RFI Work Plan for Operable Unit 1082

Environmental Restoration Program

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Executive Summary

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EXECUTIVE SUMMARY

Purpose

The primary purposes of this Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) work plan are to determine if a release has occurred, and/or the nature and extent of releases of hazardous waste or hazardous constituents from solid waste management units (SWMUs) in Operable Unit (OU) 1082, and to determine the need for corrective measures studies (CMSs). Secondly, this document satisfies part of the regulatory requirements contained in Los Alamos National Laboratory's (the Laboratory's) permit to operate under RCRA.

OU 1082 includes active Technical Areas (TAs) 11, 16, 28, and 37. These TAs are located in Los Alamos County. There are 415 potential release sites (PRSs) in OU 1082, which are located on land owned by the Department of Energy (DOE).

The Hazardous and Solid Waste Amendments (HSWA) Module, Module VIII of the permit, and schedules of the permit issued by the Environmental Protection Agency (EPA), address potential corrective action requirements for SWMUs at the Laboratory. These permit requirements are addressed by the Department of Energy's Environmental Restoration (ER) Program at the Laboratory.

This document describes the field sampling plans that will be followed to implement the RFI at OU 1082. This document, together with nine work plans to be submitted to the EPA in 1993, and nine work plans previously submitted, meets the requirement in the HSWA Module to address a cumulative percentage of the Laboratory's SWMUs in RFI work plans by August 27, 1993.

Installation Work Plan

The HSWA Module requires the Laboratory to prepare an installation work plan (IWP) to describe the Laboratory-wide system for accomplishing the RFI, corrective measures studies, and corrective measures. This requirement was satisfied by submitting the Installation Work Plan for Environmental Restoration to the EPA in November 1990. That document is updated annually, and the most recent revision (Revision 2) was published in

November 1992. The IWP identifies the Laboratory's PRSs, describes their aggregation into twenty-four OUs, and presents the Laboratory's overall management plan and technical approach for meeting requirements of the HSWA Module. When information relevant to this work plan has already been provided in the IWP, the reader is referred to a version of that document.

Both the IWP and this work plan address radioactive materials and other hazardous substances not subject to RCRA. Sites that were not defined as SWMUs but may potentially contain hazardous substances, including non-RCRA materials, are called areas of concern (AOCs). The term PRS is the generic name for both SWMUs and AOCs.

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

Background

The technical areas composing OU 1082 were established during World War II to develop, fabricate (cast and machine), and test explosive components employed in the United States' nuclear weapons development and testing program. Present use of the technical areas is essentially unchanged. The facilities have undergone extensive expansion and upgrading as explosive and manufacturing technologies have advanced. Almost all of the work conducted at OU 1082 during World War II was in support of developing, testing, and producing explosive charges for the implosion method.

Development and testing of explosive formulations, fabrication of explosive charges, and assembly of weapon test devices have continued to the present. A wide variety of explosives are currently used.

The PRSs in OU 1082 fall into three general categories as follows:

- surface contamination areas where contaminants were released at, or to, the land surface, such as debris from a firing site, surface spills, residues from burning operations, and surface solid waste disposal areas;
- surface and subsurface liquid releases, such as discharges from septic systems and industrial drainage systems; and,
- subsurface contamination areas, such as material disposal areas (MDAs) and landfills where solid wastes were placed or buried as a result of programmatic experiments or disposal of wastes from those experiments.

The predominant potential contaminants of concern at OU 1082 are high explosives (HE) and the burn, detonation, and degradation products of HE, including barium. Other potential contaminants of major concern associated with former Laboratory operations include uranium, beryllium, plutonium, silver, lead, mercury, photographic chemicals, cyanide, and solvents.

Technical Approach

For the purposes of designing and/or implementing the sampling and analysis plans described in this work plan, most PRSs are grouped into aggregates. However, selected PRSs are investigated individually. This work plan presents the description and operating history of each PRS or aggregate, together with an evaluation of the existing data, if any, in order to develop a preliminary conceptual exposure model for the site. For some sites, no further action (NFA) can be proposed on the basis of this review; these sites are discussed in Chapter 6 of this work plan. For other, currently active sites, this review is sufficient to determine that investigation (and remediation, if required) may be deferred until the site is decommissioned; these sites are also discussed in Chapter 6. The remaining sites, for which RFI fieldwork and/or voluntary corrective actions (VCAs) are proposed, are discussed in Chapter 5.

This work plan's technical approach to field sampling includes collecting data to determine if sites present a potential hazard or should be recommended for NFA, refining the conceptual exposure models for PRSs or aggregates to a level of detail sufficient for a baseline risk assessment, and evaluating remedial alternatives (including VCAs). A phased approach to the RFI is used to ensure that any environmental impacts associated with past and present activities are investigated in a manner that is cost-effective and complies with the HSWA Module. This phased approach permits intermediate data evaluation, with opportunities for additional sampling, if required.

At PRSs for which there are no existing data and little or no historical evidence that a release has occurred, the Phase I sampling strategy for OU 1082 will focus on determining the presence or absence of hazardous and/or radioactive contaminants. If contaminants are detected at concentrations above conservative screening action levels, a baseline risk assessment may be required or a VCA may be proposed. The baseline risk assessment would be used to determine the need for a corrective measures study or VCA. If the data collected during Phase I are insufficient to support a baseline risk assessment, additional RFI Phase II sampling will be undertaken to characterize the nature and extent of the release in more detail.

