial information has been gathered and a specific mailing list developed, there will be a public information meeting held in Los Alamos to introduce the public to the ER Program and forthcoming activities described in the work plan for the TA-21 OU. The TA-21 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. Additional public information meetings will be held as needed or when significant milestones within the RFI process are reached.

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-21 OU Project Leader.

2.5 Informal Public Review and Comment on the Draft TA-21 OU RFI Work Plan

Public input regarding the field sampling proposed in the draft TA-21 OU RFI Work Plan (during EPA formal review of this document in forthcoming months) is encouraged. As appropriate, public input regarding numbers of samples, types of samples, and quality assurance samples (e.g., duplicate samples) will be incorporated into the final TA-21 OU RFI Work Plan.

APPENDIX E

TA-21 OPERABLE UNIT WORK PLAN CONTRIBUTORS:

EDUCATION AND RELEVANT EXPERIENCE

I. Administrative Management

NAME AND AFFILIATION	EDUCATION/EXPERTISE	ER PROGRAM ASSIGNMENT
Bob Vocke, HSE-13	Ph.D. Water Resources • 15 years experience in hazardous waste site assessment, including waste management, regulatory compliance, and program management	Program Manager; HSE-13 Group Leader
Lars Soholt, HSE-13	Ph.D. Biology • 20 years experience in assessment of energy and waste management systems, including project management experience	Programmatic Project Leader
Micheline Devaurs, HSE-13	M.S. Hydrology • 8 years experience in environmental contamination evaluation, hydrologic modeling and field sampling, and project management	Operable Unit Project Leader
Karen West, EES-13	B.S. Chemical Engineering • 5 years experience working on the Yucca Mountain Site Characterization Project	Assistant to OUPL
Larry Maassen, HSE-13	M.S. Exploration Geology • 12 years experience in exploration geology and 5 years in radioactive waste programs quality assurance and management	Quality Project Leader
Ted Norris, HSE-13	Ph.D. Chemistry • 12 years experience in radionuclide migration; 3 years experience in atmospheric pollutant transport; and 3 years experienceas health and safety officer	Health and Safety Project Leader

II. Technical Contributors

NAME AND AFFILIATION	EDUCATION/EXPERTISE	DOCUMENT SECTIONS
Laboratory Personal		
David Bish, EES-1	Ph.D. Mineralogy–Petrology • 17 years experience in clay and zeolite mineralogy, including 10 years experience in site characterization and waste isolation	Chapters 4,12,16
Dave Broxton, EES-1	M.S. Geology • 14 years experience in geosciences, including geochemical exploration for uranium, petrologic studies of ash-flow tuffs and site characterization for nuclear waste disposal	Chapters 4, 12, 16
Micheline Devaurs, HSE-13	M.S. Hydrology • 8 years experience in environmental contamination evaluation, hydrologic modeling and field sampling, and project management	Entire Document
Barry Drennon, EES-15	14 years analytical chemistry, 3 years records management and archive investigations	Archiving
Fraser Goff, EES-1	Ph.D. Earth Science • 21 years of experience in geology and geochemistry with emphasis on field geology, volcanology, hydrogeochemistry, geothermal exploration, geothermal research, exploration drilling, research drilling of high temperature wells, and integration of geologic, geophysical, and hydrogeochemical data into geologic and hydrologic models	Chapters 4,12,16
Tom Hakonson, EES-15	Ph.D. Radiation Ecology • 18 years experience in radioecological work on environmental processes leading to transport of radioactive and hazardous materials, and management experience	Chapter 16

NAME AND AFFILIATION	EDUCATION/EXPERTISE	DOCUMENT SECTIONS
Charles Harrington, EES-1	Ph.D. Geology • 21 years experience in geosciences research including experience in geomorphic and neotectonic site characterization for nuclear waste disposal and environmental and hazardous waste site assessment	Chapters 4,12,16
Ward Hawkins, EES-1	B.S. Geology •14 years experience in geosciences including hydrogeologic site characterization and operations geology, and management	Chapters 4,12,16
Grant Heiken, EES-1	Ph.D. Geology • 27 years of experience in geology, with an emphasis on pyroclastic rocks, geothermal research, and planetology	Chapters 4,12,16
Martin Janowski, PA-3	B.A. Journalism • 10 years experience in public relations with 4 years in hazardous/radioactive waste communications and community relations	Chapter 1, Appendix D
Elizabeth J. Kelly, A-1	Ph.D. Biostatistics • 3 years experience in devising sampling plans and data analysis techniques for environmental studies including surface covers, site integrity, and decision analysis for ER programs	Chapters 12,16
Sallie McNulty, University of Kansas	Ph.D Statistics • 2 years experience in devising sampling plans and data analysis techniques for environmental studies including surface covers and site integrity for ER programs • Area of expertise in statistical sampling, modeling, and statistical computing.	Chapters 16
Linda Nonno, A-1	B.A. Anthropology • Currently completing B.S. in Computer Science • 3.5 years experience in computer graphics, researching new computer technologies and administration	Chapters 16

NAME AND AFFILIATION	EDUCATION/EXPERTISE	DOCUMENT SECTIONS
Steven Reneau, EES-1	Ph.D. Geology • 5 years experience in geosciences, including evaluation of geologic hazards, surficial erosion, and mass wasting	Chapter 16
Everett P. Springer, EES-13	Ph.D. Watershed Science • 9 years experience in research on environmental systems including simulation of contaminant transport by surface and subsurface hydrologic flow systems	Chapters 4,7,16
Lawrence O. Ticknor, A-1	M.S. Statistics • 4 years experience in environmental sampling, data analysis, and modeling for site characterization, integrity, and surface cover	Chapter 16
David Vaniman, EES-1	Ph.D. Geology 17 years experience in geosciences, including petrology, mineralogy, waste isolation, and site characterization	Chapters 4,12,16
Kenneth Wohletz, EES-1	Ph.D. Geology • 17 years experience in geology with emphasis on physical properties of volcanic rocks and numerical/experimental hydrodynamics	Chapters 4,12,16

Contractor Support

Christopher A. Aas	M.S. Environmental Engineering and Water Chemistry • 8 years experience in technical activities and project management of multidisciplinary environmental studies, including RCRA and CERCLA investigations at radioactive mixed waste sites	
Robert H. Gilkeson	M.S. Earth Science • 18 years experience as a research/service and supervising hydrogeologist with diverse experience in design and conduct of geophysical programs	

Contractor Support

Mark D. Hansen	M.A. Biology • 17 years experience in environmental sciences, including project manager, office manager, and field team leader on numerous environmental programs for federal and state agencies, and private industry
William M. Little	M.S. Civil Engineering M.S. Hydrology • Over 18 years of diversified experience in a consulting environment for federal agencies and private firms in the fields of earth and environmental sciences with emphasis on environmental consequences of hazardous waste disposal; technical director for multiple hazardous waste site investigations
Michael D. McVey	M.S. Hydrogeology B.S. Geological Engineering • 3 years experience in geological engineering and hydrogeological studies; planned and implemented field programs in variety of geologic settings; coordinated and participated in activities related to CERCLA investigations
Jeffrey D. Slater	B.S. Industrial Safety • 6 years experience in environmental science, with emphasis on industrial hygiene, toxicology, personnel safety training, hazardous waste site investigation, hazardous materials incident emergency response and control, and contingency planning; Regional Safety Officer, US EPA Technical Assistance Team and US DOE ER Program
Miles Clay Smith	M.S. Health Physics • 2 years health physics, experience in environmental monitoring, occupational monitoring, quality assurance/control, implementation of health and safety plans, microdosimetry; 2 years experience as an assistant radiation safety officer; 5 years as a nuclear, biological, and chemical safety officer in the Oklahoma Army National Guard

Contractor Support

W. John Smith, II	Ph.D. Radiation Ecology M.S. Radiation Health • 17 years experience in environmental radiation problems, uranium mill tailings, CERCLA and RCRA investigations at mixed waste sites

III. Administrative Support

NAME AND AFFILIATION	EDUCATION/EXPERIENCE	CONTRIBUTION
E.B. Barnett, IS-11	B.A. Language • 21 years experience in environmental work; 11 years experience writer-editor	Consulting editor
Gracia Coffin, HSE-13	B.S. Anthropology/Environmental Studies • 10 years experience in word processing and computers	Word processing, flow charts
Andrea Kron, contractor	B.A. Geology • 15 years experience cartography, geology, and technical illustration	Illustrations, flow charts
Patricia Leyba, IS-5	B.B.A. (Business Administration) • 9 years experience in office/information management systems	Document layout and production
Janice Lynn, IS-11	M.A. English • 14 years combined experience in journalism and public relations; 5 years experience in environmental field as technical writer-editor	Editor
Nathan McCranie, contractor	B.S. Mathematics • 3 years experience applied environmental radiation studies; uranium mill tailings, RCRA, CERCLA, mixed waste site investigation/ cleanup experience	Analytical tables
Robin Roybal, HSE-13	A.A.S. Word Processing • 7 years experience in word processing	Word processing

Table F.2-I

SCREENING AND ANALYSIS FOR
INITIAL SURFACE INVESTIGATIONS AT MDA B.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements							Laboratory Analysis											
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
	21	0.0 - 6.0 in						X	X												X	X	X	X		X		X	X			
	22	0.0 - 6.0 in						X	X												X	X	X	X		X		X	X			
	23	0.0 - 6.0 in						X	X												X	X	X	X		X		X	X			
	24	0.0 - 6.0 in						X	X												X	X	X	X		X		X	X			
	25	0.0 - 6.0 in						X	X												X	X	X	X		X		X	X			
	26	0.0 - 6.0 in						X	X												X	X	X	X		X		X	X			
Field Duplicate																					X	X	X	X		X		X	X			
	27	0.0 - 6.0 in						X	X												X	X	X	X		X		X	X			
	28	0.0 - 6.0 in						X	X												X	X	X	X		X		X	X			
	29	0.0 - 6.0 in						X	X												X	X	X	X		X		X	X			
	30	0.0 - 6.0 in						X	X												X	X	X	X		X		X	X			
	31	0.0 - 6.0 in						X	X												X	X	X	X		X		X	X			
	32	0.0 - 6.0 in						X	X												X	X	X	X		X		X	X			
	33	0.0 - 6.0 in						X	X												X	X	X	X		X		X	X			
	34	0.0 - 6.0 in						X	X												X	X	X	X		X		X	X			
	35	0.0 - 6.0 in						X	X												X	X	X	X		X		X	X			
	36	0.0 - 6.0 in						X	X												X	X	X	X		X		X	X			
Rinsate Blank																					X	X	X	X		X		X	X			
Field Blank																												X	X			
	37	0.0 - 6.0 in						X	X												X	X	X	X		X		X	X			
	38	0.0 - 6.0 in						X	X												X	X	X	X		X		X	X			
	39	0.0 - 6.0 in						X	X												X	X	X	X		X		X	X			
	40	0.0 - 6.0 in						X	X												X	X	X	X		X		X	X			
	41	0.0 - 6.0 in						X	X												X	X	X	X		X		X	X			
	42	0.0 - 6.0 in						X	X												X	X	X	X		X		X	X			
	43	0.0 - 6.0 in						X	X												X	X	X	X		X		X	X			

Table F.2-1

SCREENING AND ANALYSIS FOR
INITIAL SURFACE INVESTIGATIONS AT MDA B.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals		
	44	0.0 – 6.0 in								X	X	X																					
	45	0.0 – 6.0 in								X	X	X																					
	46	0.0 – 6.0 in								X	X	X																					
Field Duplicate	47	0.0 – 6.0 in							X	X																							
	48	0.0 – 6.0 in							X	X																							
	49	0.0 – 6.0 in							X	X																							
	50	0.0 – 6.0 in							X	X																							
	51	0.0 – 6.0 in							X	X																							
	52	0.0 – 6.0 in							X	X																							
	53	0.0 – 6.0 in							X	X																							
	54	0.0 – 6.0 in							X	X																							
Rinsate Blank	55	0.0 – 6.0 in							X	X																							
Field Blank	56	0.0 – 6.0 in	1						X	X												X	X	X	X	X	X	X	X	X	X	X	
	57	0.0 – 6.0 in	2						X	X												X	X	X	X	X	X	X	X	X	X	X	
	58	0.0 – 6.0 in	3						X	X												X	X	X	X	X	X	X	X	X	X	X	
	59	0.0 – 6.0 in	4						X	X												X	X	X	X	X	X	X	X	X	X	X	
	60	0.0 – 6.0 in	5						X	X												X	X	X	X	X	X	X	X	X	X	X	
	61	0.0 – 6.0 in	6						X	X												X	X	X	X	X	X	X	X	X	X	X	
	62	0.0 – 6.0 in	7						X	X												X	X	X	X	X	X	X	X	X	X	X	
	63	0.0 – 6.0 in	8						X	X												X	X	X	X	X	X	X	X	X	X	X	
	64	0.0 – 6.0 in	9						X	X												X	X	X	X	X	X	X	X	X	X	X	
Replicate Surface Soil Sample	1	0.0 – 6.0 in	10						X	X												X	X	X	X	X	X	X	X	X	X	X	
	2	0.0 – 6.0 in	11																														

Table F.2-1

SCREENING AND ANALYSIS FOR
INITIAL SURFACE INVESTIGATIONS AT MDA B.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening: Organic Vapor	Field Screening: Combustible Hydrocarbon	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals
	3	0.0 – [illegible]						X	X					C	C				X	X	X	X	X	X		X	X		
	4	0.0 – 6.0 in						X	X					C	C				X	X	X	X	X	X		X	X		
	5	0.0 – 6.0 in						X	X					C	C				X	X	X	X	X	X		X	X		
	6	0.0 – 6.0 in						X	X					C	C				X	X	X	X	X	X		X	X		
Field Duplicate		0.0 – 6.0 in												C	C				C	C	C	C	C	C		C	C		
Contingency Surface Soil	1	0.0 – 6.0 in						C	C					C	C				C	C	C	C	C	C		C	C		
	2	0.0 – 6.0 in						C	C					C	C				C	C	C	C	C	C		C	C		
	3	0.0 – 6.0 in						C	C					C	C				C	C	C	C	C	C		C	C		
	4	0.0 – 6.0 in						C	C					C	C				C	C	C	C	C	C		C	C		
	5	0.0 – 6.0 in						C	C					C	C				C	C	C	C	C	C		C	C		
	6	0.0 – 6.0 in						C	C					C	C				C	C	C	C	C	C		C	C		
	7	0.0 – 6.0 in						C	C					C	C				C	C	C	C	C	C		C	C		
	8	0.0 – 6.0 in						C	C					C	C				C	C	C	C	C	C		C	C		
	9	0.0 – 6.0 in						C	C					C	C				C	C	C	C	C	C		C	C		
	10	0.0 – 6.0 in						C	C					C	C				C	C	C	C	C	C		C	C		
Rinsate Blank																										C	C		
Field Blank																										C	C		

Table F.2-II

SCREENING AND ANALYSIS FOR SUBSEQUENT SURFACE INVESTIGATIONS AT MDA B.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Surface Sampling at MDA B																																	
Surface Soil Sample	1	0.0 - 6.0 in		X	X			X	X																								
	2	0.0 - 6.0 in						X	X																								
	3	0.0 - 6.0 in						X	X																								
	4	0.0 - 6.0 in						X	X																								
	5	0.0 - 6.0 in						X	X																								
Rinsate Blank																																	
Field Blank																																	
	6	0.0 - 6.0 in						X	X																								
	7	0.0 - 6.0 in						X	X																								
	8	0.0 - 6.0 in						X	X																								
Field Duplicate	9	0.0 - 6.0 in						X	X																								
	10	0.0 - 6.0 in						X	X																								
	11	0.0 - 6.0 in						X	X																								
	12	0.0 - 6.0 in						X	X																								
	13	0.0 - 6.0 in						X	X																								
	14	0.0 - 6.0 in						X	X																								
	15	0.0 - 6.0 in						X	X																								
	16	0.0 - 6.0 in						X	X																								
	17	0.0 - 6.0 in						X	X																								
	18	0.0 - 6.0 in						X	X																								
	19	0.0 - 6.0 in						X	X																								
	20	0.0 - 6.0 in						X	X																								
	21	0.0 - 6.0 in						X	X																								

Table F.2-II

SCREENING AND ANALYSIS FOR SUBSEQUENT SURFACE INVESTIGATIONS AT MDA B.

				Field Surveys					Field Screening					Field Laboratory Measurements									Laboratory Analysis															
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey		Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging		Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals				
	22	0.0 - 6.0 in							X	X													X	X	X	X		X		X	X					
	23	0.0 - 6.0 in							X	X													X	X	X	X		X		X	X					
	24	0.0 - 6.0 in							X	X													X	X	X	X		X		X	X					
Rinsate Blank																							X	X	X	X		X		X	X					
Field Blank																														X	X					
	25	0.0 - 6.0 in							X	X													X	X	X	X		X		X	X					
	26	0.0 - 6.0 in							X	X													X	X	X	X		X		X	X					
	27	0.0 - 6.0 in							X	X													X	X	X	X		X		X	X					
Field Duplicate																							X	X	X	X		X		X	X					
	28	0.0 - 6.0 in							X	X													X	X	X	X		X		X	X					
	29	0.0 - 6.0 in							X	X													X	X	X	X		X		X	X					
	30	0.0 - 6.0 in							X	X													X	X	X	X		X		X	X					
Rinsate Blank																							X	X	X	X		X		X	X					
Field Blank																														X	X					

Table F.2-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA B.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Subsurface samples at MDA B																																	
Angled Borehole 10 degrees	1	0.0 - 5.0 ft						X	X		X	X	X						X			X	X	X		X	X	X	X	X		
		5.0 - 10.0 ft						X	X		X	X	X						X			X	X	X		X	X	X	X	X		
		10.0 - 15.0 ft						X	X		X	X	X						X			X	X	X		X	X	X	X	X		
		15.0 - 20.0 ft						X	X		X	X	X						X			X	X	X		X	X	X	X	X		
		20.0 - 25.0 ft						X	X		X	X	X						X			X	X	X		X	X	X	X	X		
		25.0 - 30.0 ft						X	X		X	X	X						X			X	X	X		X	X	X	X	X		
Field Duplicate		30.0 - 35.0 ft						X	X		X	X	X						X			X	X	X		X	X	X	X	X		
		35.0 - 40.0 ft						X	X		X	X	X						X			X	X	X		X	X	X	X	X		
		40.0 - 45.0 ft						X	X		X	X	X						X			X	X	X		X	X	X	X	X		
		45.0 - 50.0 ft						X	X		X	X	X						X			X	X	X		X	X	X	X	X		
		50.0 - 55.0 ft						X	X		X	X	X						X			X	X	X		X	X	X	X	X		
		55.0 - 60.0 ft						X	X		X	X	X						X			X	X	X		X	X	X	X	X		
		60.0 - 65.0 ft						X	X		X	X	X						X			X	X	X		X	X	X	X	X		
		65.0 - 70.0 ft						X	X		X	X	X						X			X	X	X		X	X	X	X	X		
		70.0 - 75.0 ft						X	X		X	X	X						X			X	X	X		X	X	X	X	X		
		75.0 - 80.0 ft						X	X		X	X	X						X			X	X	X		X	X	X	X	X		
		80.0 - 85.0 ft						X	X		X	X	X						X			X	X	X		X	X	X	X	X		
		85.0 - 90.0 ft						X	X		X	X	X						X			X	X	X		X	X	X	X	X		
		90.0 - 95.0 ft						X	X		X	X	X						X			X	X	X		X	X	X	X	X		
		95.0 - 100.0 ft						X	X		X	X	X						X			X	X	X		X	X	X	X	X		
Rinsate Blank																						X	X	X		X	X	X	X	X		
Field Blank																						X	X	X		X	X	X	X	X		
		100.0 - 105.0 ft																															

Table F.2-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA B.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha	Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals
		105.0 - 110.0 ft						<	<	<	<	<						X	X	X	X	X		X	X	X	X		
		110.0 - 115.0 ft						X	X	X	X	X						X	X	X	X	X		X	X	X	X		
Field Duplicate																			X	X	X	X		X	X	X	X		
Trip Blank																									X				
		115.0 - 120.0 ft						X	X	X	X	X						X	X	X	X	X		X	X	X	X		
		120.0 - 125.0 ft						X	X	X	X	X						X	X	X	X	X		X	X	X	X		
		125.0 - 130.0 ft						X	X	X	X	X						X	X	X	X	X		X	X	X	X		
		130.0 - 135.0 ft						X	X	X	X	X						X	X	X	X	X		X	X	X	X		
		135.0 - 140.0 ft						X	X	X	X	X						X	X	X	X	X		X	X	X	X		
		140.0 - 145.0 ft						X	X	X	X	X						X	X	X	X	X		X	X	X	X		
		145.0 - 150.0 ft						X	X	X	X	X						X	X	X	X	X		X	X	X	X		
		150.0 - 155.0 ft						X	X	X	X	X						X	X	X	X	X		X	X	X	X		
		155.0 - 160.0 ft						X	X	X	X	X						X	X	X	X	X		X	X	X	X		
		160.0 - 165.0 ft						X	X	X	X	X						X	X	X	X	X		X	X	X	X		
		165.0 - 170.0 ft						X	X	X	X	X						X	X	X	X	X		X	X	X	X		
		170.0 - 175.0 ft						X	X	X	X	X						X	X	X	X	X		X	X	X	X		
		175.0 - 180.0 ft						X	X	X	X	X						X	X	X	X	X		X	X	X	X		
Fracture Sampling Contingency								C	C	C	C	C						C	C	C	C	C		C	C	C	C		
								C	C	C	C	C						C	C	C	C	C		C	C	C	C		
								C	C	C	C	C						C	C	C	C	C		C	C	C	C		
								C	C	C	C	C						C	C	C	C	C		C	C	C	C		
								C	C	C	C	C						C	C	C	C	C		C	C	C	C		
Rinsate Blank																			X	X	X	X		X	X	X	X		
Field Blank																									X	X	X		
Field Duplicate																			X	X	X	X		X	X	X	X		
Trip Blank																									X				

Table F.2-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA B.

Sample Identification	Sampling Location	Interval	Sample Type	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture		Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Technetic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCL Metals		
	Angled Borehole 10 degrees																															
	2	0.0 – 5.0 ft						X	X		X	X	X							X												
		5.0 – 10.0 ft						X	X		X	X	X							X												
		10.0 – 15.0 ft						X	X		X	X	X							X												
		15.0 – 20.0 ft						X	X		X	X	X							X												
		20.0 – 25.0 ft						X	X		X	X	X							X												
		25.0 – 30.0 ft						X	X		X	X	X							X												
		30.0 – 35.0 ft						X	X		X	X	X							X												
		35.0 – 40.0 ft						X	X		X	X	X							X												
		40.0 – 45.0 ft						X	X		X	X	X							X												
		45.0 – 50.0 ft						X	X		X	X	X							X												
		50.0 – 55.0 ft						X	X		X	X	X							X												
		55.0 – 60.0 ft						X	X		X	X	X							X												
		60.0 – 65.0 ft						X	X		X	X	X							X												
		65.0 – 70.0 ft						X	X		X	X	X							X												
		70.0 – 75.0 ft						X	X		X	X	X							X												
		75.0 – 80.0 ft						X	X		X	X	X							X												
		80.0 – 85.0 ft						X	X		X	X	X							X												
		85.0 – 90.0 ft						X	X		X	X	X							X												
		90.0 – 95.0 ft						X	X		X	X	X							X												
		95.0 – 100.0 ft						X	X		X	X	X							X												
	Rinsate Blank																				X	X	X	X	X	X	X	X	X			
	Field Blank							X	X		X	X	X							X	X	X	X	X	X	X	X	X	X	X			
		100.0 – 105.0 ft						X	X		X	X	X							X	X	X	X	X	X	X	X	X	X	X			
		105.0 – 110.0 ft						X	X		X	X	X							X	X	X	X	X	X	X	X	X	X	X			
		110.0 – 115.0 ft						X	X		X	X	X							X	X	X	X	X	X	X	X	X	X	X			

Table F.2-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA B.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements							Laboratory Analysis											
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	
Field Duplicate																					X	X	X	X	X	X	X	X			
Trip Blank																										X					
		115.0 – 120.0 ft						X	X		X	X	X						X		X										
		120.0 – 125.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X			
		125.0 – 130.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X			
		130.0 – 135.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X			
		135.0 – 140.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X			
		140.0 – 145.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X			
		145.0 – 150.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X			
		150.0 – 155.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X			
		155.0 – 160.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X			
		160.0 – 165.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X			
		165.0 – 170.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X			
		170.0 – 175.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X			
		175.0 – 180.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X			
Rinsate Blank																					X	X	X	X		X	X	X	X		
Field Blank																											X	X	X		
Field Duplicate																					X	X	X	X		X	X	X	X		
Trip Blank																											X				
Fracture Sampling Contingency								C	C		C	C	C						C		C	C	C	C		C	C	C	C		
								C	C		C	C	C						C		C	C	C	C		C	C	C	C		
								C	C		C	C	C						C		C	C	C	C		C	C	C	C		
								C	C		C	C	C						C		C	C	C	C		C	C	C	C		
								C	C		C	C	C						C		C	C	C	C		C	C	C	C		
Angled Borehole 10 degrees	3	0.0 – 5.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X		
		5.0 – 10.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X		

Table F.2-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA B.

Sample Identification	Sampling Location	Interval	Sample Type	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals		
		10.0 – 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		25.0 – 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		30.0 – 35.0 ft	Field Duplicate					X	X		X	X	X		X	X	X		X			X	X	X	X		X	X	X	X			
		35.0 – 40.0 ft						X	X		X	X	X		X	X	X		X			X	X	X	X		X	X	X	X			
		40.0 – 45.0 ft						X	X		X	X	X		X	X	X		X			X	X	X	X		X	X	X	X			
		45.0 – 50.0 ft						X	X		X	X	X		X	X	X		X			X	X	X	X		X	X	X	X			
		50.0 – 55.0 ft						X	X		X	X	X		X	X	X		X			X	X	X	X		X	X	X	X			
		55.0 – 60.0 ft						X	X		X	X	X		X	X	X		X			X	X	X	X		X	X	X	X			
		60.0 – 65.0 ft						X	X		X	X	X		X	X	X		X			X	X	X	X		X	X	X	X			
		65.0 – 70.0 ft						X	X		X	X	X		X	X	X		X			X	X	X	X		X	X	X	X			
		70.0 – 75.0 ft						X	X		X	X	X		X	X	X		X			X	X	X	X		X	X	X	X			
		75.0 – 80.0 ft						X	X		X	X	X		X	X	X		X			X	X	X	X		X	X	X	X			
		80.0 – 85.0 ft						X	X		X	X	X		X	X	X		X			X	X	X	X		X	X	X	X			
		85.0 – 90.0 ft						X	X		X	X	X		X	X	X		X			X	X	X	X		X	X	X	X			
		90.0 – 95.0 ft						X	X		X	X	X		X	X	X		X			X	X	X	X		X	X	X	X			
		95.0 – 100.0 ft						X	X		X	X	X		X	X	X		X			X	X	X	X		X	X	X	X			
			Rinsate Blank												X	X	X		X			X	X	X	X		X	X	X	X			
		100.0 – 105.0 ft	Field Blank					X	X		X	X	X									X	X	X	X		X	X	X	X			
		105.0 – 110.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		110.0 – 115.0 ft	Field Duplicate					X	X		X	X	X		X	X	X		X			X	X	X	X		X	X	X	X			
			Trip Blank																			X	X	X	X		X	X	X	X			

Table F.2–III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA B.

				Field Surveys					Field Screening					Field Laboratory Measurements							Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low–Energy Gamma	Electromagnetic	Land Survey		Gross Gamma	Gross Alpha		Organic Vapor	Combustible	Lithological Logging		Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
		115.0 – 120.0 ft							X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		120.0 – 125.0 ft							X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		125.0 – 130.0 ft							X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		130.0 – 135.0 ft							X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		135.0 – 140.0 ft							X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		140.0 – 145.0 ft							X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		145.0 – 150.0 ft							X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		150.0 – 155.0 ft							X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		155.0 – 160.0 ft							X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		160.0 – 165.0 ft							X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		165.0 – 170.0 ft							X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		170.0 – 175.0 ft																			X			X	X	X	X		X	X	X	X				
		175.0 – 180.0 ft							X	X		X	X	X							X			X	X	X	X		X	X	X	X				
Fracture Sampling Contingency									C	C		C	C	C							C			C	C	C	C		C	C	C	C				
									C	C		C	C	C							C			C	C	C	C		C	C	C	C				
									C	C		C	C	C							C			C	C	C	C		C	C	C	C				
									C	C		C	C	C							C			C	C	C	C		C	C	C	C				
									C	C		C	C	C							C			C	C	C	C		C	C	C	C				
Rinsate Blank																								X	X	X	X		X	X	X	X				
Field Blank																														X	X	X				
Field Duplicate																								X	X	X	X		X	X	X	X				
Trip Blank																														X						
Angled Borehole 20 degrees	4	0.0 – 5.0 ft							X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		5.0 – 10.0 ft							X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		10.0 – 15.0 ft							X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		15.0 – 20.0 ft							X	X		X	X	X							X			X	X	X	X		X	X	X	X				

Table F.2-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA B.