For some PRSs in OU 1082, there are existing data and/or strong historical evidence to support the hypothesis that a release has occurred. In these cases, the existing information has been evaluated to determine whether there is a need for a baseline risk assessment and/or the evaluation of remedial alternatives. If the information for these sites is deemed insufficient, Phase I data will be collected to refine the site conceptual exposure model.

To ensure that the right type, amount, and quality of data are collected, data quality objectives to support the required decisions are developed for the RFI Phase I sampling and analysis plans. Fieldwork for many sites includes field surveys and field screening of samples upon which the selection of samples for laboratory analysis will be based. Laboratory analyses will be performed in mobile and fixed analytical laboratories.

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

Schedule, Costs, and Reports

The RFI fieldwork described in this document and two subsequent work plans will require five years (Fig. ES-1) to complete. A single phase of fieldwork is expected to be sufficient to complete the RFI for most PRSs; however, a second phase will occur if warranted by the results of the first phase. This second phase is built into the five-year estimate. Because of the large number of PRSs in OU 1082, additional field activities will be defined in work plans deliverable in 1994 and 1995.

Cost estimates for baseline activities for OU 1082 are provided in Table ES-1. The estimated escalated cost for implementing the RFI and reporting is $73.1 million. If a CMS is necessary, the estimated escalated cost for implementation and reporting is $5.8 million. The total estimated escalated cost for the corrective action process at OU 1082 is approximately $0.3 million.

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

- a partial summary of the results of initial site characterization activities;
- vehicles for proposing modifications to the sampling plans suggested by the initial findings;
- work plans that describe the next phase of sampling, when such sampling is required;
- vehicles for recommending VCA or no further action as mechanisms for delisting PRSs shown by the RFI to have acceptable health-based risk levels; and,
- summary reports of the sampling plans.

ACTIVITY ID	ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH
07016M050	1082: Start bench/pilot studies	1 Oct 92	
07012M131	1082: EPA/NMED draft complete		25 May 93
07012M151	1082: RFI work plan complete		30 Sep 93
07013M000	1082: Start RFI	1 Oct 93	
07012M132	1082: EPA/NMED draft complete		7 Jul 94
07012M152	1082: RFI work plan complete		15 Dec 94
07012M133	1082: EPA/NMED draft complete		7 Jul 95
07012M153	1082: RFI work plan complete		15 Dec 95
07014M300	1082: Start developing RFI report	4 Sep 96	
07014M115	1082: DOE draft of report complete		12 Jan 98
07014M130	1082: EPA/NMED draft of Phase I report		27 Mar 98
07013M500	1082: RFI fieldwork complete		16 Oct 98
07014M315	1082: DOE draft of RFI report		3 Sep 99
07014M330	1082: EPA/NMED draft; complete		19 Nov 99
07015M100	1082: Start development of CMS	22 Nov 99	
07014M350	1082: Revised RFI report complete		28 Feb 00
07028M000	1082: Start VCA soils remediation	1 Mar 00	
07015M105	1082: Receipt of EPA CMS notification		28 Mar 00
07015M115	1082: DOE draft of CMS plan complete		24 Apr 00
07015M130	1082: EPA/NMED draft of CMS plan		21 Jun 00
07015M150	1082: EPA approved CMS plan		13 Oct 00
07016M100	1082: Start CMS field study	16 Oct 00	
07016M150	1082: CMS field study complete		28 Aug 01
07017M100	1082: Start development of CMS	29 Aug 01	
07017M115	1082: DOE draft of CMS report		11 Jan 02
07017M130	1082: EPA/NMED draft; complete		28 Mar 02
07017M135	1082: EPA notification of CMI		30 May 02
07017M150	1082: Assessment complete		27 Jun 02
07017M450	1082: Revised CMS report complete		27 Jun 02
07023M000	1082: Start corrective measure	30 Oct 05	
07023M500	1082: Corrective measures implement		30 Sep 10
07028M500	1082: VCA soils remediation complete		28 Sep 18
07028M750	1082: Project complete		28 Sep 18

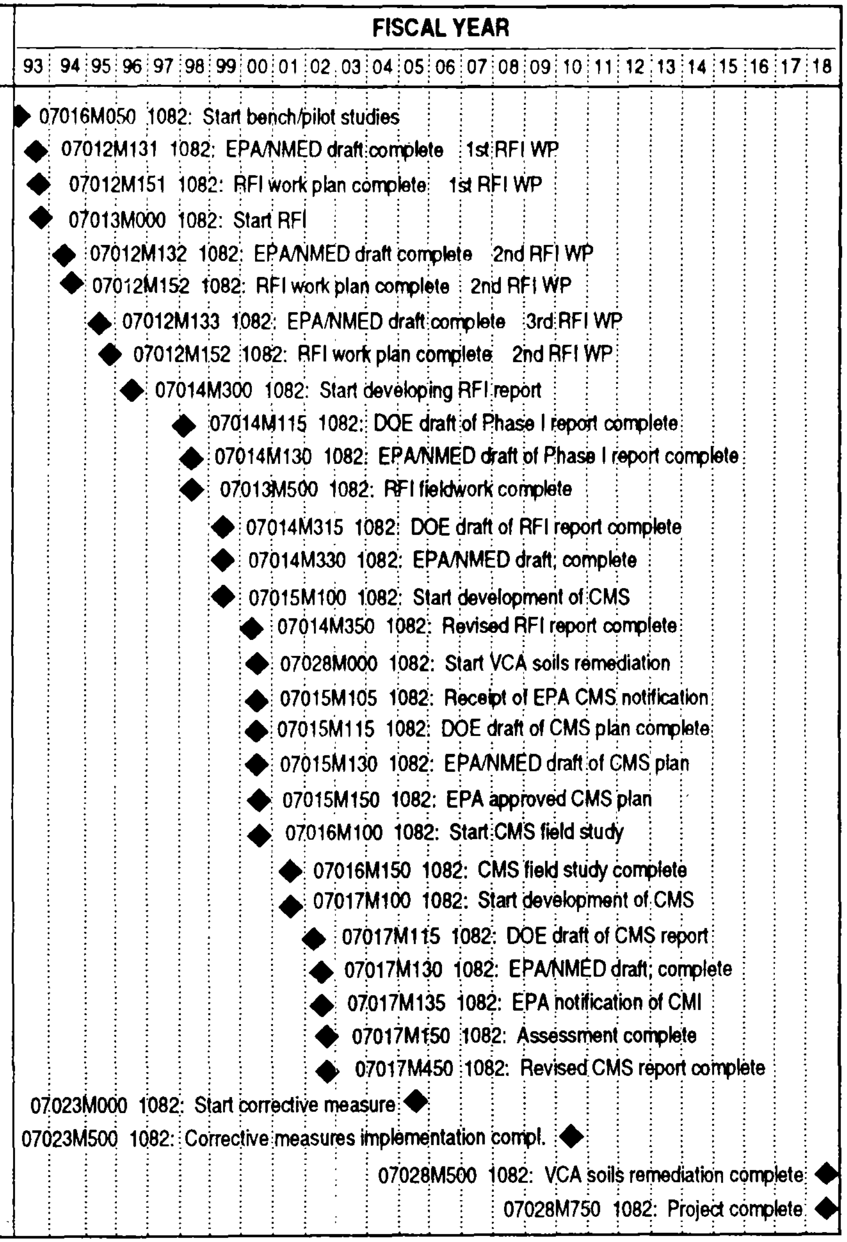

Fig. ES-1. RFI/CMS milestone chart for OU 1082.

TABLE ES-1

ESTIMATED COSTS OF BASELINE ACTIVITIES AT OU 1082 (ASSESSMENT PHASE ONLY)

TASK	BUDGET ($K)	SCHEDULED START	SCHEDULED FINISH
RFI work plans	6 199	10/01/91	07/07/95
RFI	42 723	10/01/93	10/16/98
RFI report	9 618	09/04/96	02/28/00
CMS plan	1 537	11/22/99	10/13/00
CMS	1 343	10/01/92	08/28/01
CMS report	1 388	08/29/01	06/27/02
Activity data sheet (ADS) management	1 916	10/01/91	07/27/02
Voluntary corrective action	236	10/01/91	09/30/99
Total	64 960		
Estimate to completion	63 485		
Escalation	14 202		
Prior years	1 475		
Total at completion	79 162		

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

Public Involvement

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

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ABBREVIATIONS AND ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
ADS	Activity data sheet
AEA	Atomic Energy Act
AEC	US Atomic Energy Commission
ALARA	As low as reasonably achievable
ANSI	American National Standards Institute
AOC	Area of concern
CDC	Centers for Disease Control
CEARP	Comprehensive Environmental Assessment and Response Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CGI	Combustible gas indicator
CMI	Corrective measures implementation
CMS	Corrective measures study
COC	Contaminant of concern
cpm	Counts per minute
D&D	Decontamination and decommissioning
DA	Deferred action
dB	Decibel
DNB*	Dinitrobenzene
DNT*	Dinitrotoluene
DOE	US Department of Energy
DOE/AL	US Department of Energy/Albuquerque Operations Office
DQO	Data quality objective
EIS	Environmental impact statement
EM	Environmental Management (Division)
EPA	US Environmental Protection Agency
ER	Environmental Restoration (Program)
FID	Flame ionization detector
FY	Fiscal year
GC	Gas chromatography
HAZWOP	Hazardous Waste Operations Program
HAZWOPER	Hazardous Waste Operations and Emergency Response
HE	High explosive(s)
HMX*	Cyclotetramethylenetetranitramine
HPLC	High-pressure liquid chromatography
HSWA	Hazardous and Solid Waste Amendments
IDLH	Immediately dangerous to life and health
IWP	Installation work plan
kV	Kilovolt
LAAO	Los Alamos Area Office (a branch of the Department of Energy)
LANL	Los Alamos National Laboratory
LASL	Los Alamos Scientific Laboratory (the Laboratory before January 1, 1981)
MCL	Maximum contaminant level
MDA	Material disposal area
MSDWF	Mixed-waste storage and disposal facility
NEPA	National Environmental Policy Act
NFA	No further action
NIOSH	National Institute of Occupational Safety and Health
NMED	New Mexico Environment Department (NMEID prior to April 1991)
NPDES	National Pollutant Discharge Elimination System