Sample Identification	Sampling Location	Interval	Sample Type	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Field Laboratory Measurements:	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 8010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals	Laboratory Analysis:	Laboratory Analysis:
		20.0 – 25.0 ft									X	X	X						X	X														
		25.0 – 30.0 ft	Field Duplicate								X	X	X						X	X														
		30.0 – 35.0 ft						X	X		X	X	X																					
		35.0 – 40.0 ft						X	X		X	X	X																					
		40.0 – 45.0 ft						X	X		X	X	X																					
		45.0 – 50.0 ft						X	X		X	X	X																					
		50.0 – 55.0 ft						X	X		X	X	X																					
		55.0 – 60.0 ft						X	X		X	X	X																					
		60.0 – 65.0 ft						X	X		X	X	X																					
		65.0 – 70.0 ft						X	X		X	X	X																					
		70.0 – 75.0 ft						X	X		X	X	X																					
		75.0 – 80.0 ft						X	X		X	X	X																					
		80.0 – 85.0 ft						X	X		X	X	X																					
		85.0 – 90.0 ft						X	X		X	X	X																					
		90.0 – 95.0 ft						X	X		X	X	X																					
		95.0 – 100.0 ft						X	X		X	X	X																					
			Rinsate Blank																		X	X	X	X	X	X	X	X	X	X	X			
			Field Blank																		X	X	X	X	X	X	X	X	X	X	X			
		100.0 – 105.0 ft						X	X		X	X	X								X	X	X	X	X	X	X	X	X	X	X			
		105.0 – 110.0 ft						X	X		X	X	X								X	X	X	X	X	X	X	X	X	X	X			
		110.0 – 115.0 ft						X	X		X	X	X								X	X	X	X	X	X	X	X	X	X	X			
			Field Duplicate																		X	X	X	X	X	X	X	X	X	X	X			
			Trip Blank																		X	X	X	X	X	X	X	X	X	X	X			
	115.0 – 120.0 ft						X	X		X	X	X							X	X														
	120.0 – 125.0 ft																																	

Table F.2-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA B.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis															
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals				
		125.0 – 130.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		130.0 – 135.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		135.0 – 140.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		140.0 – 145.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		145.0 – 150.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		150.0 – 155.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		155.0 – 160.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		160.0 – 165.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		165.0 – 170.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		170.0 – 175.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		175.0 – 180.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
Rinsate Blank																						X	X	X	X		X	X	X	X						
		180.0 – 185.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		185.0 – 190.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		190.0 – 195.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		195.0 – 200.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
Fracture Sampling Contingency								C	C		C	C	C						C			C	C	C	C		C	C	C	C						
								C	C		C	C	C						C			C	C	C	C		C	C	C	C						
								C	C		C	C	C						C			C	C	C	C		C	C	C	C						
								C	C		C	C	C						C			C	C	C	C		C	C	C	C						
								C	C		C	C	C						C			C	C	C	C		C	C	C	C						
Field Blank																						X	X	X	X		X	X	X	X						
Field Duplicate																												X								
Trip Blank																																				
Angled Borehole 20 degrees	5	0.0 – 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		5.0 – 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						

Table F.2-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA B.

Sample Identification	Sampling Location	Interval	Sample Type	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
		10.0 – 15.0 ft																																
		15.0 – 20.0 ft																																
		20.0 – 25.0 ft																																
		25.0 – 30.0 ft																																
			Field Duplicate																															
		30.0 – 35.0 ft																																
		35.0 – 40.0 ft																																
		40.0 – 45.0 ft																																
		45.0 – 50.0 ft																																
		50.0 – 55.0 ft																																
		55.0 – 60.0 ft																																
		60.0 – 65.0 ft																																
		65.0 – 70.0 ft																																
		70.0 – 75.0 ft																																
		75.0 – 80.0 ft																																
		80.0 – 85.0 ft																																
		85.0 – 90.0 ft																																
		90.0 – 95.0 ft																																
		95.0 – 100.0 ft																																
			Rinsate Blank																															
		100.0 – 105.0 ft	Field Blank																															
		105.0 – 110.0 ft																																
		110.0 – 115.0 ft																																
			Field Duplicate																															
			Trip Blank																															

Table F.2-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA B.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements							Laboratory Analysis															
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals				
		115.0 – 120.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		120.0 – 125.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		125.0 – 130.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		130.0 – 135.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		135.0 – 140.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		140.0 – 145.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		145.0 – 150.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		150.0 – 155.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		155.0 – 160.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		160.0 – 165.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		[illegible]						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		170.0 – 175.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		175.0 – 180.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
Rinsate Blank																						X	X	X	X		X	X	X	X					
		180.0 – 185.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		185.0 – 190.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		190.0 – 195.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		195.0 – 200.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
Fracture Sampling Contingency								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
Field Blank																						X	X	X	X		X	X	X	X					
Field Duplicate																												X							
Trip Blank																																			

Table F.2-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA B.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	CLP Metals		
Vertical Borehole	6	0.0 - 5.0 ft						X	X		X	X	X	X	X				X			X	X	X		X	X	X	X				
		5.0 - 10.0 ft						X	X		X	X	X									X	X	X		X	X	X	X				
		10.0 - 15.0 ft						X	X		X	X	X									X	X	X		X	X	X	X				
		15.0 - 20.0 ft						X	X		X	X	X									X	X	X		X	X	X	X				
		20.0 - 25.0 ft						X	X		X	X	X									X	X	X		X	X	X	X				
		25.0 - 30.0 ft						X	X		X	X	X	X	X		X		X			X	X	X		X	X	X	X				
Fracture Sampling Contingency								C	C		C	C	C	X	X		X		X			X	X	X		X	X	X	X				
Field Duplicate								C	C		C	C	C									X	X	X		X	X	X	X				
Rinsate Blank																						X	X	X		X	X	X	X				
Field Blank																						X	X	X		X	X	X	X				
Trip Blank																												X	X				
Vertical Borehole	7	0.0 - 5.0 ft						X	X		X	X	X							X		X	X	X		X	X	X	X				
		5.0 - 10.0 ft						X	X		X	X	X							X		X	X	X		X	X	X	X				
		10.0 - 15.0 ft						X	X		X	X	X							X		X	X	X		X	X	X	X				
		15.0 - 20.0 ft						X	X		X	X	X							X		X	X	X		X	X	X	X				
		20.0 - 25.0 ft						X	X		X	X	X							X		X	X	X		X	X	X	X				
		25.0 - 30.0 ft						X	X		X	X	X							X		X	X	X		X	X	X	X				
Fracture Sampling Contingency								C	C		C	C	C							X		X	X	X		X	X	X	X				

Table F.2-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA B.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
Field Duplicate																						X	X	X	X		X	X	X	X				
Rinsate Blank																						X	X	X			X	X	X	X				
Field Blank																						X	X	X			X	X	X	X				
Trip Blank																						X	X				X	X						
Vertical Borehole	B	0.0 – 5.0 ft						X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X			
		5.0 – 10.0 ft						X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X			
		10.0 – 15.0 ft						X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X			
		15.0 – 20.0 ft						X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X			
		20.0 – 25.0 ft						X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X			
		25.0 – 30.0 ft						X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X			
Fracture Sampling Contingency								C	C	C	C	C	C	C	C	C	C	C	C			C	C	C	C	C	C	C	C	C	C			
								C	C	C	C	C	C	C	C	C	C	C	C			C	C	C	C	C	C	C	C	C	C			
								C	C	C	C	C	C	C	C	C	C	C	C			C	C	C	C	C	C	C	C	C	C			
								C	C	C	C	C	C	C	C	C	C	C	C			C	C	C	C	C	C	C	C	C	C			
								C	C	C	C	C	C	C	C	C	C	C	C			C	C	C	C	C	C	C	C	C	C			
Field Duplicate																						X	X	X	X		X	X	X	X				
Rinsate Blank																						X	X	X			X	X						
Field Blank																						X	X	X			X	X						
Trip Blank																												X					

Table F.2-IV

MDA B GEOPHYSICAL

MINERALOGICAL DETERMINATIONS

				Hydrogeological and Geochemical																Environmental Isotopes								Open Hole Tests: Straddle Packer Tests							Open Hole Tests: Geophysics										
Sample Type	Sampling Location	Interval	Sample Identification	Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (He injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Chloride-35/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-18/Oxygen-18	Tritium	Carbon-14	Chloride-36	In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6	Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
MDA B																																													
Ang Borehole 10 deg	1	0.0 - 5.0 ft																																											
		5.0 - 10.0 ft										X	X	X	X	X	X	X	X																										
		10.0 - 15.0 ft																																											
		15.0 - 20.0 ft																																											
		20.0 - 25.0 ft																																											
		25.0 - 30.0 ft										X	X	X	X	X	X	X	X																										
		30.0 - 35.0 ft																																											
		35.0 - 40.0 ft																																											
		40.0 - 45.0 ft																																											
		45.0 - 50.0 ft										X	X	X	X	X	X	X	X																										
		50.0 - 55.0 ft																																											
		55.0 - 60.0 ft																																											
		60.0 - 65.0 ft																																											
		65.0 - 70.0 ft										X	X	X	X	X	X	X	X																										
		70.0 - 75.0 ft																																											
		75.0 - 80.0 ft																																											
		80.0 - 85.0 ft																																											
		85.0 - 90.0 ft										X	X	X	X	X	X	X	X																										
		90.0 - 95.0 ft																																											
		95.0 - 100.0 ft																																											
		100.0 - 105.0 ft																																											
		105.0 - 110.0 ft										X	X	X	X	X	X	X	X																										
		110.0 - 115.0 ft																																											
		115.0 - 120.0 ft																																											
		120.0 - 125.0 ft																																											
		125.0 - 130.0 ft										X	X	X	X	X	X	X	X																										
		130.0 - 135.0 ft																																											
		135.0 - 140.0 ft																																											
		140.0 - 145.0 ft																																											
		145.0 - 150.0 ft										X	X	X	X	X	X	X	X																										
		150.0 - 155.0 ft																																											
		155.0 - 160.0 ft																																											
		160.0 - 165.0 ft																																											
		165.0 - 170.0 ft										X	X	X	X	X	X	X	X																										
		170.0 - 175.0 ft																																											
		175.0 - 180.0 ft																																											
Fracture Contingency Sample												C	C	C	C	C	C	C	C																										
												C	C	C	C	C	C	C	C																										
												C	C	C	C	C	C	C	C																										

Table F.2-IV

MDA B GEOPHYSICAL

MINERALOGICAL DETERMINATIONS

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical: Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (Hg Injection)	Saturated Hy. Hydraulic Conductivity	Air Water Re. Pore Permeability	Moisture Char. Isotherm Curve	Clay Minerals	Zeolite Minerals	Matrix Minerals	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Environmental Isotopes: Chloride-36/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-18/Oxygen-16	Tritium	Carbon-14	Chloride-36	Open Hole Tests: Straddle Packer Tests: In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF-6	Open Hole Tests: Geophysics: Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Slide Scan Video
Ang Borehole 10 deg	2	0.0 – 5.0 ft										C	C		C		C	C	C																										
		5.0 – 10.0 ft										X	X		X		X	X	X																										
		10.0 – 15.0 ft																																										
		15.0 – 20.0 ft																																										
		20.0 – 25.0 ft										X			X		X	X	X																										
		25.0 – 30.0 ft										X			X		X	X	X																										
		30.0 – 35.0 ft																																										
		35.0 – 40.0 ft																																										
		40.0 – 45.0 ft										X			X		X	X	X																										
		45.0 – 50.0 ft										X			X		X	X	X																										
		50.0 – 55.0 ft																																										
		55.0 – 60.0 ft																																										
		60.0 – 65.0 ft										X			X		X	X	X																										
		65.0 – 70.0 ft										X			X		X	X	X																										
		70.0 – 75.0 ft																																										
		75.0 – 80.0 ft																																										
		80.0 – 85.0 ft										X			X		X	X	X																										
		85.0 – 90.0 ft										X			X		X	X	X																										
		90.0 – 95.0 ft																																										
		95.0 – 100.0 ft																																										
		100.0 – 105.0 ft										X			X		X	X	X																										
		105.0 – 110.0 ft										X			X		X	X	X																										
		110.0 – 115.0 ft																																										
		115.0 – 120.0 ft																																										
		120.0 – 125.0 ft										X			X		X	X	X																										
		125.0 – 130.0 ft										X			X		X	X	X																										
		130.0 – 135.0 ft																																										
		135.0 – 140.0 ft																																										
		140.0 – 145.0 ft										X			X		X	X	X																										
		145.0 – 150.0 ft										X			X		X	X	X																										
		150.0 – 155.0 ft																																										
		155.0 – 160.0 ft																																										
		160.0 – 165.0 ft																																										

Table F.2-IV

MDA B GEOPHYSICAL

MINERALOGICAL DETERMINATIONS

				Hydrogeological and Geochemical																Environmental Isotopes								Open Hole Tests: Straddle Packer Tests								Open Hole Tests: Geophysics										
Sample Type	Sampling Location	Interval	Sample Identification	Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (He injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Chloride-35/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-16/Oxygen-18	Tritium	Carbon-14	Chloride-36	In Situ Permeability	VOA's - Pore Gas	CO_2 - Pore Gas	CH_4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6		Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
		165.0 - 170.0 ft										X	X	X	X	X	X	X	X																											
		170.0 - 175.0 ft																																												
		175.0 - 180.0 ft																																												
Fracture Contingency Sample												C	C	C	C	C	C	C	C																											
												C	C	C	C	C	C	C	C																											
												C	C	C	C	C	C	C	C																											
												C	C	C	C	C	C	C	C																											
												C	C	C	C	C	C	C	C																											
Ang Borehole 10 deg	3	0.0 - 5.0 ft																																												
		5.0 - 10.0 ft										X	X	X	X	X	X	X	X																											
		10.0 - 15.0 ft																																												
		15.0 - 20.0 ft																																												
		20.0 - 25.0 ft																																												
		25.0 - 30.0 ft										X	X	X	X	X	X	X	X																											
		30.0 - 35.0 ft																																												
		35.0 - 40.0 ft																																												
		40.0 - 45.0 ft																																												
		45.0 - 50.0 ft										X	X	X	X	X	X	X	X																											
		50.0 - 55.0 ft																																												
		55.0 - 60.0 ft																																												
		60.0 - 65.0 ft																																												
		65.0 - 70.0 ft										X	X	X	X	X	X	X	X																											
		70.0 - 75.0 ft																																												
		75.0 - 80.0 ft																																												
		80.0 - 85.0 ft																																												
		85.0 - 90.0 ft										X	X	X	X	X	X	X	X																											
		90.0 - 95.0 ft																																												
		95.0 - 100.0 ft																																												
		100.0 - 105.0 ft																																												
		105.0 - 110.0 ft										X	X	X	X	X	X	X	X																											
		110.0 - 115.0 ft																																												
		115.0 - 120.0 ft																																												
		120.0 - 125.0 ft																																												
		125.0 - 130.0 ft										X	X	X	X	X	X	X	X																											
		130.0 - 135.0 ft																																												

Table F.2-IV

MDA B GEOPHYSICAL

MINERALOGICAL DETERMINATIONS

Sample Type	Sampling Location	Interval	Sample Identification	Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (Hg injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry PH		Chloride-36/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-18/Oxygen-16	Tritium	Carbon-14	Chloride-36		In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6		Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Gaochemical (Californium-252)	Side Scan Video
		135.0 – 140.0 ft																																													
		140.0 – 145.0 ft																																													
		145.0 – 150.0 ft		X								X			X	X	X	X	X																												
		150.0 – 155.0 ft																																													
		155.0 – 160.0 ft																																													
		160.0 – 165.0 ft		X								X			X	X	X	X	X																												
		165.0 – 170.0 ft		X								X			X	X	X	X	X																												
		170.0 – 175.0 ft																																													
		175.0 – 180.0 ft										C	C	C	C	C	C	C	C																												
Fracture Contingency Sample												C	C	C	C	C	C	C	C																												
												C	C	C	C	C	C	C	C																												
												C	C	C	C	C	C	C	C																												
Ang Borehole 20 deg	5	0.0 – 5.0 ft										X			X	X	X	X	X																												
		5.0 – 10.0 ft										X			X	X	X	X	X																												
		10.0 – 15.0 ft																																													
		15.0 – 20.0 ft																																													
		20.0 – 25.0 ft																																													
		25.0 – 30.0 ft										X			X	X	X	X	X																												
		30.0 – 35.0 ft																																													
		35.0 – 40.0 ft																																													
		40.0 – 45.0 ft										X			X	X	X	X	X																												
		45.0 – 50.0 ft										X			X	X	X	X	X																												
		50.0 – 55.0 ft																																													
		55.0 – 60.0 ft																																													
		60.0 – 65.0 ft										X			X	X	X	X	X																												
		65.0 – 70.0 ft										X			X	X	X	X	X																												
		70.0 – 75.0 ft																																													
		75.0 – 80.0 ft																																													
		80.0 – 85.0 ft										X			X	X	X	X	X																												
		85.0 – 90.0 ft										X			X	X	X	X	X																												
		90.0 – 95.0 ft																																													
		95.0 – 100.0 ft																																													
		100.0 – 105.0 ft																																													

Table F.2-IV

MDA B GEOPHYSICAL

MINERALOGICAL DETERMINATIONS

				Hydrogeological and Geochemical																	Environmental Isotopes									Open Hole Tests: Straddle Packer Tests								Open Hole Tests: Geophysics										
Sample Type	Sampling Location	Interval	Sample Identification	Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (He injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph		Chloride-36/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-16/Oxygen-18	Tritium	Carbon-14	Chloride-36		In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6		Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
		105.0 - 110.0 ft										X	X	X	X	X	X	X	X																													
		110.0 - 115.0 ft																																														
		115.0 - 120.0 ft																																														
		120.0 - 125.0 ft																																														
		125.0 - 130.0 ft										X	X	X	X	X	X	X	X																													
		130.0 - 135.0 ft																																														
		135.0 - 140.0 ft																																														
		140.0 - 145.0 ft																																														
		145.0 - 150.0 ft										X	X	X	X	X	X	X	X																													
		150.0 - 155.0 ft																																														
		155.0 - 160.0 ft																																														
		160.0 - 165.0 ft																																														
		165.0 - 170.0 ft										X	X	X	X	X	X	X	X																													
		170.0 - 175.0 ft																																														
		175.0 - 180.0 ft																																														
		180.0 - 185.0 ft																																														
		185.0 - 190.0 ft										X	X	X	X	X	X	X	X																													
		190.0 - 195.0 ft																																														
		195.0 - 200.0 ft																																														
Fracture Contingency Sample												C	C	C	C	C	C	C	C																													
												C	C	C	C	C	C	C	C																													
												C	C	C	C	C	C	C	C																													
												[illegible]	[illegible]	C	C	C	C	C	C																													
												C	C	C	C	C	C	C	C																													
Ang Borehole 20 deg	6	0.0 - 5.0 ft																																														
		5.0 - 10.0 ft										X	X	X	X	X	X	X	X																													
		10.0 - 15.0 ft																																														
		15.0 - 20.0 ft																																														
		20.0 - 25.0 ft																																														
		25.0 - 30.0 ft										X	X	X	X	X	X	X	X																													
		30.0 - 35.0 ft																																														
		35.0 - 40.0 ft																																														
		40.0 - 45.0 ft																																														
		45.0 - 50.0 ft										X	X	X	X	X	X	X	X																													
		50.0 - 55.0 ft																																														

Table F.2-IV

MDA B GEOPHYSICAL

MINERALOGICAL DETERMINATIONS

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical																	Environmental Isotopes									Open Hole Tests: Straddle Packer Tests								Open Hole Tests: Geophysics										
				Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (He injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry pH		Chloride-35/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-16/Oxygen-18	Tritium	Carbon-14	Chloride-36		In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6		Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
		55.0 - 60.0 ft																																														
		60.0 - 65.0 ft																																														
		65.0 - 70.0 ft										X	X	X	X	X	X	X	X																													
		70.0 - 75.0 ft																																														
		75.0 - 80.0 ft																																														
		80.0 - 85.0 ft																																														
		85.0 - 90.0 ft										X	X	X	X	X	X	X	X																													
		90.0 - 95.0 ft																																														
		95.0 - 100.0 ft																																														
		100.0 - 105.0 ft																																															
		105.0 - 110.0 ft										X	X	X	X	X	X	X	X																													
		110.0 - 115.0 ft																																														
		115.0 - 120.0 ft																																														
		120.0 - 125.0 ft																																														
		125.0 - 130.0 ft										X	X	X	X	X	X	X	X																													
		130.0 - 135.0 ft																																														
		135.0 - 140.0 ft																																														
		140.0 - 145.0 ft																																														
		145.0 - 150.0 ft										X	X	X	X	X	X	X	X																													
		150.0 - 155.0 ft																																														
		155.0 - 160.0 ft																																														
		160.0 - 165.0 ft																																														
		165.0 - 170.0 ft										X	X	X	X	X	X	X	X																													
		170.0 - 175.0 ft																																														
		175.0 - 180.0 ft																																														
		180.0 - 185.0 ft																																														
		185.0 - 190.0 ft										X	X	X	X	X	X	X	X																													
		190.0 - 195.0 ft																																														
		195.0 - 200.0 ft																																														
Fracture Contingency Sample												C	C	C	C	C	C	C	C																													
												C	C	C	C	C	C	C	C																													
												C	C	C	C	C	C	C	C																													
												C	C	C	C	C	C	C	C																													
												C	C	C	C	C	C	C	C																													
Vertical Borehole	7	0.0 - 5.0 ft																																														

Table F.2-IV

MDA B GEOPHYSICAL

MINERALOGICAL DETERMINATIONS

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical: Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (He injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Environmental Isotopes: Chloride-35/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-16/Oxygen-18	Tritium	Carbon-14	Chloride-36	Open Hole Tests: Straddle Packer Tests: In Situ Permeability	VOCs - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6	Open Hole Tests: Geophysics: Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
		5.0 - 10.0 ft										X	X	X	X	X	X	X	X																										
		10.0 - 15.0 ft																																											
		15.0 - 20.0 ft																																											
		20.0 - 25.0 ft																																											
		25.0 - 30.0 ft										X	X	X	X	X	X	X	X																										
Fracture Contingency Sample												C	C	C	C	C	C	C	C																										
												C	C	C	C	C	C	C	C																										
												C	C	C	C	C	C	C	C																										
												C	C	C	C	C	C	C	C																										
												C	C	C	C	C	C	C	C																										
Vertical Borehole	8	0.0 - 5.0 ft																																											
		5.0 - 10.0 ft										X	X	X	X	X	X	X	X																										
		10.0 - 15.0 ft																																											
		15.0 - 20.0 ft																																											
		20.0 - 25.0 ft																																											
		25.0 - 30.0 ft										X	X	X	X	X	X	X	X																										
Fracture Contingency Sample												C	C	C	C	C	C	C	C																										
												C	C	C	C	C	C	C	C																										
												C	C	C	C	C	C	C	C																										
												C	C	C	C	C	C	C	C																										
												C	C	C	C	C	C	C	C																										
Vertical Borehole	9	0.0 - 5.0 ft																																											
		5.0 - 10.0 ft										X	X	X	X	X	X	X	X																										
		10.0 - 15.0 ft																																											
		15.0 - 20.0 ft																																											
		20.0 - 25.0 ft																																											
		25.0 - 30.0 ft										X	X	X	X	X	X	X	X																										
Fracture Contingency Sample												C	C	C	C	C	C	C	C																										
												C	C	C	C	C	C	C	C																										
												C	C	C	C	C	C	C	C																										
												C	C	C	C	C	C	C	C																										
												C	C	C	C	C	C	C	C																										

Table F.2-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA B.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
Subsurface samples at MDA B																																			
Vertical Borehole	1	0.0 – 5.0 ft						X	X		X	X	X						X					X			X	X	X	X	X				
		5.0 – 10.0 ft						X	X		X	X	X						X					X			X	X	X	X	X				
		10.0 – 15.0 ft						X	X		X	X	X						X					X			X	X	X	X	X				
		15.0 – 20.0 ft						X	X		X	X	X						X					X			X	X	X	X	X				
		20.0 – 25.0 ft						X	X		X	X	X						X					X			X	X	X	X	X				
		25.0 – 30.0 ft						X	X		X	X	X						X					X			X	X	X	X	X				
Field Duplicate																																			
		30.0 – 35.0 ft						X	X		X	X	X						X					X			X	X	X	X	X				
		35.0 – 40.0 ft						X	X		X	X	X						X					X			X	X	X	X	X				
		40.0 – 45.0 ft						X	X		X	X	X						X					X			X	X	X	X	X				
		45.0 – 50.0 ft						X	X		X	X	X						X					X			X	X	X	X	X				
		50.0 – 55.0 ft						X	X		X	X	X						X					X			X	X	X	X	X				
		55.0 – 60.0 ft						X	X		X	X	X						X					X			X	X	X	X	X				
		60.0 – 65.0 ft						X	X		X	X	X						X					X			X	X	X	X	X				
		65.0 – 70.0 ft						X	X		X	X	X						X					X			X	X	X	X	X				
		70.0 – 75.0 ft						X	X		X	X	X						X					X			X	X	X	X	X				
Rinsate Blank																																			
Field Blank																																			
Trip Blank																													X						
Vertical Borehole	2	0.0 – 5.0 ft						X	X		X	X	X						X					X			X	X	X	X	X				
		5.0 – 10.0 ft						X	X		X	X	X						X					X			X	X	X	X	X				
		10.0 – 15.0 ft						X	X		X	X	X						X					X			X	X	X	X	X				
		15.0 – 20.0 ft						X	X		X	X	X						X					X			X	X	X	X	X				
		20.0 – 25.0 ft						X	X		X	X	X						X					X			X	X	X	X	X				

Table F.2-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA B.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low–Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Field Laboratory Measurements:	Field Laboratory Measurements:	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals		
Field Duplicate		25.0 – 30.0 ft						X											X			X	X	X	X	X	X	X	X	X				
		30.0 – 35.0 ft						X			X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X				
		35.0 – 40.0 ft						X			X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X				
		40.0 – 45.0 ft						X			X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X				
		45.0 – 50.0 ft						X			X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X				
		50.0 – 55.0 ft						X			X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X				
		55.0 – 60.0 ft						X			X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X				
		60.0 – 65.0 ft						X			X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X				
		65.0 – 70.0 ft						X			X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X				
		70.0 – 75.0 ft						X			X	X	X	X	X	X	X	X				X	X	X	X	X	X	X	X	X				
Rinsate Blank																						X	X	X	X	X	X	X	X	X				
Field Blank																						X	X	X	X	X	X	X	X	X				
Trip Blank																						X	X	X	X	X	X	X	X	X				
Vertical Borehole	3	0.0 – 5.0 ft		X	X	X	X	X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		5.0 – 10.0 ft		X	X	X	X	X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		10.0 – 15.0 ft		X	X	X	X	X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		15.0 – 20.0 ft		X	X	X	X	X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		20.0 – 25.0 ft		X	X	X	X	X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		25.0 – 30.0 ft		X	X	X	X	X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
Field Duplicate		30.0 – 35.0 ft		X	X	X	X	X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		35.0 – 40.0 ft		X	X	X	X	X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		40.0 – 45.0 ft		X	X	X	X	X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		45.0 – 50.0 ft		X	X	X	X	X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		50.0 – 55.0 ft		X	X	X	X	X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				

Table F.2-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA B.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
				Gross Gamma	Low-Energy Gamma (Pu)	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logg	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
		55.0 – 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		60.0 – 65.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		65.0 – 70.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		70.0 – 75.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
Rinsate Blank																						X	X	X	X		X	X	X	X			
Field Blank																												X	X	X			
Trip Blank																												X					
Vertical Borehole	4	0.0 – 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		5.0 – 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		10.0 – 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		25.0 – 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
Field Duplicate																						X	X	X	X		X	X	X	X			
		30.0 – 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		35.0 – 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		40.0 – 45.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		45.0 – 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		50.0 – 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		55.0 – 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		60.0 – 65.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		65.0 – 70.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		70.0 – 75.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
Rinsate Blank																						X	X	X	X		X	X	X	X			
Field Blank																												X	X	X			
Trip Blank																												X					

Table F.2-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA B.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Field Laboratory Measurements:	Field Laboratory Measurements:	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals		
Vertical Borehole	5	0.0 - 5.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		5.0 - 10.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		10.0 - 15.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		15.0 - 20.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		20.0 - 25.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		25.0 - 30.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
Field Duplicate		30.0 - 35.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		35.0 - 40.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		40.0 - 45.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		45.0 - 50.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		50.0 - 55.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		55.0 - 60.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		60.0 - 65.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		65.0 - 70.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		70.0 - 75.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
Rinsate Blank																						X	X	X	X	X	X	X	X	X			
Field Blank																								X				X	X	X			
Trip Blank																												X	X	X			

Table F.3-1

SCREENING AND ANALYSIS FOR INITIAL SURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis														
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals				
Surface Sampling at MDA T																																				
Surface Soil Sample	1	0.0 - 6.0 in		X	X		X	X	X													X	X	X	X		X		X	X					
	2	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X					
	3	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X					
	4	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X					
	5	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X					
Rinsate Blank																						X	X	X	X		X		X	X					
Field Blank																													X	X					
	6	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X					
	7	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X					
	8	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X					
Field Duplicate																						X	X	X	X		X		X	X					
	9	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X					
	10	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X					
	11	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X					
	12	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X					
	13	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X					
	14	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X					
	15	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X					
	16	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X					
	17	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X					
	18	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X					
	19	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X					
	20	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X					
	21	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X					