OEL	Occupational exposure limit
OSHA	Occupational Safety and Health Administration
OU	Operable unit
OUPL	Operable unit project leader
PAH	Polycyclic aromatic hydrocarbon
PBX	Plastic-bonded explosives
PCB	Polychlorinated biphenyl
PCOC	Potential contaminant of concern
PEL	Permissible exposure limit
PETN*	Pentaerythritol tetranitrate
PID	Photoionization detector
ppb	Parts per billion
PPE	Personal protective equipment
PRS	Potential release site
PVC	Polyvinyl chloride
QA	Quality assurance
QAPjP	Quality assurance project plan
QC	Quality control
QP	Quality procedure
RCRA	Resource Conservation and Recovery Act
RDX*	Cyclonitrite, cyclotrimethylenetrinitramine
RESRAD	Residual radioactive material
RFA	RCRA facility assessment
RfD	Reference dose
RFI	RCRA facility investigation
RME	Reasonable maximum exposed
RSD	Risk-specific dose
SAL	Screening action level
SARA	Superfund Amendments and Reauthorization Act
SOP	Standard operating procedure
SPCC	Spill Prevention Control and Countermeasure Plan
SSO	Site safety officer
SVOC	Semivolatile organic compount
SWMU	Solid waste management unit
TA	Technical area
TAL	Target analyte list
TATB*	Triaminotrinitrobenzene
TCL	Target compound list
TLD	Thermoluminescent dosimeter
TLV	Threshold limit value
TNB*	Trinitrobenzene
TNT*	Trinitrotoluene
TPH	Total petroleum hydrocarbons
TSCA	Toxic Substances Control Act
TSD	Treatment, storage, disposal
UST	Underground storage tank
VCA	Voluntary corrective action
VOC	Volatile organic compound
XRF	X-ray fluorescence

*Other HE abbrevations are provided in Appendix D

GLOSSARY OF TERMS

Adsorption Bonding, frequently ionic, of a substance to soil or other medium.

Aliquot A subsample removed from a sample (grab or composite) for analysis.

Alluvium Clay, silt, sand, gravel, or other rock materials transported by flowing water and deposited in fairly recent geologic time as sorted or semisorted sediments in riverbeds, estuaries, flood plains, lakes, shores, and fans at the base of mountain slopes.

Alpha radiation Ionizing radiation composed of alpha particles emitted in the radioactive decay of certain nuclides. It is the least penetrating of the three common types of radiation—alpha, beta, gamma—and can be blocked by a sheet of paper or outer dead layer of skin.

Analyte That which is being sought via analysis.

Aquifer An underground rock formation composed of materials such as sand, soil, or gravel that can store and supply groundwater to wells and springs. Most aquifers used in the United States are within a thousand feet of the earth's surface.

Background levels The distribution of concentrations of naturally occurring or widely distributed constituents in environmental media.

Bandelier Tuff A rhyolitic (a fine-grained equivalent of granite) tephra (volcanic ejecta including dust, ash, pumice, and bombs) that was erupted during formation of the Valles and Toledo Calderas in the Jemez volcanic field. It is divided into lower (Otowi, formed 1.5 million years ago) and upper (Tshirege, formed 1.1 million years ago) members, each associated with caldera collapse.

Baratol Pourable TNT mixtures with 10 - 20% barium nitrate.

Basalt A hard, dark volcanic rock.

Baseline risk assessment A risk assessment that uses an appropriate, site-specific exposure scenario but assumes no mitigating or corrective measures beyond those already in place.

Bedrock Solid rock that underlies all soil, sand, clay, gravel, and loose material on the earth's surface.

Beta radiation Emitted from a nucleus during fission. Beta radiation can be stopped by an inch of wood or a thin sheet of aluminum.

Betatron A fixed-radius magnetic induction electron accelerator capable of accelerating electrons to energies of a few million to a few hundred million electron volts.

Biased sampling A sampling plan based on an individual's judgment.

Cerros del Rio volcanic field Basalts and basaltic andesites that lie below the Otowi Member of the Bandelier Tuff.

Cleanup Actions undertaken during a removal or remedial response to physically remove or treat a hazardous substance that poses a threat or potential threat to human health and welfare and the environment and/or real and personal property.

Closure The actions prescribed by regulations implementing the Resource Conservation and Recovery Act that must be performed at a hazardous waste facility if it will no longer receive waste for treatment or disposal. The actions include, among many others, the placement of a final cover on the buried waste, the establishment of long-term groundwater monitoring program, and the filing of a notice in state property records that a hazardous waste facility has been closed at the location. The monitoring and property record notice are also termed post-closure actions.

Cloud chamber A device in which the formation of chains of droplets on ions generated by the passage of charged subatomic particles through a supersaturated vapor is used to detect such particles, to infer the presence of neutral particles, and to study certain nuclear reactions.

Colluvium Rock debris accumulated at the base of a cliff or slope, brought there principally by gravity.

Composition B Castable mixtures of Hexagen (RDX) and TNT in the proportion such as 60:40; some of them contain wax as additive.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) The Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986.

A federal law passed in 1980 and modified in 1986 by SARA. The acts created a special tax that goes into a trust fund, commonly known as Superfund, to investigate and clean up abandoned or uncontrolled hazardous waste sites. Under the program, EPA can either:

(1) pay for site cleanup when parties responsible for the contamination cannot be located or are unwilling or unable to perform the work, or

(2) take legal action to force parties responsible for site contamination to clean up the site or pay back the federal government for the cost of the cleanup.