Table F.3-1

SCREENING AND ANALYSIS FOR INITIAL SURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals		
	22	0.0 - 6.0 in							X	X												X	X	X	X		X		X			
	23	0.0 - 6.0 in							X	X												X	X	X	X		X		X			
	24	0.0 - 6.0 in							X	X												X	X	X	X		X		X			
Rinsate Blank																																	
Field Blank																																	
	25	0.0 - 6.0 in							X	X												X	X	X	X		X		X			
	26	0.0 - 6.0 in							X	X												X	X	X	X		X		X			
	27	0.0 - 6.0 in							X	X												X	X	X	X		X		X			
Field Duplicate																																	
	28	0.0 - 6.0 in							X	X												X	X	X	X		X		X			
	29	0.0 - 6.0 in							X	X												X	X	X	X		X		X			
	30	0.0 - 6.0 in							X	X												X	X	X	X		X		X			
	31	0.0 - 6.0 in							X	X												X	X	X	X		X		X			
	32	0.0 - 6.0 in							X	X												X	X	X	X		X		X			
	33	0.0 - 6.0 in							X	X												X	X	X	X		X		X			
	34	0.0 - 6.0 in							X	X												X	X	X	X		X		X			
	35	0.0 - 6.0 in							X	X												X	X	X	X		X		X			
	36	0.0 - 6.0 in							X	X												X	X	X	X		X		X			
	37	0.0 - 6.0 in							X	X												X	X	X	X		X		X			
	38	0.0 - 6.0 in							X	X												X	X	X	X		X		X			
	39	0.0 - 6.0 in							X	X												X	X	X	X		X		X			
	40	0.0 - 6.0 in							X	X												X	X	X	X		X		X			
Replicate Surface Soil Sample	1	0.0 - 6.0 in							X	X												X	X	X	X		X		X			
	2	0.0 - 6.0 in							X	X												X	X	X	X		X		X			
Rinsate Blank	3	0.0 - 6.0 in							X	X												X	X	X	X		X		X			

Table F.3-I

SCREENING AND ANALYSIS FOR INITIAL SURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis													
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
Field Blank																												X	X					
	4	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
Field Duplicate																						X	X	X	X		X		X	X				
	5	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	6	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	7	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	8	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	9	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	10	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
Contingency Surface Soil	1	0.0 - 6.0 in																				C	C	C	C		C	C	C	C				
	2	0.0 - 6.0 in																				C	C	C	C		C	C	C	C				
	3	0.0 - 6.0 in																				C	C	C	C		C	C	C	C				
	4	0.0 - 6.0 in																				C	C	C	C		C	C	C	C				
	5	0.0 - 6.0 in																				C	C	C	C		C	C	C	C				
	6	0.0 - 6.0 in																				C	C	C	C		C	C	C	C				
	7	0.0 - 6.0 in																				C	C	C	C		C	C	C	C				
	8	0.0 - 6.0 in																				C	C	C	C		C	C	C	C				
	9	0.0 - 6.0 in																				C	C	C	C		C	C	C	C				
	10	0.0 - 6.0 in																				C	C	C	C		C	C	C	C				
Trip Blank																												C						

Table F.3-II

SCREENING AND ANALYSIS FOR SUBSEQUENT SURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Measurements: Gross Alpha	Field Measurements: Gamma Spectrometry	Field Measurements: Tritium	Field Measurements: Volatile Organics	Field Measurements: PCB	Field Measurements: Soil Moisture	Field Measurements:	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCL Metals
Surface Sampling at MDA T																															
Surface Soil Sample	1	0.0 - 6.0 in		X	X			X	X												X	X	X	X	X	X	X	X	X	
	2	0.0 - 6.0 in						X	X												X	X	X	X	X	X	X	X	X	
	3	0.0 - 6.0 in						X	X												X	X	X	X	X	X	X	X	X	
	4	0.0 - 6.0 in						X	X												X	X	X	X	X	X	X	X	X	
	5	0.0 - 6.0 in						X	X												X	X	X	X	X	X	X	X	X	
Rinsate Blank																					X	X	X	X	X	X	X	X	X	
Field Blank																					X	X	X	X	X	X	X	X	X	
	6	0.0 - 6.0 in						X	X												X	X	X	X	X	X	X	X	X	
	7	0.0 - 6.0 in						X	X												X	X	X	X	X	X	X	X	X	
	8	0.0 - 6.0 in						X	X												X	X	X	X	X	X	X	X	X	
Field Duplicate																					X	X	X	X	X	X	X	X	X	
	9	0.0 - 6.0 in						X	X												X	X	X	X	X	X	X	X	X	
	10	0.0 - 6.0 in						X	X												X	X	X	X	X	X	X	X	X	
	11	0.0 - 6.0 in						X	X												X	X	X	X	X	X	X	X	X	
	12	0.0 - 6.0 in						X	X												X	X	X	X	X	X	X	X	X	
	13	0.0 - 6.0 in						X	X												X	X	X	X	X	X	X	X	X	
	14	0.0 - 6.0 in						X	X												X	X	X	X	X	X	X	X	X	
	15	0.0 - 6.0 in						X	X												X	X	X	X	X	X	X	X	X	
	16	0.0 - 6.0 in						X	X												X	X	X	X	X	X	X	X	X	
	17	0.0 - 6.0 in						X	X												X	X	X	X	X	X	X	X	X	
	18	0.0 - 6.0 in						X	X												X	X	X	X	X	X	X	X	X	
	19	0.0 - 6.0 in						X	X												X	X	X	X	X	X	X	X	X	
	20	0.0 - 6.0 in						X	X												X	X	X	X	X	X	X	X	X	
	21	0.0 - 6.0 in						X	X												X	X	X	X	X	X	X	X	X	

Table F.3-II

SCREENING AND ANALYSIS FOR SUBSEQUENT SURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Field Laboratory Measurements:	Field Laboratory Measurements:	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals			
	22	0.0 – 6.0 in						X	X													C	C	C	C	C	C		C	C					
	23	0.0 – 6.0 in						X	X													C	C	C	C	C	C		C	C					
	24	0.0 – 6.0 in						X	X													C	C	C	C	C	C		C	C					
Rinsate Blank																																				
Field Blank																																				
	25	0.0 – 6.0 in						X	X													C	C	C	C	C	C		C	C					
	26	0.0 – 6.0 in						X	X													C	C	C	C	C	C		C	C					
	27	0.0 – 6.0 in						X	X													C	C	C	C	C	C		C	C					
Field Duplicate																																				
	28	0.0 – 6.0 in						X	X													C	C	C	C	C	C		C	C					
	29	0.0 – 6.0 in						X	X													C	C	C	C	C	C		C	C					
	30	0.0 – 6.0 in						X	X													C	C	C	C	C	C		C	C					
Contingency Surface Soil	1	0.0 – 6.0 in																				C	C	C	C	C	C		C	C					
	2	0.0 – 6.0 in																				C	C	C	C	C	C		C	C					
	3	0.0 – 6.0 in																				C	C	C	C	C	C		C	C					
	4	0.0 – 6.0 in																				C	C	C	C	C	C		C	C					
	5	0.0 – 6.0 in																				C	C	C	C	C	C		C	C					
	6	0.0 – 6.0 in																				C	C	C	C	C	C		C	C					
	7	0.0 – 6.0 in																				C	C	C	C	C	C		C	C					
	8	0.0 – 6.0 in																				C	C	C	C	C	C		C	C					
	9	0.0 – 6.0 in																				C	C	C	C	C	C		C	C					
	10	0.0 – 6.0 in																				C	C	C	C	C	C		C	C					
Trip Blank																																				

Table F.3-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Absorption Bed 1																																	
Vertical Borehole	1	0.0 – 2.5 ft						X	X																								
		2.5 – 5.0 ft						X	X		X	X	X		X	X	X	X	X			X	X	X	X		X	X	X	X			
		5.0 – 7.5 ft						X	X		X	X	X		X	X	X	X	X			X	X	X	X		X	X	X	X			
		7.5 – 10.0 ft						X	X		X	X	X		X	X	X	X	X			X	X	X	X		X	X	X	X			
		10.0 – 12.5 ft						X	X		X	X	X		X	X	X	X	X			X	X	X	X		X	X	X	X			
		12.5 – 15.0 ft						X	X		X	X	X		X	X	X	X	X			X	X	X	X		X	X	X	X			
		15.0 – 20.0 ft						X	X		X	X	X		X	X	X	X	X			X	X	X	X		X	X	X	X			
		20.0 – 25.0 ft						X	X		X	X	X		X	X	X	X	X			X	X	X	X		X	X	X	X			
		25.0 – 30.0 ft						X	X		X	X	X		X	X	X	X	X			X	X	X	X		X	X	X	X			
Field Duplicate																																	
		30.0 – 35.0 ft						X	X		X	X	X		X	X	X	X	X			X	X	X	X		X	X	X	X			
		35.0 – 40.0 ft						X	X		X	X	X		X	X	X	X	X			X	X	X	X		X	X	X	X			
		40.0 – 45.0 ft						X	X		X	X	X		X	X	X	X	X			X	X	X	X		X	X	X	X			
		45.0 – 50.0 ft						X	X		X	X	X		X	X	X	X	X			X	X	X	X		X	X	X	X			
		50.0 – 55.0 ft						X	X		X	X	X		X	X	X	X	X			X	X	X	X		X	X	X	X			
		55.0 – 60.0 ft						X	X		X	X	X		X	X	X	X	X			X	X	X	X		X	X	X	X			
		60.0 – 65.0 ft						X	X		X	X	X		X	X	X	X	X			X	X	X	X		X	X	X	X			
		65.0 – 70.0 ft						X	X		X	X	X		X	X	X	X	X			X	X	X	X		X	X	X	X			
		70.0 – 75.0 ft						X	X		X	X	X		X	X	X	X	X			X	X	X	X		X	X	X	X			
		75.0 – 80.0 ft						X	X		X	X	X		X	X	X	X	X			X	X	X	X		X	X	X	X			
		80.0 – 85.0 ft						X	X		X	X	X		X	X	X	X	X			X	X	X	X		X	X	X	X			
		85.0 – 90.0 ft						X	X		X	X	X		X	X	X	X	X			X	X	X	X		X	X	X	X			
		90.0 – 95.0 ft						X	X		X	X	X		X	X	X	X	X			X	X	X	X		X	X	X	X			
		95.0 – 100.0 ft						X	X		X	X	X		X	X	X	X	X			X	X	X	X		X	X	X	X			

Table F.3-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
		100.0 – 105.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		105.0 – 110.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		110.0 – 115.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
Trip Blank																												X						
		115.0 – 120.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		120.0 – 125.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		125.0 – 130.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		130.0 – 135.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		135.0 – 140.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		140.0 – 145.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		145.0 – 150.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		150.0 – 155.0 ft						X	X		X	X	X			X			X															
		155.0 – 160.0 ft						X	X		X	X	X			X			X															
		160.0 – 165.0 ft						X	X		X	X	X			X			X															
		165.0 – 170.0 ft						X	X		X	X	X			X			X															
		170.0 – 175.0 ft						X	X		X	X	X			X			X															
		175.0 – 180.0 ft						X	X		X	X	X			X			X															
		180.0 – 185.0 ft						X	X		X	X	X			X			X															
		185.0 – 190.0 ft						X	X		X	X	X			X			X															
		190.0 – 195.0 ft						X	X		X	X	X			X			X															
		195.0 – 200.0 ft						X	X		X	X	X			X			X															
Fracture Sampling Contingency								C	C		C	C	C						C			C	C	C	C		C	C	C	C				

Table F.3-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Vertical Borehole	2	0.0 - 2.5 ft						X	X		C	C	C						C			C	C	C	C	C	C	C	C			
		2.5 - 5.0 ft						X	X		C	C	C						C			C	C	C	C	C	C	C	C			
		5.0 - 7.5 ft						X	X		C	C	C						C			C	C	C	C	C	C	C	C			
		7.5 - 10.0 ft						X	X		C	C	C						C			C	C	C	C	C	C	C	C			
		10.0 - 12.5 ft						X	X		C	C	C						C			C	C	C	C	C	C	C	C			
		12.5 - 15.0 ft						X	X		C	C	C						C			C	C	C	C	C	C	C	C			
		15.0 - 20.0 ft						X	X		C	C	C						C			C	C	C	C	C	C	C	C			
		20.0 - 25.0 ft						X	X		C	C	C						C			C	C	C	C	C	C	C	C			
		25.0 - 30.0 ft						X	X		C	C	C						C			C	C	C	C	C	C	C	C			
Trip Blank																																	
Field Duplicate		30.0 - 35.0 ft						X	X		C	C	C						C			C	C	C	C	C	C	C	C			
		35.0 - 40.0 ft						X	X		C	C	C						C			C	C	C	C	C	C	C	C			
		40.0 - 45.0 ft						X	X		C	C	C						C			C	C	C	C	C	C	C	C			
		45.0 - 50.0 ft						X	X		C	C	C						C			C	C	C	C	C	C	C	C			
		50.0 - 55.0 ft						X	X		C	C	C						C			C	C	C	C	C	C	C	C			
		55.0 - 60.0 ft						X	X		C	C	C						C			C	C	C	C	C	C	C	C			
		60.0 - 65.0 ft						X	X		C	C	C						C			C	C	C	C	C	C	C	C			
		65.0 - 70.0 ft						X	X		C	C	C						C			C	C	C	C	C	C	C	C			
		70.0 - 75.0 ft						X	X		C	C	C						C			C	C	C	C	C	C	C	C			
		75.0 - 80.0 ft						X	X		C	C	C						C			C	C	C	C	C	C	C	C			

Table F.3-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Field Laboratory Measurements:	Field Laboratory Measurements:	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals		
		80.0 – 85.0 ft		X	X			X	X		X	X	X						X			X	X	X			X	X	X	X				
		85.0 – 90.0 ft		X	X			X	X		X	X	X						X			X	X	X			X	X	X	X				
		90.0 – 95.0 ft		X	X			X	X		X	X	X						X			X	X	X			X	X	X	X				
		95.0 – 100.0 ft		X	X			X	X		X	X	X						X			X	X	X			X	X	X	X				
Rinsate Blank																																			
Field Blank																																			
		100.0 – 105.0 ft						X	X		X	X	X						X			X	X	X			X	X	X	X				
		105.0 – 110.0 ft						X	X		X	X	X						X			X	X	X			X	X	X	X				
		110.0 – 115.0 ft						X	X		X	X	X						X			X	X	X			X	X	X	X				
Field Duplicate																																			
Trip Blank																																			
		115.0 – 120.0 ft						X	X		X	X	X						X			X	X	X			X	X	X	X				
		120.0 – 125.0 ft						X	X		X	X	X						X			X	X	X			X	X	X	X				
		125.0 – 130.0 ft						X	X		X	X	X						X			X	X	X			X	X	X	X				
		130.0 – 135.0 ft						X	X		X	X	X						X			X	X	X			X	X	X	X				
		135.0 – 140.0 ft						X	X		X	X	X						X			X	X	X			X	X	X	X				
		140.0 – 145.0 ft						X	X		X	X	X						X			X	X	X			X	X	X	X				
		145.0 – 150.0 ft						X	X		X	X	X						X			X	X	X			X	X	X	X				
Trip Blank																																			
Fracture Sampling Contingency								C	C		C	C	C						C			C	C	C			C	C	C	C				
								C	C		C	C	C						C			C	C	C			C	C	C	C				
								C	C		C	C	C						C			C	C	C			C	C	C	C				
								C	C		C	C	C						C			C	C	C			C	C	C	C				
								C	C		C	C	C						C			C	C	C			C	C	C	C				
Absorption Bed 2																																			

Table F.3-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA T.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis													
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
Vertical Borehole	3	0.0 - 2.5 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		2.5 - 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		5.0 - 7.5 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		7.5 - 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		10.0 - 12.5 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		12.5 - 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		15.0 - 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		20.0 - 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		25.0 - 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
Field Duplicate																						X	X	X	X		X	X	X	X					
		30.0 - 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		35.0 - 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		40.0 - 45.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		45.0 - 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		50.0 - 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		55.0 - 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		60.0 - 65.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		65.0 - 70.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		70.0 - 75.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
Fracture Sampling Contingency								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
Rinsate Blank																						X	X	X	X		X	X	X	X					

Table F.3-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys					Field Screening					Field Laboratory Measurements										Laboratory Analysis									
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey		Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithologic Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture				Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals
Field Blank																														X			
Trip Blank																													X	X			
Vertical Borehole		4	0.0 – 2.5 ft						X	X		X	X	X		X	X			X				X	X	X	X	X	X	X	X	X	X
			2.5 – 5.0 ft						X	X		X	X	X		X	X			X				X	X	X	X	X	X	X	X	X	X
			5.0 – 7.5 ft						X	X		X	X	X		X	X			X				X	X	X	X	X	X	X	X	X	X
			7.5 – 10.0 ft						X	X		X	X	X		X	X			X				X	X	X	X	X	X	X	X	X	X
			10.0 – 12.5 ft						X	X		X	X	X		X	X			X				X	X	X	X	X	X	X	X	X	X
			12.5 – 15.0 ft						X	X		X	X	X		X	X			X				X	X	X	X	X	X	X	X	X	X
			15.0 – 20.0 ft						X	X		X	X	X		X	X			X				X	X	X	X	X	X	X	X	X	X
			20.0 – 25.0 ft						X	X		X	X	X		X	X			X				X	X	X	X	X	X	X	X	X	X
			25.0 – 30.0 ft						X	X		X	X	X		X	X			X				X	X	X	X	X	X	X	X	X	X
Field Duplicate																																	
			30.0 – 35.0 ft						X	X		X	X	X		X	X			X				X	X	X	X	X	X	X	X	X	X
			35.0 – 40.0 ft						X	X		X	X	X		X	X			X				X	X	X	X	X	X	X	X	X	X
			40.0 – 45.0 ft						X	X		X	X	X		X	X			X				X	X	X	X	X	X	X	X	X	X
			45.0 – 50.0 ft						X	X		X	X	X		X	X			X				X	X	X	X	X	X	X	X	X	X
			50.0 – 55.0 ft						X	X		X	X	X		X	X			X				X	X	X	X	X	X	X	X	X	X
			55.0 – 60.0 ft						X	X		X	X	X		X	X			X				X	X	X	X	X	X	X	X	X	X
			60.0 – 65.0 ft						X	X		X	X	X		X	X			X				X	X	X	X	X	X	X	X	X	X
			65.0 – 70.0 ft						X	X		X	X	X		X	X			X				X	X	X	X	X	X	X	X	X	X
			70.0 – 75.0 ft						X	X		X	X	X		X	X			X				X	X	X	X	X	X	X	X	X	X
Fracture Sampling Contingency									C	C		C	C	C		C	C			C				C	C	C	C	C	C	C	C	C	C
									C	C		C	C	C		C	C			C				C	C	C	C	C	C	C	C	C	C
									C	C		C	C	C		C	C			C				C	C	C	C	C	C	C	C	C	C
									C	C		C	C	C		C	C			C				C	C	C	C	C	C	C	C	C	C

Table F.3-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Rinsate Blank																			C			C	C	C	C		C	C	C				
Field Blank																			C			C	C	C	C		C	C	C				
Trip Blank																														X				
Absorption Bed 3																														X	X			
Vertical Borehole	5	0.0 - 2.5 R		X	X	X	X	C	C		C	C	C	X	X	X	X	X	C			X	X	X	X		X	X	X	X			
		2.5 - 5.0 R		X	X	X	X	C	C		C	C	C	X	X	X	X	X				X	X	X	X		X	X	X	X			
		5.0 - 7.5 R		X	X	X	X	C	C		C	C	C	X	X	X	X	X				X	X	X	X		X	X	X	X			
		7.5 - 10.0 R		X	X	X	X	C	C		C	C	C	X	X	X	X	X	C			X	X	X	X		X	X	X	X			
		10.0 - 12.5 R		X	X	X	X	C	C		C	C	C	X	X	X	X	X				X	X	X	X		X	X	X	X			
		12.5 - 15.0 R		X	X	X	X	C	C		C	C	C	X	X	X	X	X				X	X	X	X		X	X	X	X			
		15.0 - 20.0 R		X	X	X	X	C	C		C	C	C	X	X	X	X	X				X	X	X	X		X	X	X	X			
		20.0 - 25.0 R		X	X	X	X	C	C		C	C	C	X	X	X	X	X				X	X	X	X		X	X	X	X			
		25.0 - 30.0 R		X	X	X	X	C	C		C	C	C	X	X	X	X	X				X	X	X	X		X	X	X	X			
Field Duplicate		30.0 - 35.0 R		X	X	X	X							X	X	X	X	X				X	X	X	X		X	X	X	X			
		35.0 - 40.0 R		X	X	X	X							X	X	X	X	X				X	X	X	X		X	X	X	X			
		40.0 - 45.0 R		X	X	X	X							X	X	X	X	X				X	X	X	X		X	X	X	X			
		45.0 - 50.0 R		X	X	X	X							X	X	X	X	X				X	X	X	X		X	X	X	X			
		50.0 - 55.0 R		X	X	X	X							X	X	X	X	X				X	X	X	X		X	X	X	X			
		55.0 - 60.0 R		X	X	X	X							X	X	X	X	X				X	X	X	X		X	X	X	X			
		60.0 - 65.0 R		X	X	X	X							X	X	X	X	X				X	X	X	X		X	X	X	X			
		65.0 - 70.0 R		X	X	X	X							X	X	X	X	X				X	X	X	X		X	X	X	X			
		70.0 - 75.0 R		X	X	X	X							X	X	X	X	X				X	X	X	X		X	X	X	X			
Fracture Sampling Contingency				C	C	C	C	C	C		C	C	C	C	C	C	C	C	C			C	C	C	C		C	C	C	C			

Table F.3-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
								C	C		C	C	C						C			C	C	C		C	C	C	C	C				
								C	C		C	C	C						C			C	C	C		C	C	C	C	C				
								C	C		C	C	C						C			C	C	C		C	C	C	C	C				
								C	C		C	C	C						C			C	C	C		C	C	C	C	C				
								C	C		C	C	C						C			C	C	C		C	C	C	C	C				
Rinsate Blank																						X	X	X		X	X	X	X	X				
Field Blank																						X	X	X		X	X	X	X	X				
Trip Blank																												X	X	X				
Adsorption Bed 4																						X	X	X		X	X	X	X	X				
Vertical Borehole	6	0.0 – 2.5 ft						X	X		X	X	X	X	X				X			X	X	X		X	X	X	X	X				
		2.5 – 5.0 ft						X	X		X	X	X	X	X				X			X	X	X		X	X	X	X	X				
		5.0 – 7.5 ft						X	X		X	X	X	X	X				X			X	X	X		X	X	X	X	X				
		7.5 – 10.0 ft						X	X		X	X	X	X	X				X			X	X	X		X	X	X	X	X				
		10.0 – 12.5 ft						X	X		X	X	X	X	X				X			X	X	X		X	X	X	X	X				
		12.5 – 15.0 ft						X	X		X	X	X	X	X				X			X	X	X		X	X	X	X	X				
		15.0 – 20.0 ft						X	X		X	X	X	X	X				X			X	X	X		X	X	X	X	X				
		20.0 – 25.0 ft						X	X		X	X	X	X	X				X			X	X	X		X	X	X	X	X				
		25.0 – 30.0 ft						X	X		X	X	X	X	X				X			X	X	X		X	X	X	X	X				
Field Duplicate																						X	X	X		X	X	X	X	X				
		30.0 – 35.0 ft						X	X		X	X	X	X	X				X			X	X	X		X	X	X	X	X				
		35.0 – 40.0 ft						X	X		X	X	X	X	X				X			X	X	X		X	X	X	X	X				
		40.0 – 45.0 ft						X	X		X	X	X	X	X				X			X	X	X		X	X	X	X	X				
		45.0 – 50.0 ft						X	X		X	X	X	X	X				X			X	X	X		X	X	X	X	X				
		50.0 – 55.0 ft						X	X		X	X	X	X	X				X			X	X	X		X	X	X	X	X				
		55.0 – 60.0 ft						X	X		X	X	X	X	X				X			X	X	X		X	X	X	X	X				
		60.0 – 65.0 ft						X	X		X	X	X	X	X				X			X	X	X		X	X	X	X	X				

Table F.3-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA T.

	Sample Type	Sampling Location	Interval	Sample Identification
			65.0 - 70.0 ft	
			70.0 - 75.0 ft	
	Fracture Sampling Contingency			
	Rinsate Blank			
	Field Blank			
	Trip Blank			
Field Surveys	Gross Gamma			
	Low-Energy Gamma			
	Electromagnetic			
	Land Survey			
Field Screening	Gross Gamma		X	X
	Gross Alpha		X	X
	Organic Vapor		X	X
	Combustible Gas/Oxygen		X	X
	Lithological Logging		X	X
Field Laboratory Measurements	Gross Alpha			
	Gamma Spectrometry			
	Tritium			
	Volatile Organics			
	PCB			
	Soil Moisture		X	X
Laboratory Analysis	Gamma Spectrometry		X	X
	Tritium		X	X
	Total Uranium		X	X
	Isotopic Plutonium		X	X
	Isotopic Uranium			
	Strontium 90		X	X
	VOA (SW 8240)		X	X
	Semivolatiles (SW 8270)		X	X
	Metals (SW 6010)		X	X
	PCB (SW 8080)			
	TCLP Metals			

Table F.3-IV

MDA T GEOPHYSICAL

MINERALOGICAL DETERMINATIONS

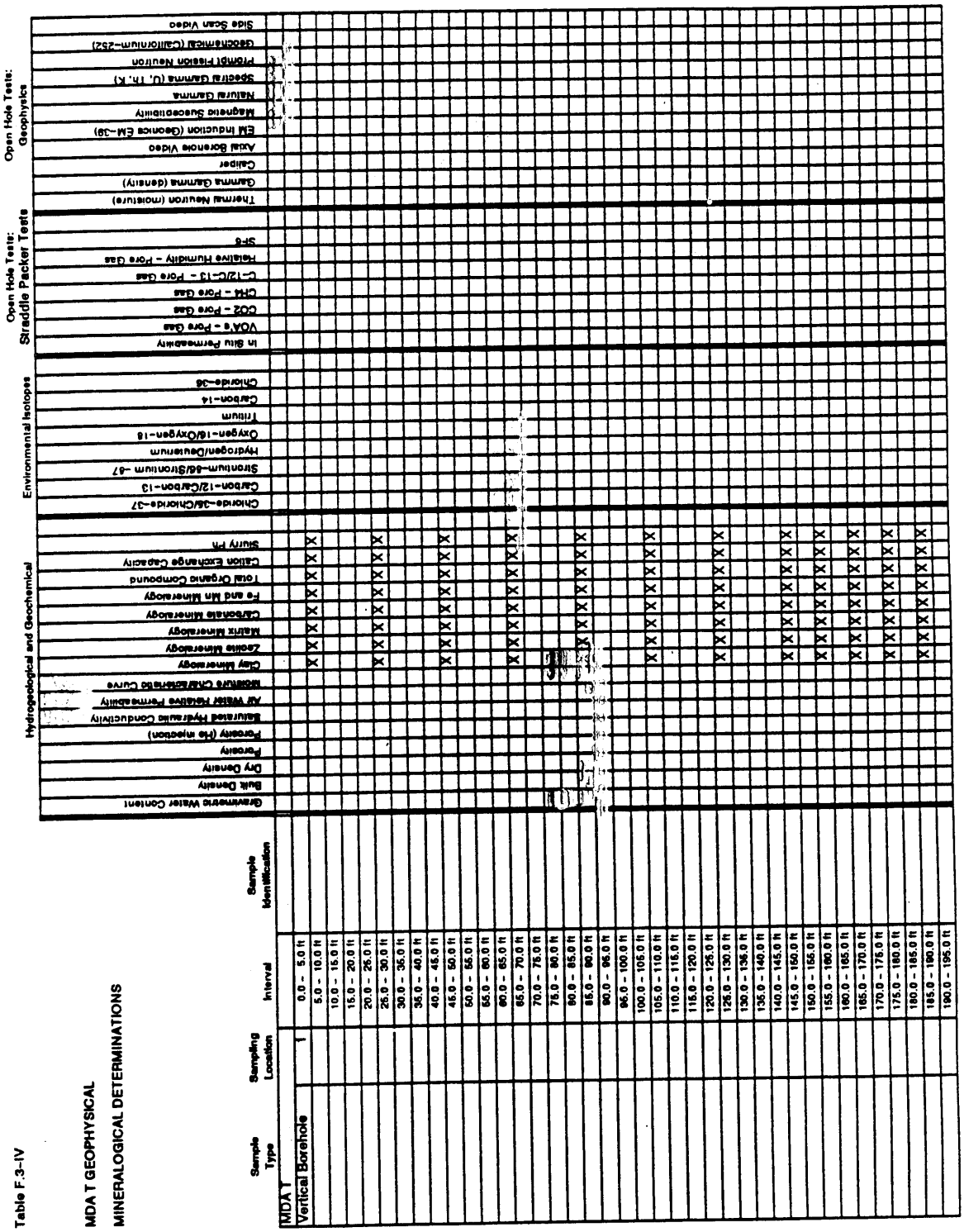


Table F.3-IV

MDA T GEOPHYSICAL

MINERALOGICAL DETERMINATIONS

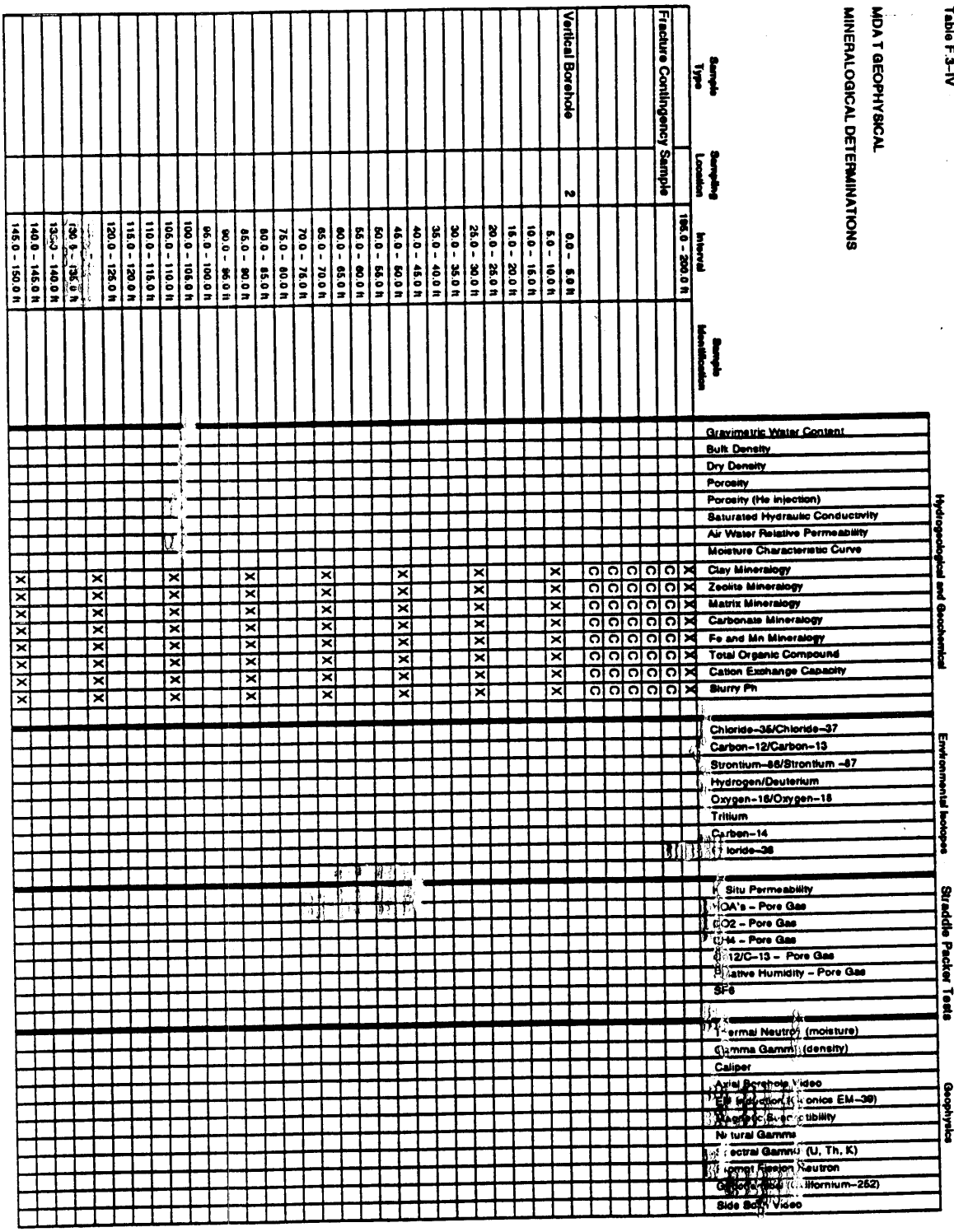


Table F.3-IV

MDA T GEOPHYSICAL

MINERALOGICAL DETERMINATIONS

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical: Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (Hg injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Environmental Isotopes: Chlorine-36/Chloride-37	Calcium-12/Calcium-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-18/Oxygen-16	Tritium	Carbon-14	Chlorine-36	Open Hole Tests: Straddle Packer Tests: In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6	Open Hole Tests: Geophysics: Thermal Neutron (Moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
Fracture Contingency Sample												C	C	C	C	C	C	C	C																									
												C	C	C	C	C	C	C	C																									
												C	C	C	C	C	C	C	C																									
												C	C	C	C	C	C	C	C																									
Vertical Borehole	3	0.0 - 5.0 ft										X	X	X	X	X	X	X	X																									
		5.0 - 10.0 ft										X	X	X	X	X	X	X	X																									
		10.0 - 15.0 ft																																									
		15.0 - 20.0 ft																																									
		20.0 - 25.0 ft																																									
		25.0 - 30.0 ft										X	X	X	X	X	X	X	X																									
		30.0 - 35.0 ft																																									
		35.0 - 40.0 ft																																									
		40.0 - 45.0 ft										X	X	X	X	X	X	X	X																									
		45.0 - 50.0 ft										X	X	X	X	X	X	X	X																									
		50.0 - 55.0 ft																																									
		55.0 - 60.0 ft																																									
		60.0 - 65.0 ft																																									
		65.0 - 70.0 ft										X	X	X	X	X	X	X	X																									
		70.0 - 75.0 ft																																									
Fracture Contingency Sample												C	C	C	C	C	C	C	C																									
												C	C	C	C	C	C	C	C																									
												C	C	C	C	C	C	C	C																									
												C	C	C	C	C	C	C	C																									
												C	C	C	C	C	C	C	C																									
Vertical Borehole	4	0.0 - 5.0 ft										X	X	X	X	X	X	X	X																									
		5.0 - 10.0 ft																																									
		10.0 - 15.0 ft																																									
		15.0 - 20.0 ft																																									
		20.0 - 25.0 ft										X	X	X	X	X	X	X	X																									
		25.0 - 30.0 ft																																									
		30.0 - 35.0 ft																																									
		35.0 - 40.0 ft																																									
		40.0 - 45.0 ft																																									
		45.0 - 50.0 ft										X	X	X	X	X	X	X	X																									

Table F.3-IV

MDA T GEOPHYSICAL
MINERALOGICAL DETERMINATIONS

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical: Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (He Injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Environmental Isotopes: Chloride-35/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-16/Oxygen-18	Tritium	Carbon-14	Chloride-36	Open Hole Tests: Straddle Packer Tests: In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6	Open Hole Tests: Geophysics: Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
		50.0 - 55.0 ft																																									
		55.0 - 60.0 ft																																									
		60.0 - 65.0 ft												X																													
		65.0 - 70.0 ft												X																													
		70.0 - 75.0 ft												X																													
Fracture Contingency Sample												C		C																													
												C		C																													
												C		C																													
												C		C																													
												C		C																													
Vertical Borehole	5	0.0 - 5.0 ft																																									
		5.0 - 10.0 ft												X		C																												
		10.0 - 15.0 ft												X		C																												
		15.0 - 20.0 ft												X		C																												
		20.0 - 25.0 ft												X		C																												
		25.0 - 30.0 ft												X		C																												
		30.0 - 35.0 ft												X		C																												
		35.0 - 40.0 ft																																									
		40.0 - 45.0 ft												X		C																												
		45.0 - 50.0 ft												X		C																												
		50.0 - 55.0 ft												X		C																												
		55.0 - 60.0 ft												X		C																												
		60.0 - 65.0 ft												X		C																												
		65.0 - 70.0 ft												X		C																												
		70.0 - 75.0 ft												X		C																												
Fracture Contingency Sample												C		C																													
												C		C																													
												C		C																													
												C		C																													
												C		C																													
Vertical Borehole	6	0.0 - 5.0 ft																																									
		5.0 - 10.0 ft												X		C																												
		10.0 - 15.0 ft												X		C																												
		15.0 - 20.0 ft												X		C																												
		20.0 - 25.0 ft												X		C																												

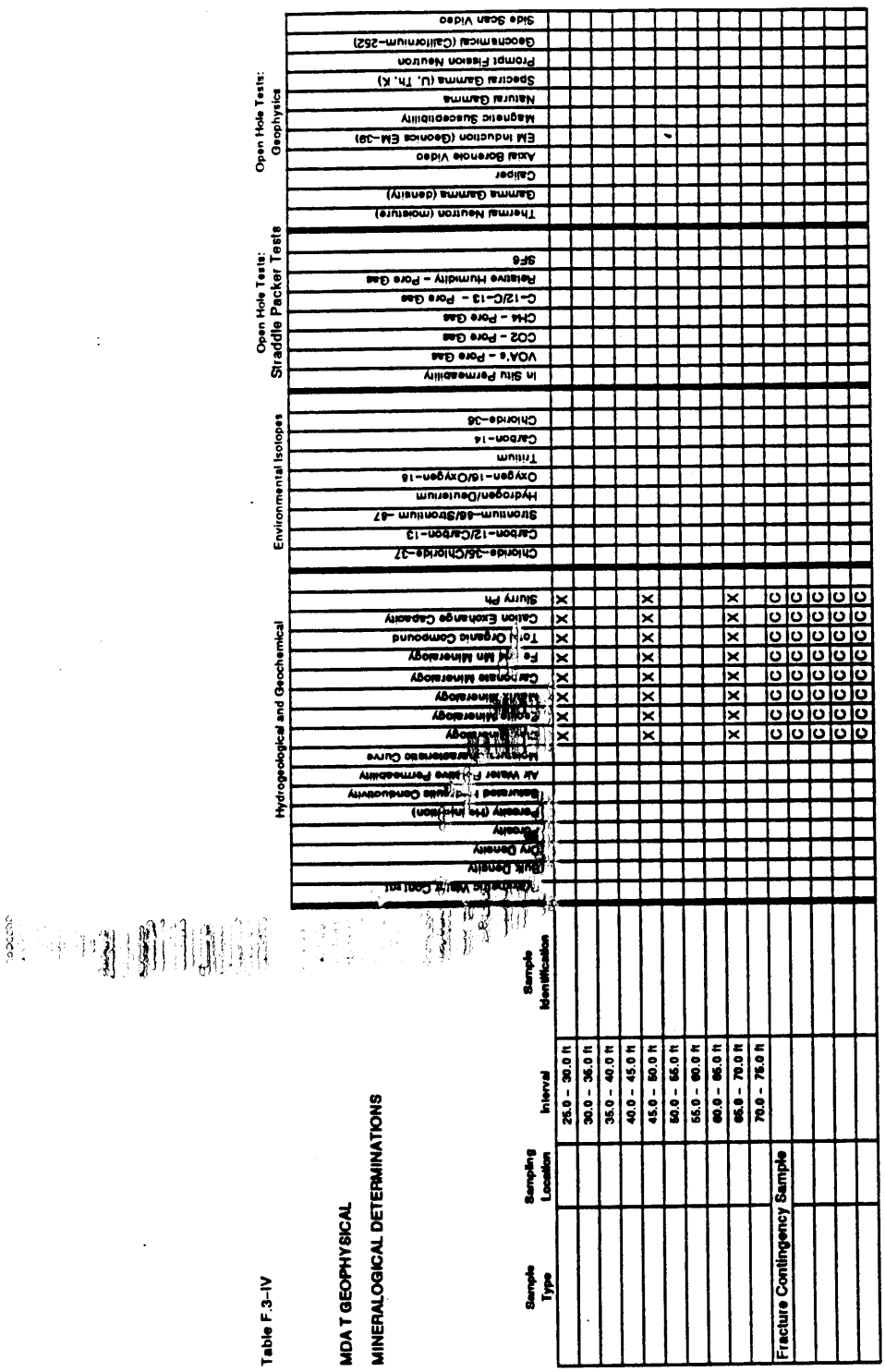


Table F.3-IV

MDA T GEOPHYSICAL

MINERALOGICAL DETERMINATIONS

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical: Moisture/Water Content; Bulk Density; Dry Density; Porosity; Porosity (Hg Intrusion); Saturated Hydraulic Conductivity; Air Water Relative Permeability; Moisture Characteristic Curve; Clay Mineralogy; Crystalline Mineralogy; Calcite Mineralogy; Feldspar Mineralogy; Fe and Mn Mineralogy; Total Organic Compound; Cation Exchange Capacity; Slurry Ph	Environmental Isotopes: Chloride-35/Chloride-37; Carbon-12/Carbon-13; Strontium-86/Strontium-87; Hydrogen/Deuterium; Oxygen-18/Oxygen-16; Tritium; Carbon-14; Chloride-36	Open Hole Tests: Straddle Packer Tests: In Situ Permeability; VOA's - Pore Gas; CO2 - Pore Gas; CH4 - Pore Gas; C-12/C-13 - Pore Gas; Relative Humidity - Pore Gas; SF6	Open Hole Tests: Geophysics: Thermal Neutron (moisture); Gamma Gamma (density); Caliper; Axial Borehole Video; EM Induction (Geonics EM-39); Magnetic Susceptibility; Natural Gamma; Spectral Gamma (U, Th, K); Prompt Fission Neutron; Geochemical (Californium-252); Side Scan Video
		25.0 – 30.0 ft		X X X X X X X X X X X X X X			
		30.0 – 36.0 ft					
		35.0 – 40.0 ft					
		40.0 – 45.0 ft		X X X X X X X X X X X X X X			
		45.0 – 50.0 ft					
		50.0 – 55.0 ft					
		55.0 – 60.0 ft					
		60.0 – 66.0 ft		X X X X X X X X X X X X X X			
		66.0 – 70.0 ft					
		70.0 – 75.0 ft		C C C C C C C C C C C C C C			
Fracture Contingency Sample				C C C C C C C C C C C C C C			
				C C C C C C C C C C C C C C			
				C C C C C C C C C C C C C C			
				C C C C C C C C C C C C C C			

Table F.3-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatile (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Subsurface samples at MDA T																																	
Angled Borehole 80 degrees	1	0.0 – 5.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		5.0 – 10.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		10.0 – 15.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		15.0 – 20.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		20.0 – 25.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		25.0 – 30.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
Field Duplicate		30.0 – 35.0 ft						X	X			X	X									X	X	X	X		X	X	X	X			
		35.0 – 40.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		40.0 – 45.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		45.0 – 50.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		50.0 – 55.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		55.0 – 60.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		60.0 – 65.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		65.0 – 70.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		70.0 – 75.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		75.0 – 80.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		80.0 – 85.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		85.0 – 90.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		90.0 – 95.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		95.0 – 100.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
Field Blank																						X	X	X	X		X	X	X	X			
Rinsate Blank																						X	X	X	X		X	X	X	X			
		100.0 – 105.0 ft																															

Table F.3-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
		105.0 – 110.0 ft		X				X	X		X	X	X						X			X	X	X			X	X	X	X				
		110.0 – 115.0 ft		X				X	X		X	X	X						X			X	X	X			X	X	X	X				
Field Duplicate																																		
Trip Blank																																		
		115.0 – 120.0 ft						X	X		X	X	X						X			X	X	X			X	X	X	X				
		120.0 – 125.0 ft						X	X		X	X	X						X			X	X	X			X	X	X	X				
		125.0 – 130.0 ft						X	X		X	X	X						X			X	X	X			X	X	X	X				
		130.0 – 135.0 ft						X	X		X	X	X						X			X	X	X			X	X	X	X				
		135.0 – 140.0 ft						X	X		X	X	X						X			X	X	X			X	X	X	X				
		140.0 – 145.0 ft						X	X		X	X	X						X			X	X	X			X	X	X	X				
		145.0 – 150.0 ft						X	X		X	X	X						X			X	X	X			X	X	X	X				
		150.0 – 155.0 ft						X	X		X	X	X						X			X	X	X			X	X	X	X				
		155.0 – 160.0 ft						X	X		X	X	X						X			X	X	X			X	X	X	X				
		160.0 – 165.0 ft						X	X		X	X	X						X			X	X	X			X	X	X	X				
		165.0 – 170.0 ft						X	X		X	X	X						X			X	X	X			X	X	X	X				
		170.0 – 175.0 ft						X	X		X	X	X						X			X	X	X			X	X	X	X				
		175.0 – 180.0 ft						X	X		X	X	X						X			X	X	X			X	X	X	X				
Rinsate Blank																																		
		180.0 – 185.0 ft						X	X		X	X	X						X			X	X	X			X	X	X	X				
		185.0 – 190.0 ft						X	X		X	X	X						X			X	X	X			X	X	X	X				
		190.0 – 195.0 ft						X	X		X	X	X			X	X		X			X	X	X			X	X	X	X				
		195.0 – 200.0 ft						X	X		X	X	X			X	X		X			X	X	X			X	X	X	X				
Fracture Sampling Contingency				C				C	C		C	C	C						C			C	C	C			C	C	C	C				
				C				C	C		C	C	C						C			C	C	C			C	C	C	C				
				C				C	C		C	C	C						C			C	C	C			C	C	C	C				
				C				C	C		C	C	C						C			C	C	C			C	C	C	C				

Table F.3-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Field Blank																			C			C	C	C	C	C	C	C	C	C			
Field Duplicate																			C			C	C	C	C		C	C	C	C			
Trip Blank																			C			C	C	C	C		C	C	C	C			
Angled Borehole 80 degrees	2	0.0 – 5.0 ft						X	X				X									X	X	X	X	X	X	X	X	X			
		5.0 – 10.0 ft						X	X				X						X			X	X	X	X	X	X	X	X	X			
		10.0 – 15.0 ft						X	X				X						X			X	X	X	X	X	X	X	X	X			
		15.0 – 20.0 ft						X	X				X						X			X	X	X	X	X	X	X	X	X			
		20.0 – 25.0 ft						X	X				X						X			X	X	X	X	X	X	X	X	X			
		25.0 – 30.0 ft						X	X				X						X			X	X	X	X	X	X	X	X	X			
Field Duplicate																																	
		30.0 – 35.0 ft						X	X				X						X			X	X	X	X	X	X	X	X	X			
		35.0 – 40.0 ft						X	X				X						X			X	X	X	X	X	X	X	X	X			
		40.0 – 45.0 ft						X	X				X						X			X	X	X	X	X	X	X	X	X			
		45.0 – 50.0 ft						X	X				X						X			X	X	X	X	X	X	X	X	X			
		50.0 – 55.0 ft						X	X				X						X			X	X	X	X	X	X	X	X	X			
		55.0 – 60.0 ft						X	X				X						X			X	X	X	X	X	X	X	X	X			
		60.0 – 65.0 ft						X	X				X						X			X	X	X	X	X	X	X	X	X			
		65.0 – 70.0 ft						X	X				X						X			X	X	X	X	X	X	X	X	X			
		70.0 – 75.0 ft						X	X				X						X			X	X	X	X	X	X	X	X	X			
		75.0 – 80.0 ft						X	X				X						X			X	X	X	X	X	X	X	X	X			
		80.0 – 85.0 ft						X	X				X						X			X	X	X	X	X	X	X	X	X			
		85.0 – 90.0 ft						X	X				X						X			X	X	X	X	X	X	X	X	X			
		90.0 – 95.0 ft						X	X				X						X			X	X	X	X	X	X	X	X	X			
		95.0 – 100.0 ft						X	X				X						X			X	X	X	X	X	X	X	X	X			
Rinsate Blank																																	

Table F.3–V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements						Laboratory Analysis													
				Gross Gamma	Low–Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Field Blank																																	
		100.0 – 105.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		105.0 – 110.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		110.0 – 115.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
Field Duplicate																						X	X	X	X		X	X	X	X			
Trip Blank																												X					
		115.0 – 120.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		120.0 – 125.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		125.0 – 130.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		130.0 – 135.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		135.0 – 140.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		140.0 – 145.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		145.0 – 150.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		150.0 – 155.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		155.0 – 160.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		160.0 – 165.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		165.0 – 170.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		170.0 – 175.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		175.0 – 180.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
Rinsate Blank																						X	X	X	X		X	X	X	X			
		180.0 – 185.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		185.0 – 190.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		190.0 – 195.0 ft						X	X		X	X	X	X	X		X		X			X	X	X	X		X	X	X	X			
		195.0 – 200.0 ft						X	X		X	X	X	X	X		X		X			X	X	X	X		X	X	X	X			
Fracture Sampling Contingency								C	C		C	C	C						C			C	C	C	C		C	C	C	C			
								C	C		C	C	C						C			C	C	C	C		C	C	C	C			

Table F.3-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Identification	Interval	Sampling Location	Sample Type		Field Surveys	Field Screening	Field Laboratory Measurements	Laboratory Analysis
					Gross Gamma			
					Low-Energy Gamma			
					Electromagnetic			
					Land Survey			
				C	Gross Gamma			
				C	Gross Alpha			
				C	Organic Vapor			
				C	Combustible Gas/Oxygen			
				C	Lithological Logging			
					Gross Alpha			
					Gamma Spectrometry			
					Tritium			
					Volatile Organics			
					PCB			
				C	Soil Moisture			
				C	Gamma Spectrometry			
			X	C	Tritium			
			X	C	Total Uranium			
			X	C	Isotopic Plutonium			
			X		Isotopic Uranium			
			X	C	Strontium 90			
			X	C	VOA (SW 8240)			
			X	C	Semivolatiles (SW 8270)			
			X	C	Metals (SW 6010)			
			X		PCB (SW 8080)			
					TCLP Metals			

Table F.3-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis															
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals				
Subsurface samples at MDA T																																			
Angled Borehole 60 degrees	3	0.0 – 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		5.0 – 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		10.0 – 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		25.0 – 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
Field Duplicate																						X	X	X	X		X	X	X	X					
		30.0 – 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		35.0 – 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		40.0 – 45.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		45.0 – 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		50.0 – 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		55.0 – 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		60.0 – 65.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		65.0 – 70.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		70.0 – 75.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		75.0 – 80.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		80.0 – 85.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		85.0 – 90.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		90.0 – 95.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		95.0 – 100.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
Rinsate Blank																						X	X	X	X		X	X	X	X					
Field Blank																												X	X	X					
		100.0 – 105.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					

Table F.3-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis													
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
		105.0 - 110.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		110.0 - 115.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
Field Duplicate																						X	X	X	X		X	X	X	X					
Trip Blank																												X							
		115.0 - 120.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		120.0 - 125.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		125.0 - 130.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		130.0 - 135.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		135.0 - 140.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X					
		140.0 - 145.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X					
		145.0 - 150.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
Fracture Sampling Contingency								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
Rinsate Blank																						X	X	X	X		X	X	X	X					
Field Blank																												X	X	X					
Field Duplicate																						X	X	X	X		X	X	X	X					
Trip Blank																												X							
Angled Borehole 60 degrees	4	0.0 - 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		5.0 - 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		10.0 - 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		15.0 - 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		20.0 - 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		25.0 - 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					

Table F.3–V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low–Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
Field Duplicate																						X	X	X	X		X	X	X	X				
		30.0 – 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		35.0 – 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		40.0 – 45.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		45.0 – 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		50.0 – 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		55.0 – 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		60.0 – 65.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		65.0 – 70.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		70.0 – 75.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		75.0 – 80.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		80.0 – 85.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		85.0 – 90.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		90.0 – 95.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		95.0 – 100.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
		100.0 – 105.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		105.0 – 110.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		110.0 – 115.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
Trip Blank																												X						
		115.0 – 120.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		120.0 – 125.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		125.0 – 130.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		130.0 – 135.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				

Table F.3-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

	Sample Type	Sampling Location	Interval	Sample Identification
			135.0 – 140.0 ft	
			140.0 – 145.0 ft	
			145.0 – 150.0 ft	
	Fracture Sampling Contingency			
	Rinsate Blank			
	Field Blank			
	Field Duplicate			
	Trip Blank			
Field Surveys	Gross Gamma			
	Low-Energy Gamma			
	Electromagnetic			
	Land Survey			
Field Screening	Gross Gamma		X	X
	Gross Alpha		X	X
	Organic Vapor		X	X
	Combustible Gas/Oxygen		X	X
	Lithological Logging		X	X
Laboratory Measurements	Gross Alpha		X	X
	Gamma Spectrometry		X	X
	Tritium		X	X
	Volatile Organics		X	X
	PCB			
	Soil Moisture		X	X
Laboratory Analysis	Gamma Spectrometry		X	X
	Tritium		X	X
	Total Uranium		X	X
	Isotopic Plutonium		X	X
	Isotopic Uranium			
	Strontium 90		X	X
	VOA (SW 8240)		X	X
	Semivolatiles (SW 8270)		X	X
	Metals (SW 6010)		X	X
	PCB (SW 8080)			
	TCLP Metals			

Table F.3-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis													
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
Subsurface samples at MDA T																																			
Vertical Borehole	5	0.0 – 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		5.0 – 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		10.0 – 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		25.0 – 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
		30.0 – 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		35.0 – 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		40.0 – 45.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		45.0 – 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		50.0 – 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		55.0 – 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		60.0 – 65.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		65.0 – 70.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		70.0 – 75.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		75.0 – 80.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		80.0 – 85.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		85.0 – 90.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		90.0 – 95.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		95.0 – 100.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
		100.0 – 105.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				

Table F.3-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
		105.0 – 110.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		110.0 – 115.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
Trip Blank																												X						
		115.0 – 120.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		120.0 – 125.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		125.0 – 130.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		130.0 – 135.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		135.0 – 140.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		140.0 – 145.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X				
		145.0 – 150.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X				
Fracture Sampling Contingency								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
Trip Blank																												X						
Vertical Borehole	6	0.0 – 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		5.0 – 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		10.0 – 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		25.0 – 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				

Table F.3-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements							Laboratory Analysis													
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Field Duplicate																						X	X	X	X		X	X	X	X				
		30.0 – 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		35.0 – 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		40.0 – 45.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		45.0 – 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		50.0 – 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		55.0 – 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		60.0 – 65.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		65.0 – 70.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		70.0 – 75.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		75.0 – 80.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		80.0 – 85.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		85.0 – 90.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		90.0 – 95.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		95.0 – 100.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
		100.0 – 105.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		105.0 – 110.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		110.0 – 115.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
Trip Blank																												X						
		115.0 – 120.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		120.0 – 125.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		125.0 – 130.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		130.0 – 135.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				

Table F.3-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals		
		135.0 – 140.0 ft												X	X	X						X	X	X	X		X	X	X	X				
		140.0 – 145.0 ft												X	X	X						X	X	X	X		X	X	X	X				
		145.0 – 150.0 ft												X	X	X	X	X	X	X		X	X	X	X		X	X	X	X				
Fracture Sampling Contingency								C	C		C	C	C																					
								C	C		C	C	C																					
								C	C		C	C	C																					
								C	C		C	C	C																					
								C	C		C	C	C																					
								C	C		C	C	C																					
Rinsate Blank								C	C		C	C	C																					
Field Blank								C	C		C	C	C																					
Field Duplicate								C	C		C	C	C																					
Trip Blank																																		
Vertical Borehole	7	0.0 – 5.0 ft		X	X	X	X	X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		5.0 – 10.0 ft		X	X	X	X	X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		10.0 – 15.0 ft		X	X	X	X	X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		15.0 – 20.0 ft		X	X	X	X	X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		20.0 – 25.0 ft		X	X	X	X	X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		25.0 – 30.0 ft		X	X	X	X	X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Field Duplicate		30.0 – 35.0 ft		X	X	X	X	X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		35.0 – 40.0 ft		X	X	X	X	X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		40.0 – 45.0 ft		X	X	X	X	X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		45.0 – 50.0 ft		X	X	X	X	X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		50.0 – 55.0 ft		X	X	X	X	X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		55.0 – 60.0 ft		X	X	X	X	X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		60.0 – 65.0 ft		X	X	X	X	X	X		X	X	X						X			X	X	X	X		X	X	X	X				

Table F.3-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

				Field Surveys				Field Screening						Field Laboratory Measurements							Laboratory Analysis												
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
		65.0 – 70.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		70.0 – 75.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		75.0 – 80.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		80.0 – 85.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		85.0 – 90.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		90.0 – 95.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		95.0 – 100.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
		100.0 – 105.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		105.0 – 110.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		110.0 – 115.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
Trip Blank																												X						
		115.0 – 120.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		120.0 – 125.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		125.0 – 130.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		130.0 – 135.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		135.0 – 140.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		140.0 – 145.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X				
		145.0 – 150.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X				
Fracture Sampling Contingency								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				

Table F.3-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Rinsate Blank																						X	X	X	X	X	X	X	X	X		
Field Blank																					X						X	X	X			
Field Duplicate																					X						X	X	X			
Trip Blank																						X	X	X	X	X	X	X	X	X		
Vertical Borehole	8	0.0 – 5.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X		
		5.0 – 10.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X		
		10.0 – 15.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X		
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X		
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X		
		25.0 – 30.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X		
Field Duplicate		30.0 – 35.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X		
		35.0 – 40.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X		
		40.0 – 45.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X		
		45.0 – 50.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X		
		50.0 – 55.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X		
		55.0 – 60.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X		
		60.0 – 65.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X		
		65.0 – 70.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X		
		70.0 – 75.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X		
		75.0 – 80.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X		
		80.0 – 85.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X		
		85.0 – 90.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X		
		90.0 – 95.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X		
		95.0 – 100.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X		
Rinsate Blank																						X	X	X	X	X	X	X	X	X		

Table F.3-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Field Blank																												X	X	X				
		100.0 - 105.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		105.0 - 110.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		110.0 - 115.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
Trip Blank																												X						
		115.0 - 120.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		120.0 - 125.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		125.0 - 130.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		130.0 - 135.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		135.0 - 140.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		140.0 - 145.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X				
		145.0 - 150.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X				
Fracture Sampling Contingency								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
Trip Blank																												X						