Conceptual exposure model A conceptual model whose objects are qualitative or quantitative descriptions of sources of contamination, environmental transport pathways for contamination, and biota that may be impacted by contamination (called receptors) and whose relationships describe qualitatively or quantitatively the release of contamination from the sources, the movement of contamination along the pathways to the exposure points, and the uptake of contaminants by the receptors.

Conceptual model A mathematical model that represents, by means of symbolic objects and qualitative or quantitative relationships among them, a physical, biological, or social system.

Constituent Any compound or element present in environmental media, including both naturally occurring and man-made elements.

Contaminant, contaminant of concern (COC) Any constituent present in environmental media or on structural debris at a concentration above its screening action level.

Corrective measures study (CMS) The portion of a RCRA corrective action that is generally equivalent to a feasibility study taken under Superfund.

Dacite A fine-grained extrusive rock containing plagioclase, quartz, alkali feldspar, pyroxene, hornblende, and biotite

Data quality objectives (DQOs) Qualitative and quantitative statements that are developed before sampling begins to allow EPA to identify the quality of data that must be collected during Superfund actions.

Decision model A conceptual model whose objects are qualitative or quantitative descriptions of options (decision alternatives), knowledge (and uncertainties), and objectives (or values) with respect to a given problem.

Decommissioning The permanent removal from service of surface facilities and components necessary for preclosure activities in accordance with regulatory requirements and environmental policies.

Decontamination The removal of unwanted material (especially radioactive material) from the surface of or from within another material.

Deferred action Postponement of selection and implementation of corrective measures until a future date, usually following decommissioning of an active site.

Depleted uranium Uranium that contains less than 0.7 per cent of the fissionable isotope uranium-235.

Detection level The minimum concentration of a substance that can be measured with a 99% confidence that the analytical concentration is greater than zero.

Detection limit The smallest amount of a particular chemical that can be detected by a specific analytical instrument or method.

Dose The quantity of radiation absorbed, per unit of mass, by the body or by any portion of the body.

Eolian Pertaining to the wind, especially said of sediment deposition by the wind, of structures such as wind-formed ripple marks, or of erosion accomplished by the wind.

Ephemeral stream A stream or portion of a stream which flows only in direct response to precipitation. It receives little or no water from springs and no long-continued supply from melting snow or other sources. Its channel is at all times above the water table.

Evapotranspiration Discharge of water from the earth's surface to the atmosphere by evaporation from lakes, streams, and soil surfaces, and by transpiration from plants.

Field duplicate A second specimen collected as near as possible to one already included in the sample. In channel sediment sampling, field duplicates come from the same sediment catchment as another specimen.

Gamma radiation A form of electromagnetic, high-energy radiation emitted from a nucleus. Gamma rays are essentially the same as x-rays and require heavy shieldings, such as concrete or steel, to be stopped.

Gas chromatograph The analytical instrument used to perform qualitative and quantitative evaluations of sample mixtures of volatile substances.

Groundwater Water in a saturated zone or stratum beneath the surface of land or water.

Hazardous substance The term "hazardous substance" means (A) any substance designated to pursuant to Section 311(b)(2)(A) of the Federal Water Pollution Control Act, (B) any element, compound, mixture, solution, or substance designated pursuant to Section 102 of this act, (c) any hazardous waste having the characteristics identified under or listed pursuant to Section 3001 of the Solid Waste Disposal Act (but not including any waste the regulation of which under the SWDA has been suspended by an act of Congress, (D) any toxic pollutant listed under Section 307(a) of the FWPCA, (E) any hazardous air pollutant listed under Section 112 of the Clean Water Act, and (F) any imminently hazardous chemical substance or mixture with respect to which the administrator has taken action pursuant to the Toxic Substances Control Act. The term does not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance under Subparagraphs A through F of this paragraph, and the term does not include natural gas, natural gas liquids, liquefied natural gas, or synthetic gas usable for fuel (or mixtures of natural gas and such synthetic gas).

Hazardous waste A solid waste, or combination of solid waste, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may (1) cause, or significantly contribute to, an increase in mortality or an increase in serious, irreversible, or incapacitating reversible illness; or (2) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

High-efficiency air particulate (filter) An air filter capable of removing at least 99.97% of particulate material as small as 0.3 micron in diameter from an air stream.

Institutional controls Controls prohibiting or limiting access to contaminated media; may consist of deed restrictions, use restrictions, permitting requirements, etc.

Joint A surface of a fracture or parting in a rock, without displacement.

Leachate A contaminated liquid resulting when water percolates or trickles through waste materials and collects components of those wastes. Leaching may occur at landfills and may result in hazardous substances entering soil, surface water, or groundwater.

Low-level waste (LLW) Radioactive waste material with a radiation intensity of less than 10 nanocuries per gram.

Magazine A storage area for explosives.

Mass wasting A general term for a variety of processes by which large masses of earth material are moved by gravity either slowly or quickly from one place to another.

Matrix Relatively fine material in which coarser fragments or crystals are embedded; also called "ground mass."

Migration The movement of oil, gas, or water (including that containing radionuclides) through porous and permeable rock.