Table F.3-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis															
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals				
Subsurface samples at MDA T																																					
Angled Borehole 60 degrees	9	0.0 – 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X							
		5.0 – 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X							
		10.0 – 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X							
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X							
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X							
		25.0 – 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X							
Field Duplicate																						X	X	X	X		X	X	X	X							
		30.0 – 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X							
		35.0 – 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X							
		40.0 – 45.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X							
		45.0 – 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X							
		50.0 – 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X							
		55.0 – 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X							
		60.0 – 65.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X							
		65.0 – 70.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X							
		70.0 – 75.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X							
		75.0 – 80.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X							
		80.0 – 85.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X							
		85.0 – 90.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X							
		90.0 – 95.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X							
		95.0 – 100.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X							
Rinsate Blank																						X	X	X	X		X	X	X	X							
Field Blank																												X	X	X							
		100.0 – 105.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X							

Table F.3–V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements							Laboratory Analysis											
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
		105.0 – 110.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		110.0 – 115.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
Trip Blank																												X						
		115.0 – 120.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		120.0 – 125.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		125.0 – 130.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		130.0 – 135.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X				
		135.0 – 140.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X				
Fracture Sampling Contingency								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
Angled Borehole 80 degrees	10	0.0 – 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		5.0 – 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		10.0 – 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		25.0 – 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
		30.0 – 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		35.0 – 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		40.0 – 45.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		45.0 – 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		50.0 – 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				

Table F.3-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis													
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
		55.0 - 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		60.0 - 65.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		65.0 - 70.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		70.0 - 75.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		75.0 - 80.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		80.0 - 85.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		85.0 - 90.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		90.0 - 95.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		95.0 - 100.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
Rinsate Blank																						X	X	X	X		X	X	X	X					
Field Blank																												X	X	X					
		100.0 - 105.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		105.0 - 110.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		110.0 - 115.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		115.0 - 120.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		120.0 - 125.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X					
		125.0 - 130.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X					
Fracture Sampling Contingency								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
Field Blank																												X	X	X					
Field Duplicate																						X	X	X	X		X	X	X	X					
Trip Blank																												X							
Angled Borehole 20 degrees	11	0.0 - 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					

Table F.3–V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis															
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low–Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging		Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium		Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)		PCB (SW 8080)		TCLP Metals				
		5.0 – 10.0 ft						X	X		X	X	X							X			X	X	X	X			X	X	X	X							
		10.0 – 15.0 ft						X	X		X	X	X							X			X	X	X	X			X	X	X	X							
		15.0 – 20.0 ft						X	X		X	X	X							X			X	X	X	X			X	X	X	X							
		20.0 – 25.0 ft						X	X		X	X	X							X			X	X	X	X			X	X	X	X							
		25.0 – 30.0 ft						X	X		X	X	X							X			X	X	X	X			X	X	X	X							
Field Duplicate																							X	X	X	X			X	X	X	X							
		30.0 – 35.0 ft						X	X		X	X	X							X			X	X	X	X			X	X	X	X							
		35.0 – 40.0 ft						X	X		X	X	X							X			X	X	X	X			X	X	X	X							
		40.0 – 45.0 ft						X	X		X	X	X							X			X	X	X	X			X	X	X	X							
		45.0 – 50.0 ft						X	X		X	X	X							X			X	X	X	X			X	X	X	X							
		50.0 – 55.0 ft						X	X		X	X	X							X			X	X	X	X			X	X	X	X							
		55.0 – 60.0 ft						X	X		X	X	X							X			X	X	X	X			X	X	X	X							
		60.0 – 65.0 ft						X	X		X	X	X							X			X	X	X	X			X	X	X	X							
		65.0 – 70.0 ft						X	X		X	X	X							X			X	X	X	X			X	X	X	X							
		70.0 – 75.0 ft						X	X		X	X	X							X			X	X	X	X			X	X	X	X							
		75.0 – 80.0 ft						X	X		X	X	X							X			X	X	X	X			X	X	X	X							
		80.0 – 85.0 ft						X	X		X	X	X							X			X	X	X	X			X	X	X	X							
		85.0 – 90.0 ft						X	X		X	X	X							X			X	X	X	X			X	X	X	X							
		90.0 – 95.0 ft						X	X		X	X	X							X			X	X	X	X			X	X	X	X							
		95.0 – 100.0 ft						X	X		X	X	X							X			X	X	X	X			X	X	X	X							
Rinsate Blank																							X	X	X	X			X	X	X	X							
Field Blank																														X	X	X							
		100.0 – 105.0 ft						X	X		X	X	X							X			X	X	X	X			X	X	X	X							
		105.0 – 110.0 ft						X	X		X	X	X							X			X	X	X	X			X	X	X	X							
Field Duplicate																							X	X	X	X			X	X	X	X							
Trip Blank																														X									

Table F.3-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals		
Fracture Sampling Contingency								C	C		C	C	C						C			C	C	C	C		C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C				
								C			C	C	C									C	C	C	C		C	C	C				
Angled Borehole 20 degrees	12	0.0 – 5.0 ft						X	X		X	X	X						C			C	C	C	C		C	C	C				
		5.0 – 10.0 ft						X	X		X	X	X						C			C	C	C	C		C	C	C				
		10.0 – 15.0 ft						X	X		X	X	X						C			C	C	C	C		C	C	C				
		15.0 – 20.0 ft						X	X		X	X	X						C			C	C	C	C		C	C	C				
		20.0 – 25.0 ft						X	X		X	X	X						C			C	C	C	C		C	C	C				
		25.0 – 30.0 ft						X	X		X	X	X						C			C	C	C	C		C	C	C				
Field Duplicate								X	X		X	X	X						C			C	C	C	C		C	C	C				
		30.0 – 35.0 ft						X	X		X	X	X						C			C	C	C	C		C	C	C				
		35.0 – 40.0 ft						X	X		X	X	X						C			C	C	C	C		C	C	C				
		40.0 – 45.0 ft						X	X		X	X	X						C			C	C	C	C		C	C	C				
		45.0 – 50.0 ft						X	X		X	X	X						C			C	C	C	C		C	C	C				
		50.0 – 55.0 ft						X	X		X	X	X						C			C	C	C	C		C	C	C				
		55.0 – 60.0 ft						X	X		X	X	X						C			C	C	C	C		C	C	C				
		60.0 – 65.0 ft						X	X		X	X	X						C			C	C	C	C		C	C	C				
		65.0 – 70.0 ft						X	X		X	X	X						C			C	C	C	C		C	C	C				
		70.0 – 75.0 ft						X	X		X	X	X						C			C	C	C	C		C	C	C				
		75.0 – 80.0 ft						X	X		X	X	X						C			C	C	C	C		C	C	C				
		80.0 – 85.0 ft						X	X		X	X	X						C			C	C	C	C		C	C	C				
		85.0 – 90.0 ft						X	X		X	X	X						C			C	C	C	C		C	C	C				
		90.0 – 95.0 ft						X	X		X	X	X						C			C	C	C	C		C	C	C				
		95.0 – 100.0 ft						X	X		X	X	X						C			C	C	C	C		C	C	C				

Table F.3-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																											X	X	X				
		100.0 – 105.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		105.0 – 110.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Fracture Sampling Contingency								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
Field Blank																											X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
Trip Blank																											X							

Table F.3-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Subsurface samples at MDA T																																		
Vertical Borehole	13	0.0 - 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		5.0 - 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		10.0 - 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		15.0 - 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		20.0 - 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		25.0 - 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
		30.0 - 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		35.0 - 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		40.0 - 45.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		45.0 - 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		50.0 - 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		55.0 - 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		60.0 - 65.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		65.0 - 70.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X				
		70.0 - 75.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X				
Fracture Sampling Contingency								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
Rinseate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
Trip Blank																												X						

Table F.3-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Vertical Borehole	14	0.0 - 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		5.0 - 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		10.0 - 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		15.0 - 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		20.0 - 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		25.0 - 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
		30.0 - 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		35.0 - 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		40.0 - 45.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		45.0 - 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		50.0 - 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		55.0 - 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		60.0 - 65.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		65.0 - 70.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X				
		70.0 - 75.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X				
Fracture Sampling Contingency								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
								C	C		C	C	C						C			C	C	C	C		C	C	C	C				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
Trip Blank																												X						
Vertical Borehole	15	0.0 - 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				

Table F.3-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis													
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
		5.0 - 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		10.0 - 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		15.0 - 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		20.0 - 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		25.0 - 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
Field Duplicate																						X	X	X	X		X	X	X	X					
		30.0 - 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		35.0 - 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		40.0 - 45.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		45.0 - 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		50.0 - 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		55.0 - 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		60.0 - 65.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		65.0 - 70.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X					
		70.0 - 75.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X					
Fracture Sampling Contingency								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
Rinsate Blank																						X	X	X	X		X	X	X	X					
Field Blank																												X	X	X					
Field Duplicate																						X	X	X	X		X	X	X	X					
Trip Blank																												X							
Vertical Borehole	16	0.0 - 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		5.0 - 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					

Table F.3-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis															
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
		10.0 – 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		25.0 – 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
Field Duplicate																						X	X	X	X		X	X	X	X					
		30.0 – 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		35.0 – [illegible]						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		40.0 – 45.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		45.0 – 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		50.0 – 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		[illegible]						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		60.0 – 65.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		65.0 – 70.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X					
		70.0 – 75.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X					
Fracture Sampling Contingency								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
								C	C		C	C	C						C			C	C	C	C		C	C	C	C					
Rinsate Blank																						X	X	X	X		X	X	X	X					
Field Blank																												X	X						
Field Duplicate																						X	X	X	X		X	X	X	X					
Trip Blank																												X							
Angled Borehole 60 degrees	17	0.0 – 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		5.0 – 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		10.0 – 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					

Table F.3-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Identification	Interval	Sampling Location	Sample Type	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
	15.0 - 20.0 ft							X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
	20.0 - 25.0 ft							X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
	25.0 - 30.0 ft							X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
	30.0 - 35.0 ft		Field Duplicate					X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
	35.0 - 40.0 ft							X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
	40.0 - 45.0 ft							X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
	45.0 - 50.0 ft							X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
	50.0 - 55.0 ft							X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
	55.0 - 60.0 ft							X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
	60.0 - 65.0 ft							X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
	65.0 - 70.0 ft							X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
	70.0 - 75.0 ft							X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
	75.0 - 80.0 ft							X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
	80.0 - 85.0 ft							X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
	85.0 - 90.0 ft							X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
	90.0 - 95.0 ft							X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
	95.0 - 100.0 ft		Fracture Sampling Contingency					X	X		X	X	X	X	X	X	X		X			X	X	X	X	X	X	X	X	X			
								C	C		C	C	C						C			C	C	C	C	C	C	C	C	C			
								C	C		C	C	C						C			C	C	C	C	C	C	C	C	C			
								C	C		C	C	C						C			C	C	C	C	C	C	C	C	C			
								C	C		C	C	C						C			C	C	C	C	C	C	C	C	C			
								C	C		C	C	C						C			C	C	C	C	C	C	C	C	C			
			Rinsate Blank					C	C		C	C	C						C			C	C	C	C	C	C	C	C	C			
			Field Blank					C	C		C	C	C						C			C	C	C	C	C	C	C	C	C			
			Field Duplicate					C	C		C	C	C						C			C	C	C	C	C	C	C	C	C			

Table F.3–V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA T.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys	Field Screening	Field Laboratory Measurements	Laboratory Analysis
				Gross Gamma	Gross Gamma	Gamma Spectrometry	
				Low–Energy Gamma	Gross Alpha	Tritium	
				Electromagnetic		Total Uranium	
				Land Survey	Organic Vapor	Isotopic Plutonium	
					Combustible Gas/Oxygen	Isotopic Uranium	
					Lithological Logging	Strontium 90	
					Gross Alpha	VOA (SW 8240)	X
					Gamma Spectrometry	Semivolatiles (SW 8270)	
					Tritium	Metals (SW 6010)	
					Volatile Organics	PCB (SW 8080)	
					PCB	TCLP Metals	
					Soil Moisture		
Trip Blank							

Table F.6-1

SCREENING AND ANALYSIS FOR INITIAL SURFACE INVESTIGATIONS AT MDA U.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Field Laboratory Measurements:	Field Laboratory Measurements:	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals	Laboratory Analysis:	Laboratory Analysis:
Surface Sampling at MDA U																																		
Surface Soil Sample	1	0.0 - 6.0 in		X	X		X	X	X																									
	2	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X				
	3	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X				
	4	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X				
	5	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X				
Rinsate Blank																																		
Field Blank																																		
	6	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X				
	7	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X				
	8	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X				
Field Duplicate																																		
	9	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X				
	10	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X				
	11	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X				
	12	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X				
	13	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X				
	14	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X				
	15	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X				
	16	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X				
	17	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X				
	18	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X				
	19	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X				
	20	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X				
	21	0.0 - 6.0 in						X	X													X	X	X	X	X	X	X	X	X				

Table F.6-I

SCREENING AND ANALYSIS FOR INITIAL SURFACE INVESTIGATIONS AT MDA U.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electr magnetic	Field Surveys: Land Survey	Field Screening: Gro Gamma	Field Screening: Gro Alpha	Field Screening: Org vic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals
	22	0.0 – 6.0 in						X	X					X	X				X	X	X	X	X	X		X	X		
	23	0.0 – 6.0 in						X	X					X	X				X	X	X	X	X	X		X	X		
	24	0.0 – 6.0 in						X	X					X	X				X	X	X	X	X	X		X	X		
Rinsate Blank																													
Field Blank																													
	25	0.0 – 6.0 in						X	X					X	X				X	X	X	X	X	X		X	X		
	26	0.0 – 6.0 in						X	X					X	X				X	X	X	X	X	X		X	X		
	27	0.0 – 6.0 in						X	X					X	X				X	X	X	X	X	X		X	X		
Field Duplicate																													
	28	0.0 – 6.0 in						X	X					X	X				X	X	X	X	X	X		X	X		
	29	0.0 – 6.0 in						X	X					X	X				X	X	X	X	X	X		X	X		
	30	0.0 – 6.0 in						X	X					X	X				X	X	X	X	X	X		X	X		
	31	0.0 – 6.0 in						X	X					X	X				X	X	X	X	X	X		X	X		
	32	0.0 – 6.0 in						X	X					X	X				X	X	X	X	X	X		X	X		
	33	0.0 – 6.0 in						X	X					X	X				X	X	X	X	X	X		X	X		
	34	0.0 – 6.0 in						X	X					X	X				X	X	X	X	X	X		X	X		
	35	0.0 – 6.0 in						X	X					X	X				X	X	X	X	X	X		X	X		
	36	0.0 – 6.0 in						X	X					X	X				X	X	X	X	X	X		X	X		
	37	0.0 – 6.0 in						X	X					X	X				X	X	X	X	X	X		X	X		
	38	0.0 – 6.0 in						X	X					X	X				X	X	X	X	X	X		X	X		
	39	0.0 – 6.0 in						X	X					X	X				X	X	X	X	X	X		X	X		
	40	0.0 – 6.0 in						X	X					X	X				X	X	X	X	X	X		X	X		
Replicate Surface Soil Sample	1	0.0 – 6.0 in						X	X					X	X				X	X	X	X	X	X		X	X		
	2	0.0 – 6.0 in						X	X					X	X				X	X	X	X	X	X		X	X		
	3	0.0 – 6.0 in						X	X					X	X				X	X	X	X	X	X		X	X		
Rinsate Blank																													

Table F.6-1

SCREENING AND ANALYSIS FOR INITIAL SURFACE INVESTIGATIONS AT MDA U.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Field Blank																																	
	4	0.0 - 6.0 in						X	X																								
Field Duplicate																																	
	5	0.0 - 6.0 in						X	X																								
	6	0.0 - 6.0 in						X	X																								
	7	0.0 - 6.0 in						X	X																								
	8	0.0 - 6.0 in						X	X																								
	9	0.0 - 6.0 in						X	X																								
	10	0.0 - 6.0 in						X	X																								
Contingency Soil Sample																																	
	1	0.0 - 6.0 in																				C	C	C	C	C	C	C	C	C		
	2	0.0 - 6.0 in																				C	C	C	C	C	C	C	C	C		
	3	0.0 - 6.0 in																				C	C	C	C	C	C	C	C	C		
	4	0.0 - 6.0 in																				C	C	C	C	C	C	C	C	C		
	5	0.0 - 6.0 in																				C	C	C	C	C	C	C	C	C		
	6	0.0 - 6.0 in																				C	C	C	C	C	C	C	C	C		
	7	0.0 - 6.0 in																				C	C	C	C	C	C	C	C	C		
	8	0.0 - 6.0 in																				C	C	C	C	C	C	C	C	C		
	9	0.0 - 6.0 in																				C	C	C	C	C	C	C	C	C		
Trip Blank																						C	C	C	C	C	C	C	C	C		
	10	0.0 - 6.0 in																				C	C	C	C	C	C	C	C	C		

Table F.6-II

SCREENING AND ANALYSIS FOR SUBSEQUENT SURFACE INVESTIGATIONS AT MDA U.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis													
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals				
Surface Sampling at MDA U																																			
Surface Soil Sample	1	0.0 - 6.0 in		X	X			X	X													X	X	X	X		X		X	X				
	2	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	3	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	4	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	5	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
Rinsate Blank																						X	X	X	X		X		X	X				
Field Blank																													X	X				
	6	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	7	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	8	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
Field Duplicate																						X	X	X	X		X		X	X				
	9	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	10	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	11	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	12	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	13	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	14	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	15	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	16	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	17	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	18	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	19	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	20	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
Rinsate Blank																						X	X	X	X		X		X	X				

Table F.6–II

SCREENING AND ANALYSIS FOR SUBSEQUENT SURFACE INVESTIGATIONS AT MDA U.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW [illegible]40)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW [illegible]80)	TCLP Metals		
Field Blank																																	
Field Duplicate																					X								X	X			
Contingency Surface Soil	1	0.0 – 6.0 in													C	C	C	C	C	C	X	C	C	C	C	C	C	C	X	X			
	2	0.0 – 6.0 in													C	C	C	C	C	C	X	C	C	C	C	C	C	C	X	X			
	3	0.0 – 6.0 in													C	C	C	C	C	C	X	C	C	C	C	C	C	C	X	X			
	4	0.0 – 6.0 in													C	C	C	C	C	C	X	C	C	C	C	C	C	C	X	X			
	5	0.0 – 6.0 in													C	C	C	C	C	C	X	C	C	C	C	C	C	C	X	X			
	6	0.0 – 6.0 in													C	C	C	C	C	C	X	C	C	C	C	C	C	C	X	X			
	7	0.0 – 6.0 in													C	C	C	C	C	C	X	C	C	C	C	C	C	C	X	X			
	8	0.0 – 6.0 in													C	C	C	C	C	C	X	C	C	C	C	C	C	C	X	X			
	9	0.0 – 6.0 in													C	C	C	C	C	C	X	C	C	C	C	C	C	C	X	X			
	10	0.0 – 6.0 in													C	C	C	C	C	C	X	C	C	C	C	C	C	C	X	X			
Trip Blank																						C	C	C	C	C	C	C					

Table F.6–III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA U.

				Field Surveys				Field Screening						Field Laboratory Measurements							Laboratory Analysis														
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Subsurface samples at MDA U																																		
Vertical Borehole	1	0.0 – 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		5.0 – 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		10.0 – 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		25.0 – 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
		30.0 – 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		35.0 – 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		40.0 – 45.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X				
		45.0 – 50.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X				
		50.0 – 55.0 ft						X	X		X	X	X			X			X															
		55.0 – 60.0 ft						X	X		X	X	X			X			X															
		60.0 – 65.0 ft						X	X		X	X	X			X			X															
		65.0 – 70.0 ft						X	X		X	X	X			X			X															
		70.0 – 75.0 ft						X	X		X	X	X			X			X															
		75.0 – 80.0 ft						X	X		X	X	X			X			X															
		80.0 – 85.0 ft						X	X		X	X	X			X			X															
		85.0 – 90.0 ft						X	X		X	X	X			X			X															
		90.0 – 95.0 ft						X	X		X	X	X			X			X															
		95.0 – 100.0 ft						X	X		X	X	X			X			X															
Fracture Sampling Contingency																					C	C	C	C		C	C	C	C				
																					C	C	C	C		C	C	C	C				
																					C	C	C	C		C	C	C	C				

Table F.6-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA U.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
																						C	C	C	C	C	C							
Rinsate Blank																			X	C	C	C	C	C	C	C	C	C						
Field Blank																			X	C	C	C	C	C	C	C	C	C						
Trip Blank																			X	C	C	C	C	C	C	C	C	C						
Vertical Borehole	2	0.0 - 5.0 R						X	X		X	X	X						X															
		5.0 - 10.0 R						X	X		X	X	X																					
		10.0 - 15.0 R						X	X		X	X	X																					
		15.0 - 20.0 R						X	X		X	X	X																					
		20.0 - 25.0 R						X	X		X	X	X																					
		25.0 - 30.0 R						X	X		X	X	X																					
Field Duplicate		30.0 - 35.0 R						X	X		X	X	X																					
		35.0 - 40.0 R						X	X		X	X	X																					
		40.0 - 45.0 R						X	X		X	X	X	X	X	X	X																	
		45.0 - 50.0 R						X	X		X	X	X	X	X	X	X																	
Fracture Sampling Contingency																				C	C	C	C	C	C	C	C	C						
Rinsate Blank																				C	C	C	C	C	C	C	C	C						
																				C	C	C	C	C	C	C	C	C						
																				C	C	C	C	C	C	C	C	C						
																				C	C	C	C	C	C	C	C	C						
																				C	C	C	C	C	C	C	C	C						
Field Blank																				C	C	C	C	C	C	C	C	C						
Trip Blank																				C	C	C	C	C	C	C	C	C						
Vertical Borehole	3	0.0 - 5.0 R		X	X														X															
		5.0 - 10.0 R																																

Table F.6-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA U.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
		10.0 – 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		25.0 – 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
		30.0 – 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		35.0 – 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		40.0 – 45.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X				
		45.0 – 50.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X				
Fracture Sampling Contingency																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
Trip Blank																												X						
Vertical Borehole	4	0.0 – 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		5.0 – 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		10.0 – 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		25.0 – 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
		30.0 – 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		35.0 – 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				

Table F.6-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA U.

	Sample Type	Sampling Location	Interval	Sample Identification
			40.0 - 45.0 ft	
			45.0 - 50.0 ft	
Fracture Sampling Contingency				
Rinsate Blank				
Field Blank				
Trip Blank				
Field Surveys				
Gross Gamma				
Low-Energy Gamma				
Electromagnetic				
Land Survey				
Field Screening				
Gross Gamma			X	X
Gross Alpha			X	X
Organic Vapor			X	X
Combustible Gas/Oxygen			X	X
Lithological Logging			X	X
Laboratory Measurements				
Gross Alpha			X	X
Gamma Spectrometry			X	X
Tritium			X	X
Volatile Organics			X	X
PCB				
Soil Moisture			X	X
Laboratory Analysis				
Gamma Spectrometry		C	X	X
Tritium		C	X	X
Total Uranium		C	X	X
Isotopic Plutonium		C	X	X
Isotopic Uranium				
Strontium 90		C	X	X
VOA (SW 8240)	X	C	X	X
Semivolatiles (SW 8270)		C	X	X
Metals (SW 6010)		C	X	X
PCB (SW 8080)				
TCLP Metals				

Table F.6–IV

MDA U GEOPHYSICAL

MINIERALOGIC DETERMINATIONS

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical: Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (He injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristics Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Environmental Isotopes: Chloride–36/Chloride–37	Carbon–12/Carbon–13	Strontium–86/Strontium –87	Hydrogen/Deuterium	Oxygen–18/Oxygen–16	Tritium	Carbon–14	Chloride–36	Open Hole Tests: Straddle Packer Tests: In Situ Permeability	VOA's – Pore Gas	CO2 – Pore Gas	CH4 – Pore Gas	C–12/C–13 – Pore Gas	Relative Humidity – Pore Gas	SF6	Open Hole Tests: Geophysics: Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM–39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium–252)	Side Scan Video
MDA U																																													
Vertical Borehole	1	0.0 – 5.0 ft										X	X	X	X	X	X	X	X																									
		5.0 – 10.0 ft																																										
		10.0 – 15.0 ft																																										
		15.0 – 20.0 ft																																										
		20.0 – 25.0 ft																																										
		25.0 – 30.0 ft										X	X	X	X	X	X	X	X	X																									
		30.0 – 35.0 ft																																										
		35.0 – 40.0 ft																																										
		40.0 – 45.0 ft																																										
		45.0 – 50.0 ft										X	X	X	X	X	X	X	X	X																									
		50.0 – 55.0 ft																																										
		55.0 – 60.0 ft										X	X	X	X	X	X	X	X	X																									
		60.0 – 65.0 ft																																										
		65.0 – 70.0 ft										X	X	X	X	X	X	X	X	X																									
		70.0 – 75.0 ft																																										
		75.0 – 80.0 ft										X	X	X	X	X	X	X	X	X																									
		80.0 – 85.0 ft																																										
		85.0 – 90.0 ft										X	X	X	X	X	X	X	X	X																									
		90.0 – 95.0 ft																																										
		95.0 – 100.0 ft										X	X	X	X	X	X	X	X	X																									
Fracture Contingency Sample												C	C	C	C	C	C	C	C	C																									
												C	C	C	C	C	C	C	C	C																									
												C	C	C	C	C	C	C	C	C																									
												C	C	C	C	C	C	C	C	C																									
												C	C	C	C	C	C	C	C	C																									
Vertical Borehole	2	0.0 – 5.0 ft																																											
		5.0 – 10.0 ft										X	X	X	X	X	X	X	X	X																									
		10.0 – 15.0 ft																																										
		15.0 – 20.0 ft																																										
		20.0 – 25.0 ft																																										
		25.0 – 30.0 ft										X	X	X	X	X	X	X	X	X																									
		30.0 – 35.0 ft																																										
		35.0 – 40.0 ft																																										
		40.0 – 45.0 ft																																										
		45.0 – 50.0 ft										X	X	X	X	X	X	X	X	X																									
Fracture Contingency Sample												C	C	C	C	C	C	C	C	C																									
												C	C	C	C	C	C	C	C	C																									

Table F.6–IV

MDA U GEOPHYSICAL

MINERALOGIC DETERMINATIONS

Sample Type	Sampling Location	Interval	Sample Identification	Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (He injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Chloride–36/Chloride–37	Carbon–12/Carbon–13	Strontium–86/Strontium –87	Hydrogen/Deuterium	Oxygen–16/Oxygen–18	Tritium	Carbon–14	Chloride–36	In Situ Permeability	VOA's – Pore Gas	CO2 – Pore Gas	CH4 – Pore Gas	C–12/C–13 – Pore Gas	Relative Humidity – Pore Gas	SF6	Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Aerial Borehole Video	EM Induction (Geonics EM–39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium–252)	Side Scan Video
				Hydrogeological and Geochemical																Environmental Isotope								Open Hole Tests: Straddle Packer Tests								Open Hole Tests: Geophysics										
Vertical Borehole	3	0.0 – 5.0 ft										C	C	C	C																														
		5.0 – 10.0 ft										X	X	C	C	C	C	C	C																										
		10.0 – 15.0 ft										X	X	C	C	C	C	C	C																										
		15.0 – 20.0 ft										X	X	C	C	C	C	C	C																										
		20.0 – 25.0 ft										X	X	C	C	C	C	C	C																										
		25.0 – 30.0 ft										X	X	C	C	C	C	C	C																										
		30.0 – 35.0 ft										X	X	C	C	C	C	C	C																										
		35.0 – 40.0 ft										X	X	C	C	C	C	C	C																										
		40.0 – 45.0 ft										X	X	C	C	C	C	C	C																										
		45.0 – 50.0 ft										X	X	C	C	C	C	C	C																										
Fracture Contingency Sample												C	C	C	C	C	C	C	C																										
Vertical Borehole	4	0.0 – 5.0 ft										C	C	C	C	C	C	C	C																										
		5.0 – 10.0 ft										X	X	C	C	C	C	C	C																										
		10.0 – 15.0 ft										X	X	C	C	C	C	C	C																										
		15.0 – 20.0 ft										X	X	C	C	C	C	C	C																										
		20.0 – 25.0 ft										X	X	C	C	C	C	C	C																										
		25.0 – 30.0 ft										X	X	C	C	C	C	C	C																										
		30.0 – 35.0 ft										X	X	C	C	C	C	C	C																										
		35.0 – 40.0 ft										X	X	C	C	C	C	C	C																										
		40.0 – 45.0 ft										X	X	C	C	C	C	C	C																										
		45.0 – 50.0 ft										X	X	C	C	C	C	C	C																										
Fracture Contingency Sample												C	C	C	C	C	C	C	C																										

Table F.6–V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA U.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis													
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
Subsurface samples at MDA U																																			
Vertical Borehole	1	0.0 – 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		5.0 – 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		10.0 – 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		25.0 – 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
Field Duplicate																						X	X	X	X		X	X	X	X					
		30.0 – 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		35.0 – 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		40.0 – 45.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		45.0 – 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		50.0 – 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		55.0 – 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		60.0 – 65.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		65.0 – 70.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X					
		70.0 – 75.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X					
Fracture Sampling Contingency																						C	C	C	C		C	C	C	C					
																						C	C	C	C		C	C	C	C					
																						C	C	C	C		C	C	C	C					
																						C	C	C	C		C	C	C	C					
																						C	C	C	C		C	C	C	C					
Rinsate Blank																						X	X	X	X		X	X	X	X					
Field Blank																												X	X	X					
Field Duplicate																						X	X	X	X		X	X	X	X					
Trip Blank																												X							

Table F.6-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA U.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Field Laboratory Measurements:	Field Laboratory Measurements:	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals		
Vertical Borehole	2	0.0 – 5.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		5.0 – 10.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		10.0 – 15.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		15.0 – 20.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		20.0 – 25.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		25.0 – 30.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
Field Duplicate																						X	X	X	X		X	X	X	X			
		30.0 – 35.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		35.0 – 40.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		40.0 – 45.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		45.0 – 50.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		50.0 – 55.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		55.0 – 60.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		60.0 – 65.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		65.0 – 70.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		70.0 – 75.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
Fracture Sampling Contingency																						C	C	C	C		C	C	C	C			
																						C	C	C	C		C	C	C	C			
																						C	C	C	C		C	C	C	C			
																						C	C	C	C		C	C	C	C			
																						C	C	C	C		C	C	C	C			
																						C	C	C	C		C	C	C	C			
Rinsate Blank																						X	X	X	X		X	X	X	X			
Field Blank																						X	X	X	X		X	X	X	X			
Field Duplicate																						X	X	X	X		X	X	X	X			
Trip Blank																												X		X			
Angled Borehole 20 degrees	3	0.0 – 5.0 ft																				X	X	X	X		X	X	X	X			

Table F.6-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA U.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
		5.0 – 10.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		10.0 – 15.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		25.0 – 30.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
Field Duplicate		30.0 – 35.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		35.0 – 40.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		40.0 – 45.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		45.0 – 50.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		50.0 – 55.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		55.0 – 60.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		60.0 – 65.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		65.0 – 70.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		70.0 – 75.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		75.0 – 80.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		80.0 – 85.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
		85.0 – 90.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
Fracture Sampling Contingency								C	C		C	C	C						C			X	X	X	X	X	X	X	X	X			
Rinsate Blank								C	C		C	C	C						C			X	X	X	X	X	X	X	X	X			
Field Blank								C	C		C	C	C						C			X	X	X	X	X	X	X	X	X			
Trip Blank								C	C		C	C	C						C			X	X	X	X	X	X	X	X	X			

Table F.6-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA U.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Angled Borehole 20 degrees																																	
	4	0.0 – 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		5.0 – 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		10.0 – 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		25.0 – 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		30.0 – 35.0 ft						X			X	X	X						X			X	X	X	X		X	X	X	X			
Field Duplicate																																	
		35.0 – 40.0 ft						X			X	X	X						X			X	X	X	X		X	X	X	X			
		40.0 – 45.0 ft						X			X	X	X						X			X	X	X	X		X	X	X	X			
		45.0 – 50.0 ft						X			X	X	X						X			X	X	X	X		X	X	X	X			
		50.0 – 55.0 ft						X			X	X	X						X			X	X	X	X		X	X	X	X			
		55.0 – 60.0 ft						X			X	X	X						X			X	X	X	X		X	X	X	X			
		60.0 – 65.0 ft						X			X	X	X						X			X	X	X	X		X	X	X	X			
		65.0 – 70.0 ft						X			X	X	X						X			X	X	X	X		X	X	X	X			
		70.0 – 75.0 ft						X			X	X	X						X			X	X	X	X		X	X	X	X			
		75.0 – 80.0 ft						X			X	X	X						X			X	X	X	X		X	X	X	X			
		80.0 – 85.0 ft						X			X	X	X						X			X	X	X	X		X	X	X	X			
		85.0 – 90.0 ft						X			X	X	X						X			X	X	X	X		X	X	X	X			
Fracture Sampling Contingency																						C	C	C	C		C	C	C				
Rinsate Blank																						C	C	C	C		C	C	C				
Field Blank																						C	C	C	C		C	C	C				

Table F.6–V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA U.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis														
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 9010)	PCB (SW 8080)	TCLP Metals			
Trip Blank																											X							
Angled Borehole 15 degrees	5	0.0 – 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		5.0 – 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		10.0 – 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		25.0 – 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
		30.0 – 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		35.0 – 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		40.0 – 45.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		45.0 – 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		50.0 – 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		55.0 – 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Fracture Sampling Contingency																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
Trip Blank																												X						
Angled Borehole 15 degrees	6	0.0 – 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		5.0 – 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		10.0 – 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				

Table F.6-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA U.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis												
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
		20.0 - 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		25.0 - 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
		30.0 - 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		35.0 - 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		40.0 - 45.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		45.0 - 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		50.0 - 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		55.0 - 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Fracture Sampling Contingency																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
Trip Blank																												X						

Table F.7–I

SCREENING AND ANALYSIS FOR SUBSEQUENT SURFACE INVESTIGATIONS AT MDA V.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low–Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha	Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture	Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	Laboratory Analysis
Surface Sampling at MDA V																													
Surface Soil Sample	1	0.0 – 6.0 in		X	X			X	X					X					X	X	X	X		X		X	X		
	2	0.0 – 6.0 in						X	X					X					X	X	X	X		X		X	X		
	3	0.0 – 6.0 in						X	X					X					X	X	X	X		X		X	X		
	4	0.0 – 6.0 in						X	X					X					X	X	X	X		X		X	X		
	5	0.0 – 6.0 in						X	X					X					X	X	X	X		X		X	X		
Rinsate Blank																													
Field Blank													X	X					X	X	X	X		X		X	X		
	6	0.0 – 6.0 in						X	X					X					X	X	X	X		X		X	X		
	7	0.0 – 6.0 in						X	X					X					X	X	X	X		X		X	X		
	8	0.0 – 6.0 in						X	X					X					X	X	X	X		X		X	X		
Field Duplicate	9	0.0 – 6.0 in						X	X					X					X	X	X	X		X		X	X		
	10	0.0 – 6.0 in						X	X					X					X	X	X	X		X		X	X		
	11	0.0 – 6.0 in						X	X					X					X	X	X	X		X		X	X		
	12	0.0 – 6.0 in						X	X					X					X	X	X	X		X		X	X		
	13	0.0 – 6.0 in						X	X					X					X	X	X	X		X		X	X		
	14	0.0 – 6.0 in						X	X					X					X	X	X	X		X		X	X		
	15	0.0 – 6.0 in						X	X					X					X	X	X	X		X		X	X		
	16	0.0 – 6.0 in						X	X					X					X	X	X	X		X		X	X		
	17	0.0 – 6.0 in						X	X					X					X	X	X	X		X		X	X		
	18	0.0 – 6.0 in						X	X					X					X	X	X	X		X		X	X		
	19	0.0 – 6.0 in						X	X					X					X	X	X	X		X		X	X		
	20	0.0 – 6.0 in						X	X					X					X	X	X	X		X		X	X		
Rinsate Blank																													

Table F.7-1

SCREENING AND ANALYSIS FOR SUBSEQUENT SURFACE INVESTIGATIONS AT MDA V.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Field Laboratory Measurements:	Field Laboratory Measurements:	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals		
Field Blank																						X							X	X				
Field Duplicate																						C	C	C	C		C		C	C				
Contingency Soil Sample	1	0.0 - 6.0 in																				C	C	C	C	X	C	X	C	C				
	2	0.0 - 6.0 in																				C	C	C	C		C		C	C				
	3	0.0 - 6.0 in																				C	C	C	C		C		C	C				
	4	0.0 - 6.0 in																				C	C	C	C		C		C	C				
	5	0.0 - 6.0 in																				C	C	C	C		C		C	C				
	6	0.0 - 6.0 in																				C	C	C	C		C		C	C				
	7	0.0 - 6.0 in																				C	C	C	C		C		C	C				
	8	0.0 - 6.0 in																				C	C	C	C		C		C	C				
	9	0.0 - 6.0 in																				C	C	C	C		C		C	C				
	10	0.0 - 6.0 in																				C	C	C	C		C		C	C				
Trip Blank																						C	C	C	C		C		C	C				

Table F.7-II

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA V.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis															
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals				
Subsurface samples at MDA V																																			
Vertical Borehole	1	0.0 – 2.5 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		2.5 – 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		5.0 – 7.5 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		7.5 – 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		10.0 – 12.5 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		12.5 – 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		25.0 – 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
Field Duplicate																						X	X	X	X		X	X	X	X					
		30.0 – 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		35.0 – 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		40.0 – 45.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		45.0 – 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		50.0 – 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		55.0 – 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		60.0 – 65.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		65.0 – 70.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X					
		70.0 – 75.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X					
		75.0 – 80.0 ft						X	X		X	X	X			X			X																
		80.0 – 85.0 ft						X	X		X	X	X			X			X																
		85.0 – 90.0 ft						X	X		X	X	X			X			X																
		90.0 – 95.0 ft						X	X		X	X	X			X			X																
		95.0 – 100.0 ft						X	X		X	X	X			X			X																

Table F.7-II

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA V.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals		
		100.0 - 105.0 ft						X	X	X	X	X	X			X			X													
		105.0 - 110.0 ft						X	X	X	X	X	X																			
		110.0 - 115.0 ft						X	X	X	X	X	X																			
		115.0 - 120.0 ft						X	X	X	X	X	X						X													
		120.0 - 125.0 ft						X	X	X	X	X	X			X			X													
Fracture Sampling Contingency																					C	C	C	C	C	C	C	C	C			
																					C	C	C	C	C	C	C	C	C			
																					C	C	C	C	C	C	C	C	C			
																					C	C	C	C	C	C	C	C	C			
Rinsate Blank															X						C	C	C	C	C	C	C	C	C			
Field Blank																																
Trip Blank																																
Vertical Borehole	2	0.0 - 2.5 ft		X	X	X		X	X		X	X	X			X			X			X	X	X	X	X	X	X	X	X			
		2.5 - 5.0 ft		X	X	X		X	X		X	X	X									X	X	X	X	X	X	X	X	X			
		5.0 - 7.5 ft		X	X	X		X	X		X	X	X									X	X	X	X	X	X	X	X	X			
		7.5 - 10.0 ft		X	X	X		X	X		X	X	X									X	X	X	X	X	X	X	X	X			
		10.0 - 12.5 ft		X	X	X		X	X		X	X	X									X	X	X	X	X	X	X	X	X			
		12.5 - 15.0 ft		X	X	X		X	X		X	X	X									X	X	X	X	X	X	X	X	X			
		15.0 - 20.0 ft		X	X	X		X	X		X	X	X									X	X	X	X	X	X	X	X	X			
		20.0 - 25.0 ft		X	X	X		X	X		X	X	X							X		X	X	X	X	X	X	X	X	X			
		25.0 - 30.0 ft		X	X	X		X	X		X	X	X									X	X	X	X	X	X	X	X	X			
Field Duplicate		30.0 - 35.0 ft		X	X	X		X	X		X	X	X									X	X	X	X	X	X	X	X	X			
		35.0 - 40.0 ft		X	X	X		X	X		X	X	X									X	X	X	X	X	X	X	X	X			
		40.0 - 45.0 ft		X	X	X		X	X		X	X	X									X	X	X	X	X	X	X	X	X			

Table F.7-II

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA V.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements							Laboratory Analysis													
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
		45.0 – 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		50.0 – 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		55.0 – 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		60.0 – 65.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		65.0 – 70.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X				
		70.0 – 75.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X				
Fracture Sampling Contingency																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
Trip Blank																											X							
Vertical Borehole	3	0.0 – 2.5 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		2.5 – 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		5.0 – 7.5 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		7.5 – 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		10.0 – 12.5 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		12.5 – 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		25.0 – 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
		30.0 – 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		35.0 – 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				

Table F.7-II

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA V.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
		40.0 - 45.0 ft						X	X																								
		45.0 - 50.0 ft						X	X													X	X	X	X	X	X	X	X	X			
		50.0 - 55.0 ft						X	X													X	X	X	X	X	X	X	X	X			
		55.0 - 60.0 ft						X	X													X	X	X	X	X	X	X	X	X			
		60.0 - 65.0 ft						X	X													X	X	X	X	X	X	X	X	X			
		65.0 - 70.0 ft						X	X													X	X	X	X	X	X	X	X	X			
		70.0 - 75.0 ft						X	X					X	X							X	X	X	X	X	X	X	X	X			
Fracture Sampling Contingency																						C	C	C	C	C	C	C	C	C			
																						C	C	C	C	C	C	C	C	C			
																						C	C	C	C	C	C	C	C	C			
																						C	C	C	C	C	C	C	C	C			
																						C	C	C	C	C	C	C	C	C			
Rinsate Blank																						X	X	X	X	X	X	X	X	X			
Field Blank																																	
Trip Blank																						X	X	X	X	X	X	X	X	X			
Vertical Borehole	4	0.0 - 2.5 ft						X	X	X	X	X	X							X		X	X	X	X	X	X	X	X	X			
		2.5 - 5.0 ft						X	X	X	X	X	X							X		X	X	X	X	X	X	X	X	X			
		5.0 - 7.5 ft						X	X	X	X	X	X							X		X	X	X	X	X	X	X	X	X			
		7.5 - 10.0 ft						X	X	X	X	X	X							X		X	X	X	X	X	X	X	X	X			
		10.0 - 12.5 ft						X	X	X	X	X	X							X		X	X	X	X	X	X	X	X	X			
		12.5 - 15.0 ft						X	X	X	X	X	X							X		X	X	X	X	X	X	X	X	X			
		15.0 - 20.0 ft						X	X	X	X	X	X							X		X	X	X	X	X	X	X	X	X			
		20.0 - 25.0 ft						X	X	X	X	X	X							X		X	X	X	X	X	X	X	X	X			
		25.0 - 30.0 ft						X	X	X	X	X	X							X		X	X	X	X	X	X	X	X	X			
Field Duplicate		30.0 - 35.0 ft																		X		X	X	X	X	X	X	X	X	X			

Table F.7-II

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA V.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening					Field Laboratory Measurements							Laboratory Analysis													
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
		35.0 – 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		40.0 – 45.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		45.0 – 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		50.0 – 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		55.0 – 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		60.0 – 65.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		65.0 – 70.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X				
		70.0 – 75.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X				
Fracture Sampling Contingency																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X						
Trip Blank																												X						
Vertical Borehole	5	0.0 – 2.5 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		2.5 – 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		5.0 – 7.5 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		7.5 – 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		10.0 – 12.5 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		12.5 – 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		25.0 – 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				

Table F.7-II

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA V.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
		30.0 - 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		35.0 - 40.0 ft						X	X		X	X	X									X	X	X	X		X	X	X	X			
		40.0 - 45.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		45.0 - 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		50.0 - 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		55.0 - 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		60.0 - 65.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		65.0 - 70.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		70.0 - 75.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X			
Fracture Sampling Contingency																						C	C	C	C	C	C	C	C	C			
Rinsate Blank																						C	C	C	C	C	C	C	C	C			
Field Blank																						C	C	C	C	C	C	C	C	C			
Trip Blank																						C	C	C	C	C	C	C	C	C			
Vertical Borehole	6	0.0 - 2.5 ft		X	X	X	X	X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X			
		2.5 - 5.0 ft		X	X	X	X	X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X			
		5.0 - 7.5 ft		X	X	X	X	X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X			
		7.5 - 10.0 ft		X	X	X	X	X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X			
		10.0 - 12.5 ft		X	X	X	X	X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X			
		12.5 - 15.0 ft		X	X	X	X	X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X			
		15.0 - 20.0 ft		X	X	X	X	X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X			
		20.0 - 25.0 ft		X	X	X	X	X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X			
		25.0 - 30.0 ft		X	X	X	X	X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X			

Table F.7-II

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA V.

				Field Surveys				Field Screening						Field Laboratory Measurements										Laboratory Analysis													
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
Field Duplicate																						X	X	X	X		X	X	X	X					
		30.0 - 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		35.0 - 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		40.0 - 45.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		45.0 - 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		50.0 - 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		55.0 - 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		60.0 - 65.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		65.0 - 70.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X					
		70.0 - 75.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X					
Fracture Sampling Contingency																						C	C	C	C		C	C	C	C					
																						C	C	C	C		C	C	C	C					
																						C	C	C	C		C	C	C	C					
																						C	C	C	C		C	C	C	C					
																						C	C	C	C		C	C	C	C					
Rinsate Blank																						X	X	X	X		X	X	X	X					
Field Blank																												X	X	X					
Trip Blank																												X							

Table F.7-III

MDA V GEOPHYSICAL

MINERALOGICAL DETERMINATIONS

				Hydrogeological and Geochemical																Environmental Isotopes								Open Hole Tests: Straddle Packer Tests							Open Hole Tests: Geophysics										
Sample Type	Sampling Location	Interval	Sample Identification	Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (He injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Chloride-35/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-16/Oxygen-18	Tritium	Carbon-14	Chloride-36	In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6	Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
MDA V																																													
Vertical Borehole	1	0.0 - 5.0 ft																																											
		5.0 - 10.0 ft										X	X	X	X	X	X	X	X																										
		10.0 - 15.0 ft																																											
		15.0 - 20.0 ft																																											
		20.0 - 25.0 ft																																											
		25.0 - 30.0 ft										X	X	X	X	X	X	X	X																										
		30.0 - 35.0 ft																																											
		35.0 - 40.0 ft																																											
		40.0 - 45.0 ft																																											
		45.0 - 50.0 ft										X	X	X	X	X	X	X	X																										
		50.0 - 55.0 ft																																											
		55.0 - 60.0 ft																																											
		60.0 - 65.0 ft																																											
		65.0 - 70.0 ft										X	X	X	X	X	X	X	X																										
		70.0 - 75.0 ft																																											
		75.0 - 80.0 ft										X	X	X	X	X	X	X	X																										
		80.0 - 85.0 ft																																											
		85.0 - 90.0 ft										X	X	X	X	X	X	X	X																										
		90.0 - 95.0 ft																																											
		95.0 - 100.0 ft										X	X	X	X	X	X	X	X																										
		100.0 - 105.0 ft																																											
		105.0 - 110.0 ft										X	X	X	X	X	X	X	X																										
		110.0 - 115.0 ft																																											
		115.0 - 120.0 ft										X	X	X	X	X	X	X	X																										
		120.0 - 125.0 ft																																											
Fracture Contingency Sample												C	C	C	C	C	C	C	C																										
												C	C	C	C	C	C	C	C																										
												C	C	C	C	C	C	C	C																										
												C	C	C	C	C	C	C	C																										
												C	C	C	C	C	C	C	C																										
Vertical Borehole	2	0.0 - 5.0 ft																																											
		5.0 - 10.0 ft										X	X	X	X	X	X	X	X																										
		10.0 - 15.0 ft																																											
		15.0 - 20.0 ft																																											
		20.0 - 25.0 ft																																											
		25.0 - 30.0 ft										X	X	X	X	X	X	X	X																										
		30.0 - 35.0 ft																																											

Table F.7-III

MDA V GEOPHYSICAL

MINERALOGICAL DETERMINATIONS

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical: Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (Hg Injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Environmental Isotopes: Chloride-36/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium -87	Hydrogen/Deuterium	Oxygen-18/Oxygen-18	Tritium	Carbon-14	Chloride-36	Open Hole Tests: Straddle Packer Tests: In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6		Open Hole Tests: Geophysics: Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
		35.0 - 40.0 ft										X	X	X		X	X		X																										
		40.0 - 45.0 ft																																											
		45.0 - 50.0 ft		X	X	X						X	X	X		X	X		X																										
		50.0 - 55.0 ft																																											
		55.0 - 60.0 ft																																											
		60.0 - 65.0 ft		X	X	X						X	X	X		X	X		X																										
		65.0 - 70.0 ft																																											
		70.0 - 75.0 ft		X	X	X						X	X	X		X	X		X																										
Fracture Contingency Sample				C	C	C						C	C	C		C	C		C																										
				C	C	C						C	C	C		C	C		C																										
				C	C	C						C	C	C		C	C		C																										
				C	C	C						C	C	C		C	C		C																										
				C	C	C						C	C	C		C	C		C																										
Vertical Borehole	3	0.0 - 5.0 ft										X	X	X		X	X		X																										
		5.0 - 10.0 ft																																											
		10.0 - 15.0 ft																																											
		15.0 - 20.0 ft																																											
		20.0 - 25.0 ft																																											
		25.0 - 30.0 ft																																											
		30.0 - 35.0 ft																																											
		35.0 - 40.0 ft																																											
		40.0 - 45.0 ft																																											
		45.0 - 50.0 ft																																											
		50.0 - 55.0 ft																																											
		55.0 - 60.0 ft																																											
		60.0 - 65.0 ft																																											
		65.0 - 70.0 ft																																											
		70.0 - 75.0 ft																																											
Fracture Contingency Sample				C	C	C						C	C	C		C	C		C																										
				C	C	C						C	C	C		C	C		C																										
				C	C	C						C	C	C		C	C		C																										
				C	C	C						C	C	C		C	C		C																										
				C	C	C						C	C	C		C	C		C																										
Vertical Borehole	4	0.0 - 5.0 ft										X	X	X		X	X		X																										
		5.0 - 10.0 ft																																											

Table F.7-III

MDA V GEOPHYSICAL

MINERALOGICAL DETERMINATIONS

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical																
				Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (He Injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	
		10.0 - 15.0 ft																		
		15.0 - 20.0 ft																		
		20.0 - 25.0 ft																		
		25.0 - 30.0 ft										X	X	X	X	X	X	X	X	
		30.0 - 35.0 ft																		
		35.0 - 40.0 ft																		
		40.0 - 45.0 ft																		
		45.0 - 50.0 ft										X	X	X	X	X	X	X	X	
		50.0 - 55.0 ft																		
		55.0 - 60.0 ft																		
		60.0 - 65.0 ft																		
		65.0 - 70.0 ft										X	X	X	X	X	X	X	X	
		70.0 - 75.0 ft																		
Fracture Contingency Sample												C	C	C	C	C	C	C	C	
												C	C	C	C	C	C	C	C	
												C	C	C	C	C	C	C	C	
												C	C	C	C	C	C	C	C	
												C	C	C	C	C	C	C	C	
Vertical Borehole	5	0.0 - 5.0 ft																		
		5.0 - 10.0 ft										X	X	X	X	X	X	X	X	
		10.0 - 15.0 ft																		
		15.0 - 20.0 ft																		
		20.0 - 25.0 ft																		
		25.0 - 30.0 ft										X	X	X	X	X	X	X	X	
		30.0 - 35.0 ft																		
		35.0 - 40.0 ft																		
		40.0 - 45.0 ft																		
		45.0 - 50.0 ft										X	X	X	X	X	X	X	X	
		50.0 - 55.0 ft																		
		55.0 - 60.0 ft																		
		60.0 - 65.0 ft																		
		65.0 - 70.0 ft										X	X	X	X	X	X	X	X	
		70.0 - 75.0 ft																		
Fracture Contingency Sample												C	C	C	C	C	C	C	C	
												C	C	C	C	C	C	C	C	

Sample Type	Sampling Location	Interval	Environmental Isotopes									Open Hole Tests: Straddle Packer Tests								Open Hole Tests: Geophysics										
			Chloride-36/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium -87	Hydrogen/Deuterium	Oxygen-16/Oxygen-18	Tritium	Carbon-14	Chloride-36		In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6		Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
		10.0 - 15.0 ft																												
		15.0 - 20.0 ft																												
		20.0 - 25.0 ft																												
		25.0 - 30.0 ft																												
		30.0 - 35.0 ft																												
		35.0 - 40.0 ft																												
		40.0 - 45.0 ft																												
		45.0 - 50.0 ft																												
		50.0 - 55.0 ft																												
		55.0 - 60.0 ft																												
		60.0 - 65.0 ft																												
		65.0 - 70.0 ft																												
		70.0 - 75.0 ft																												
Fracture Contingency Sample																														
Vertical Borehole	5	0.0 - 5.0 ft																												
		5.0 - 10.0 ft																												
		10.0 - 15.0 ft																												
		15.0 - 20.0 ft																												
		20.0 - 25.0 ft																												
		25.0 - 30.0 ft																												
		30.0 - 35.0 ft																												
		35.0 - 40.0 ft																												
		40.0 - 45.0 ft																												
		45.0 - 50.0 ft																												
		50.0 - 55.0 ft																												
		55.0 - 60.0 ft																												
		60.0 - 65.0 ft																												
		65.0 - 70.0 ft																												
		70.0 - 75.0 ft																												
Fracture Contingency Sample																														

Table F.7-III

MDA V GEOPHYSICAL

MINERALOGICAL DETERMINATIONS

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical: Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (Hg injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Environmental Isotopes: Chloride-36/Chloride-37	Carbon-12/C ybon-13	Strontium-86/ Itrontium -87	Hydrogen/Deuterium	Oxygen-18/Oxygen-18	Tritium	Carbon-14	Chloride-36	Open Hole Tests: Straddle Packer Tests: In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF-6		Open Hole Tests: Geophysics: Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
Vertical Borehole	6	0.0 - 5.0 ft										C	C	C	C	C	C	C	C		C																							
		5.0 - 10.0 ft										X	X	X	X	X	X	X	X		X																							
		10.0 - 15.0 ft																																										
		15.0 - 20.0 ft																																									
		20.0 - 25.0 ft																																										
		25.0 - 30.0 ft										X	X	X	X	X	X	X	X		X																							
		30.0 - 35.0 ft																																										
		35.0 - 40.0 ft																																									
		40.0 - 45.0 ft																																										
		45.0 - 50.0 ft										X	X	X	X	X	X	X	X		X																							
		50.0 - 55.0 ft																																										
		55.0 - 60.0 ft																																									
		60.0 - 65.0 ft										X	X	X	X	X	X	X	X		X																							
		65.0 - 70.0 ft																																										
		70.0 - 75.0 ft																																									
Fracture Contingency Sample												C	C	C	C	C	C	C	C		C																							
												C	C	C	C	C	C	C	C		C																							
												C	C	C	C	C	C	C	C		C																							
												C	C	C	C	C	C	C	C		C																							

Table F.7-IV

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA V.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Field Laboratory Measurements:	Field Laboratory Measurements:	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals		
Subsurface samples at MDA V																																			
Vertical Borehole	1	0.0 - 5.0 ft		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X				
		5.0 - 10.0 ft		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X				
		10.0 - 15.0 ft		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X				
		15.0 - 20.0 ft		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X				
		20.0 - 25.0 ft		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X				
		25.0 - 30.0 ft		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X				
Field Duplicate		30.0 - 35.0 ft		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X				
		35.0 - 40.0 ft		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X				
		40.0 - 45.0 ft		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X				
		45.0 - 50.0 ft		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X				
		50.0 - 55.0 ft		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X				
		55.0 - 60.0 ft		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X				
		60.0 - 65.0 ft		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X				
		65.0 - 70.0 ft		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X				
		70.0 - 75.0 ft		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X			X	X	X	X	X	X	X	X	X	X				
Fracture Sampling Contingency																																			
Rinsate Blank																						C	C	C	C		C	C	C	C					
Field Blank																						C	C	C	C		C	C	C	C					
Field Duplicate																						C	C	C	C		C	C	C	C					

Table F.7-IV

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA V.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis															
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals				
Trip Blank																																					
Vertical Borehole	2	0.0 – 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		5.0 – 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		10.0 – 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		25.0 – 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
Field Duplicate																						X	X	X	X		X	X	X	X						
		30.0 – 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		35.0 – 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		40.0 – 45.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		45.0 – 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		50.0 – 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		55.0 – 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		60.0 – 65.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X						
		65.0 – 70.0 ft						X	X		X	X	X	X	X	X	X	X	X			X	X	X	X		X	X	X	X						
		70.0 – 75.0 ft						X	X		X	X	X	X	X	X	X	X	X			X	X	X	X		X	X	X	X						
Rinsate Blank																						X	X	X	X		X	X	X	X						
Field Blank																												X	X	X						
Field Duplicate																						X	X	X	X		X	X	X	X						
Trip Blank																												X								
Fracture Sampling Contingency																						C	C	C	C		C	C	C	C						
																						C	C	C	C		C	C	C	C						
																						C	C	C	C		C	C	C	C						
																						C	C	C	C		C	C	C	C						
																						C	C	C	C		C	C	C	C						

Table F.7-IV

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA V.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals		
Vertical Borehole	3	0.0 - 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		5.0 - 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		10.0 - 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		15.0 - 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		20.0 - 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		25.0 - 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
Field Duplicate																																		
		30.0 - 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		35.0 - 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		40.0 - 45.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		45.0 - 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		50.0 - 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		55.0 - 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		60.0 - 65.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			
		65.0 - 70.0 ft						X	X		X	X	X	X	X	X	X					X	X	X	X		X	X	X	X			
		70.0 - 75.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X			
Fracture Sampling Contingency																						C	C	C	C		C	C	C	C			
Rinsate Blank																						C	C	C	C		C	C	C	C			
Field Blank																						C	C	C	C		C	C	C	C			
Field Duplicate																						C	C	C	C		C	C	C	C			
Trip Blank																						C	C	C	C		C	C	C	C			
Vertical Borehole	4	0.0 - 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X			

Table F.7–IV

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA V.