Mitigation (1) Avoiding an impact altogether by not taking a certain action or parts of an action. (2) Minimizing impacts by limiting the degree or magnitude of the action and its implementation. (3) Rectifying the impact by repairing, rehabilitating, or restoring the affected environment. (4) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action. (5) Compensating for the impact by replacing or providing substitute resources or environments.

Mixed waste Waste that consists of chemical and radioactive hazards.

Model A mathematical or physical system, obeying certain specified conditions, whose behavior is used to understand a physical, biological, or social system to which it is analogous in some way.

Perched water Zones of saturated rock above an impermeable bed, underlain by unsaturated rocks of sufficient permeability to allow movement of groundwater.

Photofission The nuclear fission produced by the absorption of radiant energy.

Photoionization detector (PID) An analytical instrument that determines the amount of a specific organic material present in a gas stream by exposing the gas to ultraviolet energy that will be absorbed by that material.

Pollutant Includes, but is not limited to, any element, substance, compound, or mixture, including disease-causing agents, which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction) or physical deformations, in such organisms or their offspring; except that the terms "pollutant or contaminant" shall not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance under Subparagraphs (A) through (F) of Paragraph (14) and shall not include natural gas, liquefied natural gas, or synthetic gas of pipeline quality (or mixtures of natural gas and such synthetic gas).

Puye Formation Consists dominantly of volcanoclastic sediments deposited as an alluvial fan that built eastward from Tschicoma volcanic centers in the northeastern Jemez volcanic field.

Quality assurance (QA) All the planned and systematic actions necessary to provide adequate confidence that a structure, system, or component is constructed to plans and specifications and will perform satisfactorily.

Quality assurance/quality control (QA/QC) A system of procedures, checks, audits, and corrective actions used to ensure that fieldwork and laboratory analysis during the investigation and cleanup of Superfund sites meet established standards.

Radionuclide A radioactive species of an atom characterized by the constitution of its nucleus. An unstable form of an element that undergoes radioactive decay, emitting energy in the form of gamma rays or mass in the form of alpha particles or beta particles.

Receptor A person, plant, animal, or geographical location that is exposed to a chemical or physical agent released to the environment by human activities

Recharge The process by which water is added to the zone of saturation, either directly into a geologic formation or indirectly by way of another formation or through unconsolidated sediments.

Reference dose (RfD) The lifetime (chronic) daily exposure level to a noncarcinogen that will protect sensitive human populations from adverse effects; developed by the United States Environmental Protection Agency for exposure evaluations at Superfund Sites.

Regulatory standard, regulatory concentration criteria Media-specific contaminant concentration levels of potential concern that are mandated in specific pieces of federal or state legislation (e.g., the Safe Drinking Water Act, New Mexico Water Quality Control Commission regulations).

Release Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment (including the abandonment or discarding of barrels, containers, and other closed receptacles containing any hazardous substance or pollutant or contaminant), but excludes

(A) any release which results in exposure to persons solely within a workplace, with respect to a claim which such persons may assert against the employer of such persons;

(B) emissions from the engine exhaust of a motor vehicle, rolling stock, aircraft, vessel, or pipeline pumping station engine;

(C) release of source, by-product, or special nuclear material from a nuclear incident, as those terms are defined in the Atomic Energy Act, if such release is subject to requirements with respect to financial protection established by the Nuclear Regulatory Commission under Section 170 of such act, or, for the purposes of Section 104 of this title or any other response action, any release of source, by-product, or special nuclear material from any processing site designated under Section 102(a)(1) or 302(a) of the Uranium Mill Tailings Radiation Control Act of 1978, and

(D) the normal application of fertilizer.

Remedy Activity conducted at DOE facilities to reduce potential risks to people and/or harm to the environment from radioactive and/or hazardous substance contamination.

Representativeness Similarity between the measurements produced by a specified sampling and analysis procedure and the true target population parameters.

Resource Conservation and Recovery Act A federal law that established a structure to track and regulate hazardous wastes from the time of generation to disposal. The law also regulates the disposal of solid waste that may not be considered hazardous.

Risk assessment An assessment of the potential human health or environmental risk associated with contamination of environmental media. Risk assessment includes hazard identification, exposure assessment, and dose response analysis.

Risk assessment, baseline A risk assessment conducted using one or more scenarios appropriate for the site but assuming no mitigating or corrective measures beyond those already in place.

Screening action level (SAL) Media-specific concentration level for constituents derived using conservative criteria.

Screening assessment Evaluation of information about a PRS to determine whether hazardous or radioactive constituents are present above the levels of concern defined by media-specific SALs or regulatory standards.

Siltstone A very fine-grained consolidated clastic rock composed predominantly of particles of silt size.

Site characterization The program of exploration and research, both in the laboratory and in the field, undertaken to establish the geologic conditions and the ranges of those parameters of a particular site. Site characterization includes borings, surface excavations, excavation of exploratory shafts, limited subsurface lateral excavations and borings and geophysical testing needed to decide whether site characterization should be undertaken.

Soil gas Those gaseous elements and compounds that occur in the small spaces between particles of the earth or soil. Rock can contain gas also. Such gases can move through or leave the soil or rock, depending on changes in pressure.

Stratigraphy The study of rock strata to include age relationships.

Superfund Amendments and Reauthorization Act (SARA) of 1986 The 1986 amendments to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) that included provisions that increased the size of the Hazardous Substances Superfund, required new cleanup standards, and started the Superfund Innovative Technology Evaluation (SITE) program.