				Field Surveys				Field Screening						Field Laboratory Measurements							Laboratory Analysis													
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
		5.0 – 10.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X					
		10.0 – 15.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X					
		15.0 – 20.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X					
		20.0 – 25.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X					
		25.0 – 30.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X					
Field Duplicate																					X	X	X	X		X	X	X	X					
		30.0 – 35.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X					
		35.0 – 40.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X					
		40.0 – 45.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X					
		45.0 – 50.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X					
		50.0 – 55.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X					
		55.0 – 60.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X					
		60.0 – 65.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X					
		65.0 – 70.0 ft						X	X		X	X	X	X	X	X	X		X		X	X	X	X		X	X	X	X					
		70.0 – 75.0 ft						X	X		X	X	X	X	X	X	X		X		X	X	X	X		X	X	X	X					
Rinsate Blank																					X	X	X	X			X	X	X					
Field Blank																										X	X	X	X					
Field Duplicate																					X	X	X	X		X	X	X	X					
Trip Blank																											X							
Fracture Sampling Contingency																					C	C	C	C		C	C	C	C					
																					C	C	C	C		C	C	C	C					
																					C	C	C	C		C	C	C	C					
																					C	C	C	C		C	C	C	C					
																					C	C	C	C		C	C	C	C					
Angled Borehole 10 degrees	5	0.0 – 5.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X					
		5.0 – 10.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X					

Table F.7-IV

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA V.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
		10.0 – 15.0 ft						X	X		X	X	X						X													
		15.0 – 20.0 ft						X	X		X	X	X						X													
		20.0 – 25.0 ft						X	X		X	X	X						X													
		25.0 – 30.0 ft						X	X		X	X	X						X													
Field Duplicate																																	
		30.0 – 35.0 ft						X	X		X	X	X						X													
		35.0 – 40.0 ft						X	X		X	X	X						X													
		40.0 – 45.0 ft						X	X		X	X	X						X													
		45.0 – 50.0 ft						X	X		X	X	X						X													
		50.0 – 55.0 ft						X	X		X	X	X						X													
		55.0 – 60.0 ft						X	X		X	X	X						X													
		60.0 – 65.0 ft						X	X		X	X	X						X													
		65.0 – 70.0 ft						X	X		X	X	X						X													
		70.0 – 75.0 ft						X	X		X	X	X						X													
		75.0 – 80.0 ft						X	X		X	X	X						X													
		80.0 – 85.0 ft						X	X		X	X	X						X													
		85.0 – 90.0 ft						X	X		X	X	X						X													
		90.0 – 95.0 ft						X	X		X	X	X						X													
		95.0 – 100.0 ft						X	X		X	X	X						X													
Rinsate Blank																																	
Field Blank		100.0 – 105.0 ft						X	X		X	X	X						X													
		105.0 – 110.0 ft						X	X		X	X	X						X													
		110.0 – 115.0 ft						X	X		X	X	X						X													
Field Duplicate																																	
Trip Blank																																	

Table F.7-IV

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA V.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture				Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
		115.0 – 120.0 ft						X	X		X	X	X						X				X	X	X		X	X	X	X					
		120.0 – 125.0 ft						X	X		X	X	X						X				X	X	X		X	X	X	X					
		125.0 – 130.0 ft						X	X		X	X	X						X				X	X	X		X	X	X	X					
		130.0 – 135.0 ft						X	X		X	X	X						X				X	X	X		X	X	X	X					
		135.0 – 140.0 ft						X	X		X	X	X						X				X	X	X		X	X	X	X					
		140.0 – 145.0 ft						X	X		X	X	X						X				X	X	X		X	X	X	X					
		145.0 – 150.0 ft						X	X		X	X	X						X				X	X	X		X	X	X	X					
		150.0 – 155.0 ft						X	X		X	X	X						X				X	X	X		X	X	X	X					
		155.0 – 160.0 ft						X	X		X	X	X						X				X	X	X		X	X	X	X					
		160.0 – 165.0 ft						X	X		X	X	X						X				X	X	X		X	X	X	X					
		165.0 – 170.0 ft						X	X		X	X	X						X				X	X	X		X	X	X	X					
		170.0 – 175.0 ft						X	X		X	X	X						X				X	X	X		X	X	X	X					
		175.0 – 180.0 ft						X	X		X	X	X						X				X	X	X		X	X	X	X					
Rinsate Blank																			X				X	X	X		X	X	X	X					
		180.0 – 185.0 ft						X	X		X	X	X						X				X	X	X		X	X	X	X					
		185.0 – 190.0 ft						X	X		X	X	X						X				X	X	X		X	X	X	X					
		190.0 – 195.0 ft						X	X		X	X	X						X				X	X	X		X	X	X	X					
		195.0 – 200.0 ft						X	X		X	X	X						X				X	X	X		X	X	X	X					
Fracture Sampling Contingency																																				
															C	C	C	C					C	C	C		C	C	C	C					
															C	C	C	C					C	C	C		C	C	C	C					
															C	C	C	C					C	C	C		C	C	C	C					
															C	C	C	C					C	C	C		C	C	C	C					
															C	C	C	C					C	C	C		C	C	C	C					
																													X	X						
Field Blank																								X	X		X	X	X	X					
Field Duplicate																								X	X		X	X	X	X					
Trip Blank																														X						

Table F.7-IV

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA V.

Sample Identification	Sample Type	Sampling Location	Interval	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
	Angled Borehole 10 degrees	0	0.0 - 5.0 ft					X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
			5.0 - 10.0 ft					X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
			10.0 - 15.0 ft					X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
			15.0 - 20.0 ft					X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
			20.0 - 25.0 ft					X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
			25.0 - 30.0 ft					X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
	Field Duplicate																																	
			30.0 - 35.0 ft					X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
			35.0 - 40.0 ft					X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
			40.0 - 45.0 ft					X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
			45.0 - 50.0 ft					X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
			50.0 - 55.0 ft					X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
			55.0 - 60.0 ft					X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
			60.0 - 65.0 ft					X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
			65.0 - 70.0 ft					X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
			70.0 - 75.0 ft					X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
			75.0 - 80.0 ft					X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
			80.0 - 85.0 ft					X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
			85.0 - 90.0 ft					X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
			90.0 - 95.0 ft					X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
			95.0 - 100.0 ft					X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
	Rinsate Blank																					X	X	X	X	X	X	X	X	X			
	Field Blank		100.0 - 105.0 ft					X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
			105.0 - 110.0 ft					X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			
			110.0 - 115.0 ft					X	X		X	X	X						X			X	X	X	X	X	X	X	X	X			

Table F.7–IV

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA V.

				Field Surveys				Field Screening						Field Laboratory Measurements							Laboratory Analysis															
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals				
Field Duplicate																						X	X	X	X		X	X	X	X					
Trip Blank																											X							
		115.0 – 120.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		120.0 – 125.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		125.0 – 130.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		130.0 – 135.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		135.0 – 140.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		140.0 – 145.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		145.0 – 150.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		150.0 – 155.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		155.0 – 160.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		160.0 – 165.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		165.0 – 170.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		170.0 – 175.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		175.0 – 180.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
Rinsate Blank																						X	X	X	X		X	X	X	X					
		180.0 – 185.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		185.0 – 190.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		190.0 – 195.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		195.0 – 200.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
Fracture Sampling Contingency																						C	C	C	C		C	C	C	C					
																						C	C	C	C		C	C	C	C					
																						C	C	C	C		C	C	C	C					
																						C	C	C	C		C	C	C	C					
																						C	C	C	C		C	C	C	C					
Field Blank																												X	X	X					

Table F.7-IV

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA V.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Field Duplicate																																	
Trip Blank																												X					
Angled Borehole 30 degrees	7	0.0 - 5.0 R						X	X		X	X	X						X							X	X	X	X	X			
		5.0 - 10.0 R						X	X		X	X	X						X							X	X	X	X	X			
		10.0 - 15.0 R						X	X		X	X	X						X							X	X	X	X	X			
		15.0 - 20.0 R						X	X		X	X	X						X							X	X	X	X	X			
		20.0 - 25.0 R						X	X		X	X	X						X							X	X	X	X	X			
		25.0 - 30.0 R						X	X		X	X	X						X							X	X	X	X	X			
Field Duplicate																																	
		30.0 - 35.0 R						X	X		X	X	X						X							X	X	X	X	X			
		35.0 - 40.0 R						X	X		X	X	X						X							X	X	X	X	X			
		40.0 - 45.0 R						X	X		X	X	X						X							X	X	X	X	X			
		45.0 - 50.0 R						X	X		X	X	X						X							X	X	X	X	X			
		50.0 - 55.0 R						X	X		X	X	X						X							X	X	X	X	X			
		55.0 - 60.0 R						X	X		X	X	X						X							X	X	X	X	X			
		60.0 - 65.0 R						X	X		X	X	X						X							X	X	X	X	X			
		65.0 - 70.0 R						X	X		X	X	X						X							X	X	X	X	X			
		70.0 - 75.0 R						X	X		X	X	X						X							X	X	X	X	X			
		75.0 - 80.0 R						X	X		X	X	X						X							X	X	X	X	X			
		80.0 - 85.0 R						X	X		X	X	X						X							X	X	X	X	X			
		85.0 - 90.0 R						X	X		X	X	X						X							X	X	X	X	X			
		90.0 - 95.0 R						X	X		X	X	X						X							X	X	X	X	X			
		95.0 - 100.0 R						X	X		X	X	X						X							X	X	X	X	X			
Rinsate Blank																						X	X	X	X	X	X	X	X	X			
Field Blank																												X	X	X			
		100.0 - 105.0 R						X	X		X	X	X						X				X	X	X	X	X	X	X	X	X			

Table F.7–IV

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA V.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements							Laboratory Analysis											
				Gross Gamma	Low–Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals	
		105.0 – 110.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X			
		110.0 – 115.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X			
Field Duplicate																					X	X	X	X	X	X	X	X			
Trip Blank																										X					
		115.0 – 120.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X			
		120.0 – 125.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X			
		125.0 – 130.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X			
		130.0 – 135.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X			
		135.0 – 140.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X			
		140.0 – 145.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X			
		145.0 – 150.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X			
		150.0 – 155.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X			
		155.0 – 160.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X			
		160.0 – 165.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X			
		165.0 – 170.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X			
		170.0 – 175.0 ft						X	X		X	X	X						X		X	X	X	X	X	X	X	X			
Fracture Sampling Contingency																					C	C	C	C	C	C	C	C			
																					C	C	C	C	C	C	C	C			
																					C	C	C	C	C	C	C	C			
																					C	C	C	C	C	C	C	C			
																					C	C	C	C	C	C	C	C			
Rinsate Blank																					X	X	X	X	X	X	X	X			
Field Blank																										X	X	X			
Field Duplicate																					X	X	X	X	X	X	X	X			
Trip Blank																										X					
Angled Borehole 10 degrees	8	0.0 – 5.0 ft						X	X		X	X	X						X		X	X	X	X		X	X	X	X			

Table F.7-IV

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA V.

		Sample Type	Sampling Location	Interval	Sample Identification
Field Surveys	Gross Gamma				
	Low-Energy Gamma				
	Electromagnetic				
	Land Survey				
Field Screening	Gross Gamma			5.0 - 10.0 R	
	Gross Alpha			10.0 - 15.0 R	
				15.0 - 20.0 R	
	Organic Vapor			20.0 - 25.0 R	
	Combustible Gas/Oxygen			25.0 - 30.0 R	
	Lithological Logging	Field Duplicate			
Field Measurements	Gross Alpha			30.0 - 35.0 R	
	Gamma Spectrometry			35.0 - 40.0 R	
	Tritium			40.0 - 45.0 R	
	Volatile Organics			45.0 - 50.0 R	
	PCB			50.0 - 55.0 R	
	Moisture			55.0 - 60.0 R	
				60.0 - 65.0 R	
				65.0 - 70.0 R	
Laboratory Analysis	Gamma Spectrometry			70.0 - 75.0 R	
	Tritium			75.0 - 80.0 R	
	Total Uranium			80.0 - 85.0 R	
	Isotopic Plutonium			85.0 - 90.0 R	
	Isotopic Uranium			90.0 - 95.0 R	
	Strontium 90			95.0 - 100.0 R	
	VOA (SW 8240)	Rinsate Blank			
	Semivolatiles (SW 8270)	Field Blank		100.0 - 105.0 R	
	Metals (SW 6010)			105.0 - 110.0 R	
	PCB (SW 8080)			110.0 - 115.0 R	
	TCLP Metals	Field Duplicate			

Table F.7-IV

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA V.

				Field Surveys				Field Screening						Field Laboratory Measurements							Laboratory Analysis														
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
Trip Blank																											X							
		115.0 – 120.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		120.0 – 125.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		125.0 – 130.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		130.0 – 135.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		135.0 – 140.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		140.0 – 145.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		145.0 – 150.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		150.0 – 155.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		155.0 – 160.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		160.0 – 165.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		165.0 – 170.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		170.0 – 175.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Fracture Sampling Contingency																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
Trip Blank																												X						
Angled Borehole 10 degrees	9	0.0 – 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		5.0 – 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		10.0 – 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				

Table F.7-IV

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA V.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis													
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		25.0 – 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
Field Duplicate																						X	X	X	X		X	X	X	X					
		30.0 – 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		35.0 – 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		40.0 – 45.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		45.0 – 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		50.0 – 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		55.0 – 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		60.0 – 65.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		65.0 – 70.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		70.0 – 75.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		75.0 – 80.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		80.0 – 85.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		85.0 – 90.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		90.0 – 95.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		95.0 – 100.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
Rinsate Blank																						X	X	X	X		X	X	X	X					
Field Blank																												X	X	X					
		100.0 – 105.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		105.0 – 110.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		110.0 – 115.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
Field Duplicate																						X	X	X	X		X	X	X	X					
Trip Blank																												X							
		115.0 – 120.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		120.0 – 125.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					

Table F.7-IV

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA V.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
		125.0 – 130.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X				
		130.0 – 135.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X				
		135.0 – 140.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X				
		140.0 – 145.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X				
		145.0 – 150.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X				
		150.0 – 155.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X				
		155.0 – 160.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X				
		160.0 – 165.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X				
		165.0 – 170.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X				
		170.0 – 175.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X				
Fracture Sampling Contingency																						C	C	C	C	C	C	C	C				
																						C	C	C	C	C	C	C	C				
																						C	C	C	C	C	C	C	C				
																						C	C	C	C	C	C	C	C				
																						C	C	C	C	C	C	C	C				
Rinsate Blank																						X	X	X	X	X	X	X	X				
Field Blank																											X	X	X				
Field Duplicate																						X	X	X	X	X	X	X	X				
Trip Blank																											X						

Table F.8-1

SCREENING AND ANALYSIS FOR INITIAL SURFACE INVESTIGATIONS AT MDA A.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Sand Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture		Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)		Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Surface Sampling at MDA A																																	
Surface Soil Sample	1	0.0 - 6.0 in		X	X		X	X	X																								
	2	0.0 - 6.0 in						X	X												X	X	X	X	X	X		X	X	X	X		
	3	0.0 - 6.0 in						X	X												X	X	X	X	X	X		X	X	X	X		
	4	0.0 - 6.0 in						X	X												X	X	X	X	X	X		X	X	X	X		
	5	0.0 - 6.0 in						X	X												X	X	X	X	X	X		X	X	X	X		
Rinsate Blank																					X	X	X	X	X	X		X	X	X	X		
Field Blank																					X	X	X	X	X	X		X	X	X	X		
Field Duplicate	9	0.0 - 6.0 in						X	X												X	X	X	X	X	X		X	X	X	X		
	8	0.0 - 6.0 in						X	X												X	X	X	X	X	X		X	X	X	X		
	7	0.0 - 6.0 in						X	X												X	X	X	X	X	X		X	X	X	X		
	6	0.0 - 6.0 in						X	X												X	X	X	X	X	X		X	X	X	X		
	15	0.0 - 6.0 in						X	X												X	X	X	X	X	X		X	X	X	X		
	14	0.0 - 6.0 in						X	X												X	X	X	X	X	X		X	X	X	X		
	13	0.0 - 6.0 in						X	X												X	X	X	X	X	X		X	X	X	X		
	12	0.0 - 6.0 in						X	X												X	X	X	X	X	X		X	X	X	X		
	11	0.0 - 6.0 in						X	X												X	X	X	X	X	X		X	X	X	X		
	10	0.0 - 6.0 in						X	X												X	X	X	X	X	X		X	X	X	X		
	16	0.0 - 6.0 in						X	X												X	X	X	X	X	X		X	X	X	X		
	17	0.0 - 6.0 in						X	X												X	X	X	X	X	X		X	X	X	X		
	18	0.0 - 6.0 in						X	X												X	X	X	X	X	X		X	X	X	X		
	19	0.0 - 6.0 in						X	X												X	X	X	X	X	X		X	X	X	X		
	20	0.0 - 6.0 in						X	X												X	X	X	X	X	X		X	X	X	X		
	21	0.0 - 6.0 in						X	X												X	X	X	X	X	X		X	X	X	X		

Table F.8-1

SCREENING AND ANALYSIS FOR INITIAL SURFACE INVESTIGATIONS AT MDA A.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening					Field Laboratory Measurements							Laboratory Analysis													
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals				
	22	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	23	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	24	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
Rinsate Blank																						X	X	X	X		X		X	X				
Field Blank																													X	X				
	25	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	26	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	27	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
Field Duplicate																						X	X	X	X		X		X	X				
	28	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	29	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	30	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	31	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	32	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	33	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	34	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	35	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	36	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	37	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	38	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	39	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	40	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
Replicate Surface Soil Sample	1	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	2	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	3	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
Rinsate Blank																						X	X	X	X		X		X	X				

Table F.8-1

SCREENING AND ANALYSIS FOR INITIAL SURFACE INVESTIGATIONS AT MDA A.

Sample Type	Sampling Location	Interval	Sample Identification		Field Surveys	Field Screening	Laboratory Measurements	Laboratory Analysis
					Gross Gamma	Gross Gamma	Gross Alpha	Gamma Spectrometry
					Low-Energy Gamma	Gross Alpha	Gamma Spectrometry	Tritium
					Electromagnetic		Tritium	Total Uranium
					Land Survey		Volatile Organics	Isotopic Plutonium
						Organic Vapor	PCB	Isotopic Uranium
						Combustible Gas/Oxygen	Soil Moisture	Strontium 90
						Lithological Logging		VOA (SW 8240)
Field Blank								Semivolatiles (SW 8270)
	4	0.0 - 6.0 in			X	X	X	Metals (SW 6010)
Field Duplicate								PCB (SW 8080)
	5	0.0 - 6.0 in			X	X	X	TCLP Metals
Contingency Surface Sample	1	0.0 - 6.0 in						
	2	0.0 - 6.0 in						
	3	0.0 - 6.0 in						
	4	0.0 - 6.0 in						
	5	0.0 - 6.0 in						
	6	0.0 - 6.0 in						
	7	0.0 - 6.0 in						
	8	0.0 - 6.0 in						
	9	0.0 - 6.0 in						
	10	0.0 - 6.0 in						
Trip Blank								

Table F.8-II

SCREENING AND ANALYSIS FOR SUBSEQUENT SURFACE INVESTIGATIONS AT MDA A.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis													
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals				
Surface Sampling at MDA A																																			
Surface Soil Sample	1	0.0 - 6.0 in		X	X			X	X													X	X	X	X		X		X	X				
	2	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	3	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	4	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	5	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
Rinsate Blank																						X	X	X	X		X		X	X				
Field Blank																													X	X				
	6	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	7	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	8	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
Field Duplicate																						X	X	X	X		X		X	X				
	9	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	10	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	11	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	12	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	13	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	14	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	15	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	16	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	17	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	18	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	19	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
	20	0.0 - 6.0 in						X	X													X	X	X	X		X		X	X				
Rinsate Blank																						X	X	X	X		X		X	X				

Table F.8–II

SCREENING AND ANALYSIS FOR SUBSEQUENT SURFACE INVESTIGATIONS AT MDA A.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements							
				Gross Gamma	Low–Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture		
Field Blank																					
Field Duplicate																					
Contingency Surface Sample	1	0.0 – 6.0 in																			
	2	0.0 – 6.0 in																			
	3	0.0 – 6.0 in																			
	4	0.0 – 6.0 in																			
	5	0.0 – 6.0 in																			
	6	0.0 – 6.0 in																			
	7	0.0 – 6.0 in																			
	8	0.0 – 6.0 in																			
	9	0.0 – 6.0 in																			
	10	0.0 – 6.0 in																			
Trip Blank																					

Sample Type	Sampling Location	Laboratory Analysis												
		Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
Field Blank									X	X				
Field Duplicate		X	X	X	X		X		X	X				
Contingency Surface Sample	1	C	C	C	C		C	C	C	C				
	2	C	C	C	C		C	C	C	C				
	3	C	C	C	C		C	C	C	C				
	4	C	C	C	C		C	C	C	C				
	5	C	C	C	C		C	C	C	C				
	6	C	C	C	C		C	C	C	C				
	7	C	C	C	C		C	C	C	C				
	8	C	C	C	C		C	C	C	C				
	9	C	C	C	C		C	C	C	C				
	10	C	C	C	C		C	C	C	C				
Trip Blank								C						

Table F.8-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA A.

				Field Surveys				Field Screening						Field Laboratory Measurements							Laboratory Analysis												
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging		Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium		Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
Subsurface samples at MDA A																																				
Angled Borehole 15 degrees	1	0.0 – 5.0 ft						X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		5.0 – 10.0 ft						X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		10.0 – 15.0 ft						X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		15.0 – 20.0 ft						X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		20.0 – 25.0 ft						X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		25.0 – 30.0 ft						X	X		X	X	X							X			X	X	X	X		X	X	X	X				
Field Duplicate																							X	X	X	X		X	X	X	X				
		30.0 – 35.0 ft						X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		35.0 – 40.0 ft						X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		40.0 – 45.0 ft						X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		45.0 – 50.0 ft						X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		50.0 – 55.0 ft						X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		55.0 – 60.0 ft						X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		60.0 – 65.0 ft						X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		65.0 – 70.0 ft						X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		70.0 – 75.0 ft						X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		75.0 – 80.0 ft						X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		80.0 – 85.0 ft						X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		85.0 – 90.0 ft						X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		90.0 – 95.0 ft						X	X		X	X	X							X			X	X	X	X		X	X	X	X				
		95.0 – 100.0 ft						X	X		X	X	X							X			X	X	X	X		X	X	X	X				
Rinsate Blank																							X	X	X	X		X	X	X	X				
Field Blank																													X	X	X				
		100.0 – 105.0 ft						X	X		X	X	X							X			X	X	X	X		X	X	X	X				

Table F.8-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA A.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 8010)	PCB (SW 8080)	TCLP Metals		
		105.0 – 110.0 ft						X	X		X	X	X						X															
		110.0 – 115.0 ft						X	X		X	X	X						X															
Field Duplicate																																		
Trip Blank		115.0 – 120.0 ft						X	X		X	X	X						X															
		120.0 – 125.0 ft						X	X		X	X	X						X															
		125.0 – 130.0 ft						X	X		X	X	X						X															
		130.0 – 135.0 ft						X	X		X	X	X						X															
		135.0 – 140.0 ft						X	X		X	X	X						X															
Fracture Contingency Sampling																																		
Rinsate Blank																																		
Field Blank																																		
Trip Blank																																		
Angled Borehole 30 degrees	2	0.0 – 5.0 ft						X	X		X	X	X						X															
		5.0 – 10.0 ft						X	X		X	X	X						X															
		10.0 – 15.0 ft						X	X		X	X	X						X															
		15.0 – 20.0 ft						X	X		X	X	X						X															
		20.0 – 25.0 ft						X	X		X	X	X						X															
		25.0 – 30.0 ft						X	X		X	X	X						X															
Field Duplicate																																		
		30.0 – 35.0 ft						X	X		X	X	X						X															
		35.0 – 40.0 ft						X	X		X	X	X						X															

Table F.8-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA A.

				Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis											
Sample Type	Sampling Location	Interval	Sample Identification	Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
		40.0 – 45.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		45.0 – 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		50.0 – 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		55.0 – 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		60.0 – 65.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		65.0 – 70.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		70.0 – 75.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		75.0 – 80.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		80.0 – 85.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		85.0 – 90.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		90.0 – 95.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		95.0 – 100.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Rinse Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
Trip Blank																												X						
Fracture Contingency Sampling																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
Angled Borehole 30 degrees	3	0.0 – 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		5.0 – 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		10.0 – 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				

Table F.8-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA A.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys	Field Screening	Field Laboratory Measurements	Laboratory Analysis
				Gross Gamma	Gross Gamma	Gross Alpha	Gamma Spectrometry
				Low-Energy Gamma	Gross Alpha	Gamma Spectrometry	Tritium
				Electromagnetic		Tritium	Total Uranium
				Land Survey	Organic Vapor	Volatile Organics	Isotopic Plutonium
					Combustible Gas/Oxygen	PCB	Isotopic Uranium
					Lithological Logging	Soil Moisture	Strontium 90
							VOA (SW 8240)
							Semivolatiles (SW 8270)
							Metals (SW 6010)
							PCB (SW 8080)
							TCLP Metals
Field Duplicate		25.0 - 30.0 R		X	X	X	X
		30.0 - 35.0 R			X	X	X
		35.0 - 40.0 R			X	X	X
		40.0 - 45.0 R			X	X	X
		45.0 - 50.0 R			X	X	X
		50.0 - 55.0 R			X	X	X
		55.0 - 60.0 R			X	X	X
		60.0 - 65.0 R			X	X	X
		65.0 - 70.0 R			X	X	X
		70.0 - 75.0 R			X	X	X
		75.0 - 80.0 R			X	X	X
		80.0 - 85.0 R			X	X	X
		85.0 - 90.0 R			X	X	X
		90.0 - 95.0 R			X	X	X
		95.0 - 100.0 R			X	X	X
Rinsate Blank							X
Field Blank		100.0 - 105.0 R			X	X	X
		105.0 - 110.0 R			X	X	X
		110.0 - 115.0 R			X	X	X
Field Duplicate							X
Trip Blank		115.0 - 120.0 R			X	X	X
		120.0 - 125.0 R			X	X	X
		125.0 - 130.0 R			X	X	X

Table F.8-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA A.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
		130.0 – 135.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		135.0 – 140.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		140.0 – 145.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		145.0 – 150.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		150.0 – 155.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		155.0 – 160.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		160.0 – 165.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		165.0 – 170.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		170.0 – 175.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		175.0 – 180.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		180.0 – 185.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		185.0 – 190.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		190.0 – 195.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		195.0 – 200.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Fracture Contingency Sampling																																		
Rinsate Blank																																		
Field Blank																																		
Field Duplicate																																		
Trip Blank																																		
Vertical Borehole		0.0 – 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		5.0 – 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		10.0 – 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				

Table F.8-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA A.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semi-volatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
		15.0 - 20.0 R						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		20.0 - 25.0 R						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		25.0 - 30.0 R						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
Field Duplicate		30.0 - 35.0 R						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		35.0 - 40.0 R						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		40.0 - 45.0 R						X	X		X	X	X	X	X	X	X						X	X	X	X	X	X	X	X	X				
		45.0 - 50.0 R						X	X		X	X	X	X	X	X	X						X	X	X	X	X	X	X	X	X				
Fracture Contingency Sampling																							C	C	C	C	C	C	C	C				
																							C	C	C	C	C	C	C	C				
																							C	C	C	C	C	C	C	C				
																							C	C	C	C	C	C	C	C				
																							C	C	C	C	C	C	C	C				
Rinsate Blank																							X	X	X	X	X	X	X	X				
Field Blank																																		
Trip Blank																																		
Vertical Borehole	5	0.0 - 5.0 R						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		5.0 - 10.0 R						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		10.0 - 15.0 R						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		15.0 - 20.0 R						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		20.0 - 25.0 R						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		25.0 - 30.0 R						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
Field Duplicate		30.0 - 35.0 R						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		35.0 - 40.0 R						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		40.0 - 45.0 R						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				

Table F.8-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA A.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis													
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
		45.0 – 50.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X				
Fracture Contingency Sampling																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
Trip Blank																												X						
Vertical Borehole	6	0.0 – 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		5.0 – 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		10.0 – 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		25.0 – 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
																						X	X	X	X		X	X	X	X				
		30.0 – 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		35.0 – 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		40.0 – 45.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		45.0 – 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		50.0 – 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		55.0 – 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		60.0 – 65.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		65.0 – 70.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X				
		70.0 – 75.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X				
Fracture Contingency Sampling																						C	C	C	C		C	C	C	C				

Table F.8-III

SCREENING AND ANALYSIS FOR INITIAL SUBSURFACE INVESTIGATIONS AT MDA A.