Topography The physical features of a place or region.

Toxicity characteristic leaching procedure (TCLP) A test that measures the mobility of organic and inorganic chemical contaminants in wastes. The test, designed by the United States Environmental Protection Agency, produces an estimate of the potential for leachate formation by a waste if it is placed in the ground.

Treatment, storage, and disposal facility (TSD) Any building, structure, or installation where a hazardous substance has been treated, stored, or disposed. TSD facilities are regulated by EPA and the states under RCRA.

Tuff A compacted pyroclastic deposit of volcanic ash and dust that contains rock and mineral fragments incorporated during eruption or transport.

Unsaturated zone The zone between the land surface and the regional water table. Generally, fluid pressure in this zone is less than atmospheric pressure, and some of the voids may contain air or other gases at atmospheric pressure. Beneath flooded areas or in perched water bodies the fluid pressure locally may be greater than atmospheric.

Uranium A naturally radioactive element with the atomic number of 92 (number of protons in nucleus) and an atomic weight of approximately 238. The two principal naturally occurring isotopes are the fissionable ^{235}U (0.7% of natural uranium) and the fertile ^{238}U (99.3% of natural uranium.

Vadose zone Zone in which there is suspended water. In other words, the zone above the water table where water is present but does not saturate the host medium.

Volatile organic compound An organic (carbon-containing) compound that evaporates (volatilizes) readily at room temperature.

Voluntary corrective action (VCA) Selection and implementation of an obvious and effective corrective action during or following the RFI.

Executive Summary

Chapter 1
Introduction

Chapter 2
Background Information

Chapter 3
Environmental Setting

Chapter 4
Technical Approach

Chapter 5
Evaluation of Potential Release Site Aggregates

Chapter 6
Units Proposed for No Current RCRA Facility Investigation

Annexes

Appendices

Chapter 1

- Statutory and Regulatory Background
- Installation Work Plan
- Description of OU 1082
- Organization of Work Plan

1.0 INTRODUCTION

1.1 Statutory and Regulatory Background

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

In 1984, Congress amended RCRA by passing the Hazardous and Solid Waste Amendments (HSWA), which modified the permitting requirements of RCRA by, among other things, requiring corrective action for releases of hazardous wastes or constituents from solid waste management units (SWMUs). EPA administers the HSWA requirements in New Mexico at this time. In accordance with this statute, the Laboratory's permit to operate includes a section, referred to as the HSWA Module, that prescribes a specific corrective action program for the Laboratory (EPA 1990, 0306). The HSWA Module includes provisions for mitigating releases from facilities currently in operation and for cleaning up inactive sites. The primary purpose of this RCRA field investigation (RFI) work plan is to determine the nature and extent of releases of hazardous waste and hazardous constituents from potential release sites (PRSs). The plan meets the requirements of the HSWA Module and is consistent with the scope of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (DOE 1989, 0078).

The HSWA Module lists SWMUs, which are defined as "any discernible unit at which solid wastes have been placed at any time, irrespective of whether the unit was intended for the management of solid or hazardous waste." These wastes may be either hazardous or nonhazardous (for example, construction debris). Table A of the HSWA Module identifies 603 SWMUs at the Laboratory, and Table B lists 182 SWMUs that must be investigated first. In addition, the Laboratory has identified areas of concern (AOCs), which do not meet the HSWA Module's definition of a SWMU. These sites may contain radioactive materials and other hazardous substances listed under CERCLA. SWMUs and AOCs are collectively referred to as PRSs. The Environmental Restoration (ER) Program uses the mechanism of recommending no further action (NFA) for AOCs as well as SWMUs. However, using this approach for AOCs does not imply that AOCs fall under the jurisdiction of the HSWA Module.

For the purposes of implementing the cleanup process, the Laboratory has aggregated PRSs that are geographically related in groupings called operable units (OUs). The Laboratory has established twenty-four OUs, and an RFI work plan is prepared for each. This work plan for OU 1082 addresses PRSs located in three of the Laboratory's active technical areas (TAs): TAs 11, 16, and 37. This plan, together with nine other work plans to be submitted to EPA through August 1993, and nine plans submitted in 1990 and 1991, meets the schedule requirement of the HSWA Module, which is to address a cumulative total of 55% of the SWMUs in Table A and a cumulative total of 100% of the priority SWMUs listed in Table B.

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

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

1.2 Installation Work Plan

The HSWA Module requires that the Laboratory prepare a master plan, called the IWP, to describe the Laboratory-wide system for accomplishing all RFIs and corrective measures studies (CMSs). The IWP has been