	Sample Identification	Sampling Location	Interval	Sample Type	
					Trip Blank
					Field Blank
					Rinsate Blank
Field Surveys					Gross Gamma
					Low-Energy Gamma
					Electromagnetic
					Land Survey
Field Screening					Gross Gamma
					Gross Alpha
					Organic Vapor
					Combustible Gas/Oxygen
					Lithological Logging
Laboratory Measurements Field					Gross Alpha
					Gamma Spectrometry
					Tritium
					Volatile Organics
					PCB
					Soil Moisture
Laboratory Analysis				C	Gamma Spectrometry
				C	Tritium
				C	Total Uranium
				C	Isotopic Plutonium
					Isotopic Uranium
				C	Strontium 90
				C	VOA (SW 8240)
				C	Semivolatiles (SW 8270)
				C	Metals (SW 6010)
					PCB (SW 8080)
					TCLP Metals

Table F.8-IV

MDA A GEOPHYSICAL

MINERALOGICAL DETERMINATIONS

Sample Type	Sampling Location	Interval	Sample Identification	Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (Hg injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Chloride-35/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium-87	Hydrogen/Deuterium	Oxygen-18/Oxygen-16	Tritium	Carbon-14	Chloride-36	In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6	Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Slide Scan Video
MDA A				Hydrogeological and Geochemical																	Environmental Isotopes								Open Hole Tests: Straddle Packer Tests								Open Hole Tests: Geophysics										
Arg Borehole 15 deg	1	0.0 – 5.0 ft																																											
		5.0 – 10.0 ft										X	X	X	X	X	X	X	X																										
		10.0 – 15.0 ft										X	X	X	X	X	X	X	X																										
		15.0 – 20.0 ft																																											
		20.0 – 25.0 ft																																											
		25.0 – 30.0 ft										X	X	X	X	X	X	X	X																										
		30.0 – 35.0 ft																																											
		35.0 – 40.0 ft																																											
		40.0 – 45.0 ft																																											
		45.0 – 50.0 ft										X	X	X	X	X	X	X	X																										
		50.0 – 55.0 ft																																											
		55.0 – 60.0 ft																																											
		60.0 – 65.0 ft																																											
		65.0 – 70.0 ft										X	X	X	X	X	X	X	X																										
		70.0 – 75.0 ft																																											
		75.0 – 80.0 ft																																											
		80.0 – 85.0 ft										X	X	X	X	X	X	X	X																										
		85.0 – 90.0 ft																																											
		90.0 – 95.0 ft																																											
		95.0 – 100.0 ft																																											
		100.0 – 105.0 ft																																											
		105.0 – 110.0 ft										X	X	X	X	X	X	X	X																										
		110.0 – 115.0 ft																																											
		115.0 – 120.0 ft																																											
		120.0 – 125.0 ft																																											
		125.0 – 130.0 ft										X	X	X	X	X	X	X	X																										
		130.0 – 135.0 ft																																											
		135.0 – 140.0 ft																																											
Fracture Contingency Sample												C	C	C	C	C	C	C	C																										
													C	C	C	C	C	C	C	C																										
													C	C	C	C	C	C	C	C																										
													C	C	C	C	C	C	C	C																										
													C	C	C	C	C	C	C	C																										
													C	C	C	C	C	C	C	C																										
Arg Borehole 30 deg	2	0.0 – 5.0 ft																																												
		5.0 – 10.0 ft										X	X	X	X	X	X	X	X																										

Table F.8-IV

MDA A GEOPHYSICAL

MINERALOGICAL DETERMINATIONS

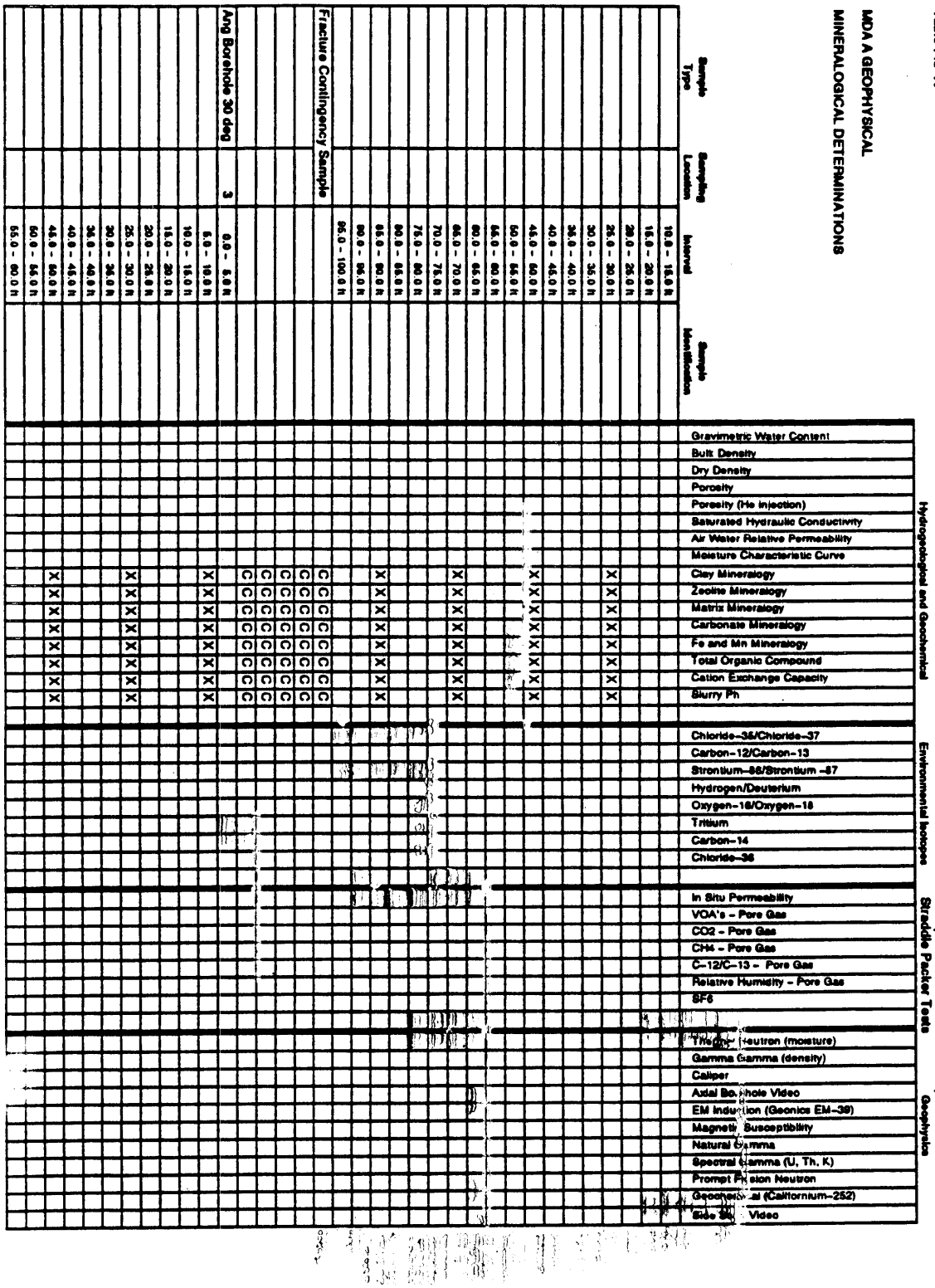


Table F.8-IV

MDA A GEOPHYSICAL

MINERALOGICAL DETERMINATIONS

Sample Type	Sampling Location	Interval	Sample Identification	Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (Hg injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Chloride-36/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium -87	Hydrogen/Deuterium	Oxygen-18/Oxygen-18	Tritium	Carbon-14	Chloride-36	In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6	Thermal Neutron (moisture)	Gamma (density)	Caliper	Acoustic Velocity	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Doscan (mical (Californium-252)	Side Scan Video
		60.0 – 65.0 ft										X	X	X	X	X	X	X	X																										
		65.0 – 70.0 ft										X	X	X	X	X	X	X	X																										
		70.0 – 75.0 ft																																										
		75.0 – 80.0 ft																																										
		80.0 – 85.0 ft										X	X	X	X	X	X	X	X																										
		85.0 – 90.0 ft										X	X	X	X	X	X	X	X																										
		90.0 – 95.0 ft																																										
		95.0 – 100.0 ft																																										
		100.0 – 105.0 ft										X	X	X	X	X	X	X	X																										
		105.0 – 110.0 ft										X	X	X	X	X	X	X	X																										
		110.0 – 115.0 ft																																										
		115.0 – 120.0 ft																																										
		120.0 – 125.0 ft																																										
		125.0 – 130.0 ft										X	X	X	X	X	X	X	X																										
		130.0 – 135.0 ft																																										
		135.0 – 140.0 ft																																										
		140.0 – 145.0 ft										X	X	X	X	X	X	X	X																										
		145.0 – 150.0 ft										X	X	X	X	X	X	X	X																										
		150.0 – 155.0 ft																																										
		155.0 – 160.0 ft																																										
		160.0 – 165.0 ft										X	X	X	X	X	X	X	X																										
		165.0 – 170.0 ft										X	X	X	X	X	X	X	X																										
		170.0 – 175.0 ft																																										
		175.0 – 180.0 ft																																										
		180.0 – 185.0 ft										X	X	X	X	X	X	X	X																										
		185.0 – 190.0 ft										X	X	X	X	X	X	X	X																										
		190.0 – 195.0 ft																																										
		195.0 – 200.0 ft																																										
Fracture Contingency Sample												C	C	C	C	C	C	C	C																										
												C	C	C	C	C	C	C	C																										
												C	C	C	C	C	C	C	C																										
												C	C	C	C	C	C	C	C																										
Vertical Borehole	4	0.0 – 5.0 ft												X	X	X	X	X	X	X	X																								
		5.0 – 10.0 ft												X	X	X	X	X	X	X	X																								

Table F.8-IV

MDA A GEOPHYSICAL

MINERALOGICAL DETERMINATIONS

Sample Type	Sampling Location	Interval	Sample Identification	Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (He injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Chloride-35/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium -87	Hydrogen/Deuterium	Oxygen-18/Oxygen-16	Tritium	Carbon-14	Chloride-36	In Situ Permeability	VOA's - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6	Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Side Scan Video
		10.0 - 15.0 ft																																										
		15.0 - 20.0 ft																																										
		20.0 - 25.0 ft																																										
		25.0 - 30.0 ft										X	X	X	X	X	X	X	X																									
		30.0 - 35.0 ft																																										
		35.0 - 40.0 ft																																										
		40.0 - 45.0 ft																																										
		45.0 - 50.0 ft										X	X	X	X	X	X	X	X																									
Fracture Contingency Sample																																												
Vertical Borehole	5	5.0 - 10.0 ft										X	X	X	X	X	X	X	X		C	C																					
		10.0 - 15.0 ft										X	X	X	X	X	X	X	X		C	C																					
		15.0 - 20.0 ft																																										
		20.0 - 25.0 ft																																										
		25.0 - 30.0 ft										X	X	X	X	X	X	X	X																									
		30.0 - 35.0 ft																																										
		35.0 - 40.0 ft																																										
		40.0 - 45.0 ft										X	X	X	X	X	X	X	X																									
		45.0 - 50.0 ft																																										
Fracture Contingency Sample																																												
Vertical Borehole	6	6.0 - 10.0 ft										X	X	X	X	X	X	X	X		C	C																					
		10.0 - 15.0 ft																																										
		15.0 - 20.0 ft																																										
		20.0 - 25.0 ft																																										
		25.0 - 30.0 ft										X	X	X	X	X	X	X	X																									
		30.0 - 35.0 ft																																										
		35.0 - 40.0 ft																																										
		40.0 - 45.0 ft										X	X	X	X	X	X	X	X																									
		45.0 - 50.0 ft																																										
Fracture Contingency Sample																																												

Hydrogeological and Geochemical

Environmental Isotope

Open Hole Tests: Straddle Packer Tests

Open Hole Tests: Geophysics

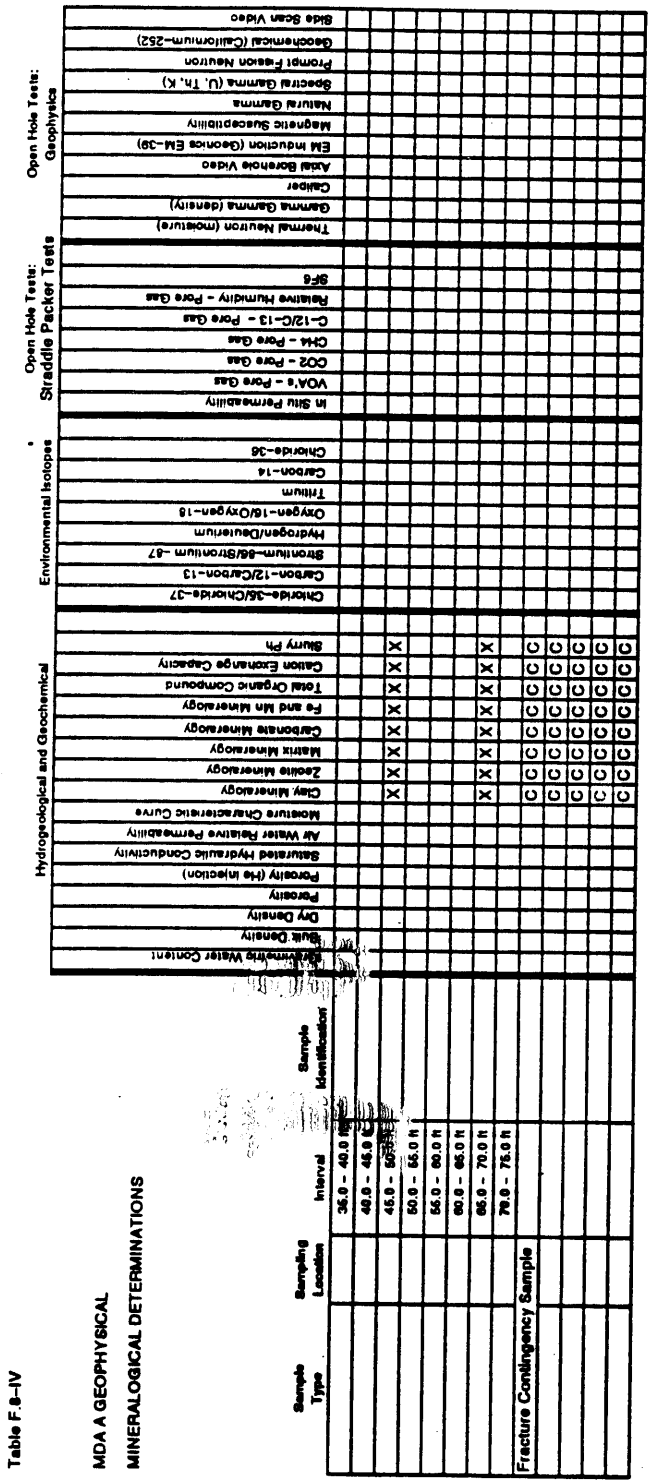


Table F.8–IV

MDA A GEOPHYSICAL

MINERALOGICAL DETERMINATIONS

Sample Type	Sampling Location	Interval	Sample Identification	Hydrogeological and Geochemical: Gravimetric Water Content	Bulk Density	Dry Density	Porosity	Porosity (He Injection)	Saturated Hydraulic Conductivity	Air Water Relative Permeability	Moisture Characteristic Curve	Clay Mineralogy	Zeolite Mineralogy	Matrix Mineralogy	Carbonate Mineralogy	Fe and Mn Mineralogy	Total Organic Compound	Cation Exchange Capacity	Slurry Ph	Environmental Isotopes: Chloride-36/Chloride-37	Carbon-12/Carbon-13	Strontium-86/Strontium -87	Hydrogen/Deuterium	Oxygen-18/Oxygen-18	Tritium	Carbon-14	Chloride-36	Open Hole Tests: Straddle Packer Tests: In Situ Permeability	VOA'S - Pore Gas	CO2 - Pore Gas	CH4 - Pore Gas	C-12/C-13 - Pore Gas	Relative Humidity - Pore Gas	SF6		Open Hole Tests: Geophysics: Thermal Neutron (moisture)	Gamma Gamma (density)	Caliper	Axial Borehole Video	EM Induction (Geonics EM-39)	Magnetic Susceptibility	Natural Gamma	Spectral Gamma (U, Th, K)	Prompt Fission Neutron	Geochemical (Californium-252)	Slide Scan Video
		35.0 – 40.0 ft										C	C	C	C	C	C	C	C																									
		40.0 – 45.0 ft										C	C	C	C	C	C	C	C																									
		45.0 – 50.0 ft		X								X	X	X	X	X	X	X	X																									
		50.0 – 55.0 ft		X								X	X	X	X	X	X	X	X																									
		55.0 – 60.0 ft																																									
		60.0 – 65.0 ft																																										
		65.0 – 70.0 ft		X								X	X	X	X	X	X	X	X																									
		70.0 – 75.0 ft																																									
Fracture Contingency Sample												C	C	C	C	C	C	C	C																									
												C	C	C	C	C	C	C	C																									
												C	C	C	C	C	C	C	C																									
												C	C	C	C	C	C	C	C																									
												C	C	C	C	C	C	C	C																									

Table F.8–V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA A.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening:	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Measurements: Gross Alpha	Field Measurements: Gamma Spectrometry	Field Measurements: Tritium	Field Measurements: Volatile Organics	Field Measurements: PCB	Field Measurements: Soil Moisture	Field Measurements:	Field Measurements:	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 8080)	Laboratory Analysis: TCLP Metals	Laboratory Analysis:	Laboratory Analysis:
Subsurface samples at MDA A																																		
Vertical Borehole	1	0.0 – 5.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		5.0 – 10.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		10.0 – 15.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		25.0 – 30.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
Field Duplicate		30.0 – 35.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		35.0 – 40.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		40.0 – 45.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		45.0 – 50.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		50.0 – 55.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		55.0 – 60.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		60.0 – 65.0 ft						X	X		X	X	X						X			X	X	X	X	X	X	X	X	X				
		65.0 – 70.0 ft						X	X		X	X	X	X	X				X			X	X	X	X	X	X	X	X	X				
		70.0 – 75.0 ft						X	X		X	X	X	X	X				X			X	X	X	X	X	X	X	X	X				
Fracture Contingency Sampling																						C	C	C	C	C	C	C	C	C				
Rinsate Blank																						C	C	C	C	C	C	C	C	C				
Field Blank																						C	C	C	C	C	C	C	C	C				
Trip Blank																						C	C	C	C	C	C	C	C	C				

Table F.8–V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA A.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low–Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha	Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals				
Vertical Borehole	2	0.0 – 5.0 ft						X	X	X	X	X						X			X	X	X	X		X	X	X	X					
		5.0 – 10.0 ft						X	X	X	X	X						X			X	X	X	X		X	X	X	X					
		10.0 – 15.0 ft						X	X	X	X	X						X			X	X	X	X		X	X	X	X					
		15.0 – 20.0 ft						X	X	X	X	X						X			X	X	X	X		X	X	X	X					
		20.0 – 25.0 ft						X	X	X	X	X						X			X	X	X	X		X	X	X	X					
		25.0 – 30.0 ft						X	X	X	X	X						X			X	X	X	X		X	X	X	X					
Field Duplicate																																		
		30.0 – 35.0 ft						X	X	X	X	X						X			X	X	X	X		X	X	X	X					
		35.0 – 40.0 ft						X	X	X	X	X						X			X	X	X	X		X	X	X	X					
		40.0 – 45.0 ft						X	X	X	X	X						X			X	X	X	X		X	X	X	X					
		45.0 – 50.0 ft						X	X	X	X	X						X			X	X	X	X		X	X	X	X					
		50.0 – 55.0 ft						X	X	X	X	X						X			X	X	X	X		X	X	X	X					
		55.0 – 60.0 ft						X	X	X	X	X						X			X	X	X	X		X	X	X	X					
		60.0 – 65.0 ft						X	X	X	X	X						X			X	X	X	X		X	X	X	X					
		65.0 – 70.0 ft						X	X	X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X					
		70.0 – 75.0 ft						X	X	X	X	X	X	X	X	X		X			C	C	C	C		C	C	C	C					
Fracture Contingency Sampling																					C	C	C	C		C	C	C	C					
																					C	C	C	C		C	C	C	C					
																					C	C	C	C		C	C	C	C					
																					C	C	C	C		C	C	C	C					
																					X	X	X	X		X	X	X	X					
Rinsate Blank																											X	X	X					
Field Blank																											X							
Trip Blank																																		
Vertical Borehole	3	0.0 – 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					
		5.0 – 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X					

Table F.8-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA A.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Field Screening: Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Field Laboratory Measurements: Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Laboratory Analysis: Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals		
		10.0 – 15.0 R						X	X		X	X	X	X					X			X	X	X	X	X	X	X	X	X			
		15.0 – 20.0 R						X	X		X	X	X	X					X			X	X	X	X	X	X	X	X	X			
		20.0 – 25.0 R						X	X		X	X	X	X					X			X	X	X	X	X	X	X	X	X			
		25.0 – 30.0 R						X	X		X	X	X	X					X			X	X	X	X	X	X	X	X	X			
Field Duplicate																																		
		30.0 – 35.0 R						X	X		X	X	X	X					X			X	X	X	X	X	X	X	X	X			
		35.0 – 40.0 R						X	X		X	X	X	X					X			X	X	X	X	X	X	X	X	X			
		40.0 – 45.0 R						X	X		X	X	X	X					X			X	X	X	X	X	X	X	X	X			
		45.0 – 50.0 R						X	X		X	X	X	X					X			X	X	X	X	X	X	X	X	X			
		50.0 – 55.0 R						X	X		X	X	X	X					X			X	X	X	X	X	X	X	X	X			
		55.0 – 60.0 R						X	X		X	X	X	X					X			X	X	X	X	X	X	X	X	X			
		60.0 – 65.0 R						X	X		X	X	X	X	X	X			X			X	X	X	X	X	X	X	X	X			
		65.0 – 70.0 R						X	X		X	X	X	X	X	X			X			X	X	X	X	X	X	X	X	X			
		70.0 – 75.0 R						X	X		X	X	X	X	X	X			X			X	X	X	X	X	X	X	X	X			
Fracture Contingency Sampling																						C	C	C	C	C	C	C	C	C			
Rinsate Blank																						C	C	C	C	C	C	C	C	C			
Field Blank																						C	C	C	C	C	C	C	C	C			
Trip Blank																						C	C	C	C	C	C	C	C	C			
Vertical Borehole	4	0.0 – 5.0 R		X	X	X	X	X	X		X	X	X	X	X	X			X			X	X	X	X		X	X	X	X			
		5.0 – 10.0 R		X	X	X	X	X	X		X	X	X	X	X	X			X			X	X	X	X		X	X	X	X			
		10.0 – 15.0 R		X	X	X	X	X	X		X	X	X	X	X	X			X			X	X	X	X		X	X	X	X			
		15.0 – 20.0 R		X	X	X	X	X	X		X	X	X	X	X	X			X			X	X	X	X		X	X	X	X			

Table F.8-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA A.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys				Field Screening						Field Laboratory Measurements								Laboratory Analysis													
				Gross Gamma	Low-Energy Gamma	Electromagnetic	Land Survey	Gross Gamma	Gross Alpha		Organic Vapor	Combustible Gas/Oxygen	Lithological Logging	Gross Alpha	Gamma Spectrometry	Tritium	Volatile Organics	PCB	Soil Moisture			Gamma Spectrometry	Tritium	Total Uranium	Isotopic Plutonium	Isotopic Uranium	Strontium 90	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCB (SW 8080)	TCLP Metals			
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		25.0 – 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
Field Duplicate																						X	X	X	X		X	X	X	X				
		30.0 – 35.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		35.0 – 40.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		40.0 – 45.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		45.0 – 50.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		50.0 – 55.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		55.0 – 60.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		60.0 – 65.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		65.0 – 70.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X				
		70.0 – 75.0 ft						X	X		X	X	X	X	X	X	X		X			X	X	X	X		X	X	X	X				
Fracture Contingency Sampling																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
																						C	C	C	C		C	C	C	C				
Rinsate Blank																						X	X	X	X		X	X	X	X				
Field Blank																												X	X	X				
Trip Blank																												X						
Vertical Borehole	5	0.0 – 5.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		5.0 – 10.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		10.0 – 15.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		15.0 – 20.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		20.0 – 25.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				
		25.0 – 30.0 ft						X	X		X	X	X						X			X	X	X	X		X	X	X	X				

Table F.8-V

SCREENING AND ANALYSIS FOR SUBSEQUENT SUBSURFACE INVESTIGATIONS AT MDA A.

Sample Type	Sampling Location	Interval	Sample Identification		
Field Duplicate				Field Surveys	Gross Gamma
					Low-Energy Gamma
					Electromagnetic
					Land Survey
		30.0 - 35.0 ft		Field Screening	Gross Gamma
		35.0 - 40.0 ft			Gross Alpha
		40.0 - 45.0 ft			
		45.0 - 50.0 ft			Organic Vapor
		50.0 - 55.0 ft			Combustible Gas/Oxygen
		55.0 - 60.0 ft			Lithological Logging
		60.0 - 65.0 ft		Field Laboratory Measurements	Gross Alpha
		65.0 - 70.0 ft			Gamma Spectrometry
		70.0 - 75.0 ft			Tritium
Fracture Contingency Sampling					Volatile Organics
					PCB
					Soil Moisture
				Laboratory Analysis	Gamma Spectrometry
					Tritium
					Total Uranium
					Isotopic Plutonium
					Isotopic Uranium
					Strontium 90
					VOA (SW 8240)
					Semivolatiles (SW 8270)
					Metals (SW 6010)
					PCB (SW 8080)
					TCLP Metals
Rinsate Blank					
Field Blank					
Trip Blank					

TAB

APPENDIX F
ANALYTICAL TABLES

This appendix contains detailed tables identifying the sample screening and analysis required for each investigation planned at the MDAs addressed in Chapter 16. Due to the large number of pages, these tables are placed herein. Tables for each MDA are found in Appendix F as follows:

MDA	Chapter 16 Section	Location of Appendix F Analytical Tables
B	16.2	F.2
T	16.3	F.3
U	16.6	F.6
V	16.7	F.7
A	16.8	F.8

Table F.2-1

SCREENING AND ANALYSIS FOR INITIAL SURFACE INVESTIGATIONS AT MDA B.

Sample Type	Sampling Location	Interval	Sample Identification	Field Surveys: Gross Gamma	Field Surveys: Low-Energy Gamma	Field Surveys: Electromagnetic	Field Surveys: Land Survey	Field Screening: Gross Gamma	Field Screening: Gross Alpha	Field Screening: Organic Vapor	Field Screening: Combustible Gas/Oxygen	Field Screening: Lithological Logging	Field Laboratory Measurements: Gross Alpha	Field Laboratory Measurements: Gamma Spectrometry	Field Laboratory Measurements: Tritium	Field Laboratory Measurements: Volatile Organics	Field Laboratory Measurements: PCB	Field Laboratory Measurements: Soil Moisture	Laboratory Analysis: Gamma Spectrometry	Laboratory Analysis: Tritium	Laboratory Analysis: Total Uranium	Laboratory Analysis: Isotopic Plutonium	Laboratory Analysis: Isotopic Uranium	Laboratory Analysis: Strontium 90	Laboratory Analysis: VOA (SW 8240)	Laboratory Analysis: Semivolatiles (SW 8270)	Laboratory Analysis: Metals (SW 6010)	Laboratory Analysis: PCB (SW 1080)	Laboratory Analysis: TCLP Metals
Surface Sampling at MDA B																													
Surface Soil Sample	1	0.0 - 6.0 in		X	X		X	X	X																				
	2	0.0 - 6.0 in						X	X										X	X	X	X	X	X	X	X	X		
	3	0.0 - 6.0 in						X	X										X	X	X	X	X	X	X	X	X		
	4	0.0 - 6.0 in						X	X										X	X	X	X	X	X	X	X	X		
	5	0.0 - 6.0 in						X	X										X	X	X	X	X	X	X	X	X		
	6	0.0 - 6.0 in						X	X										X	X	X	X	X	X	X	X	X		
	7	0.0 - 6.0 in						X	X										X	X	X	X	X	X	X	X	X		
Trip Blank	8	0.0 - 6.0 in						X	X										X	X	X	X	X	X	X	X	X		
Field Duplicate	9	0.0 - 6.0 in						X	X										X	X	X	X	X	X	X	X	X		
	10	0.0 - 6.0 in						X	X										X	X	X	X	X	X	X	X	X		
	11	0.0 - 6.0 in						X	X										X	X	X	X	X	X	X	X	X		
	12	0.0 - 6.0 in						X	X										X	X	X	X	X	X	X	X	X		
	13	0.0 - 6.0 in						X	X										X	X	X	X	X	X	X	X	X		
	14	0.0 - 6.0 in						X	X										X	X	X	X	X	X	X	X	X		
	15	0.0 - 6.0 in						X	X										X	X	X	X	X	X	X	X	X		
	16	0.0 - 6.0 in						X	X										X	X	X	X	X	X	X	X	X		
	17	0.0 - 6.0 in						X	X										X	X	X	X	X	X	X	X	X		
Rinsate Blank																													
Field Blank	18	0.0 - 6.0 in						X	X										X	X	X	X	X	X	X	X	X		
	19	0.0 - 6.0 in						X	X										X	X	X	X	X	X	X	X	X		
	20	0.0 - 6.0 in						X	X										X	X	X	X	X	X	X	X	X		

APPENDIX G

DETAILED MAPS OF TA-21 OU AND OF ASSOCIATED SWMUS

This appendix contains four maps of the TA-21 OU. One shows the TA-21 OU at 1:2400 (i.e., 1 in. equals 200 ft) with a 1000-ft buffer around it. The remaining three maps show the western, central, and eastern portions of the TA-21 OU, respectively. All maps have TA-21 possible and probable SWMU boundaries labeled. Probable boundaries are defined as those areas where, from existing data, contamination is probably present. Possible boundaries are given for those SWMUs where contamination may or may not be present. SWMUs addressing surface soil contamination from stack emissions (21-007, -008, -019, -020, -021) are not specifically identified on these maps because they address possible contamination over the entire OU.