TABLE 1-1

RCRA FACILITY INVESTIGATION GUIDANCE FROM THE HSWA MODULE

Scope of the RCRA Facility Investigation (RFI)	ER Program Equivalent	
The RFI consists of 5 tasks:	*LANL Installation RI/FS* Work Plan:*	*LANL Task/Site RI/FS:*
Task I: Description of Current Conditions A. Facility Background B. Nature and Extent of Contamination	**I. LANL Installation RI/FS Work Plan** A. Installation Background B. Tabular Summary of Contamination by Site	**I. OU 1082 Work 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 Plan	**II. LANL Task/Site RI/FS Documents** A. Quality Assurance Project Plan and Field Sampling Plan B. Records Management Project Plan C. Health and Safety Project Plan D. Community Relations Project Plan
Task III: Facility Investigation A. Environmental Setting B. Source Characterization C. Contamination Characterization D. Potential Receptor Identification	**III. Task/Site Investigation** A. Environmental Setting B. Source Characterization C. Contamination Characterization D. Potential Receptor Identification	**III. Task/Site Investigation** A. Environmental Setting B. Source Characterization C. Contamination Characterization D. Potential Receptor Identification
Task IV: Investigative Analysis A. Data Analysis B. Protection Standards	**IV. LANL Task/Site Investigative Analysis** A. Data Analysis B. Protection Standards	**IV. LANL Task/Site Investigative Analysis** A. Data Analysis B. Protection Standards
Task V: Reports A. Preliminary and Work Plan B. Progress C. Draft and Final *RI = Remedial Investigation FS = Feasibility Study	**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

TABLE 1-2

LOCATION OF HSWA MODULE REQUIREMENTS IN ER PROGRAM DOCUMENTS

HSWA MODULE REQUIREMENTS FOR RFI WORK PLANS	INSTALLATION WORK PLAN AND OTHER PROGRAM DOCUMENTS	DOCUMENTS FOR OPERABLE UNIT 1082
Task I: Description of Current Conditions		
A. Facility Background	IWP Subsection 2.1	A. RFI Work Plan Chapters 2, 3, and 5
B. Nature and Extent of Contamination	IWP Subsection 2.4 and Appendix F	B. RFI Work Plan Chapter 5
Task II: RFI Work Plan		
A. Data Collection Quality Assurance Plan	IWP Annex II (Quality Program Plan)*	RFI Work Plan Annex II
B. Data Management Plan	IWP Annex IV (Records Management Program Plan)	RFI Work Plan Annex IV
C. Health and Safety Plan	IWP Annex III (Health and Safety Program Plan)	RFI Work Plan Annex III
D. Community Relations Plan	IWP Annnex V (Community Relations Program Plan)	RFI Work Plan Annex V
E. Project Management Plan	IWP Annex I (Program Management Plan)	RFI Work Plan Annex I
Task III: Facility Investigation		
A. Environmental Setting	IWP Chapter 2	RFI Work Plan Chapter 3
B. Source Characterization	IWP Appendix F	RFI Work Plan Chapter 5
C. Contamination Characterization	IWP Appendix F	RFI Work Plan Chapters 4 and 5
D. Potential Receptor Identification	IWP Subsection 4.2	RFI Work Plan Chapters 4 and 5
Task IV: Investigative Analysis		
A. Data Analysis	IWP Subsection 4.2	Phase reports and RFI report
B. Protection Standards	IWP Subsection 4.2	RFI report
Task V: Reports		
A. Preliminary and Work Plan	IWP, Rev. 0	Work plan
B. Progress	Monthly reports, quarterly reports, and annual revisions of IWP	Phase reports
C. Draft and Final		Draft and final RFI report

* Annex II of the IWP addresses these requirements by reference to controlled documents: The Generic Quality Assurance Project Plan (LANL 1991, 0553) and the ER Program's standard operating procedures (LANL 1993, 0875).

prepared in accordance with the HSWA Module and is consistent with EPA's "Interim Final RFI Guidance" (EPA 1989, 0088) and proposed Subpart S of 40 CFR 264 (EPA 1990, 0432), which proposes the cleanup program in Section 3004(u) of RCRA. The IWP was first prepared in 1990 and is updated annually. This work plan follows the requirements specified in Revision 2 of the IWP (LANL 1992, 0768).

The IWP describes the aggregation of the Laboratory's PRSs into twenty-four OUs (Subsection 3.4.1). It presents a facilities description in Chapter 2 and a description of the structure of the Laboratory's ER Program in Chapter 3. Chapter 4 describes the technical approach to corrective action at the Laboratory. Annexes I-V contain the Program Management Plan, Quality Program Plan (LANL 1991, 0840), Health and Safety Program Plan, Records Management Program Plan, and the Community Relations Program Plan, respectively. The document also contains a proposal to integrate RCRA closure and corrective action, and a strategy for identifying and implementing interim remedial measures. When information relevant to this work plan has already been provided in the IWP, the reader is referred to the appropriate revision of the IWP.

1.3 Description of OU 1082

OU 1082 is located in Los Alamos County in north-central New Mexico (Fig. 1-1). OU 1082 consists of four operating technical areas: 11, 16, 28, and 37. Four additional technical areas, 13, 24, 25, and 29, are inactive. TA-13 and TA-25 have been absorbed into TA-16. TA-24 was abandoned and has been decommissioned. TA-29 was decommissioned and absorbed into TA-16. Only TAs 11, 16, and 37 contain PRSs (Fig. 1-2). Detailed contour maps with PRS locations are found in Appendix E.

OU 1082 covers approximately 2 410 acres lying at the southwestern corner of the Los Alamos National Laboratory complex. OU 1082 lies at elevations between about 7 100 and 7 700 ft above sea level. It is located mostly on a broad mesa that is bounded on the north by Cañon de Valle and on the south by Water Canyon. The southern boundary of OU 1082 is south of Water Canyon at the Laboratory boundary at State Road 4. The mesa also slopes eastward toward branches of Water Canyon and Cañon de Valle. Canyon walls are steep in this area.

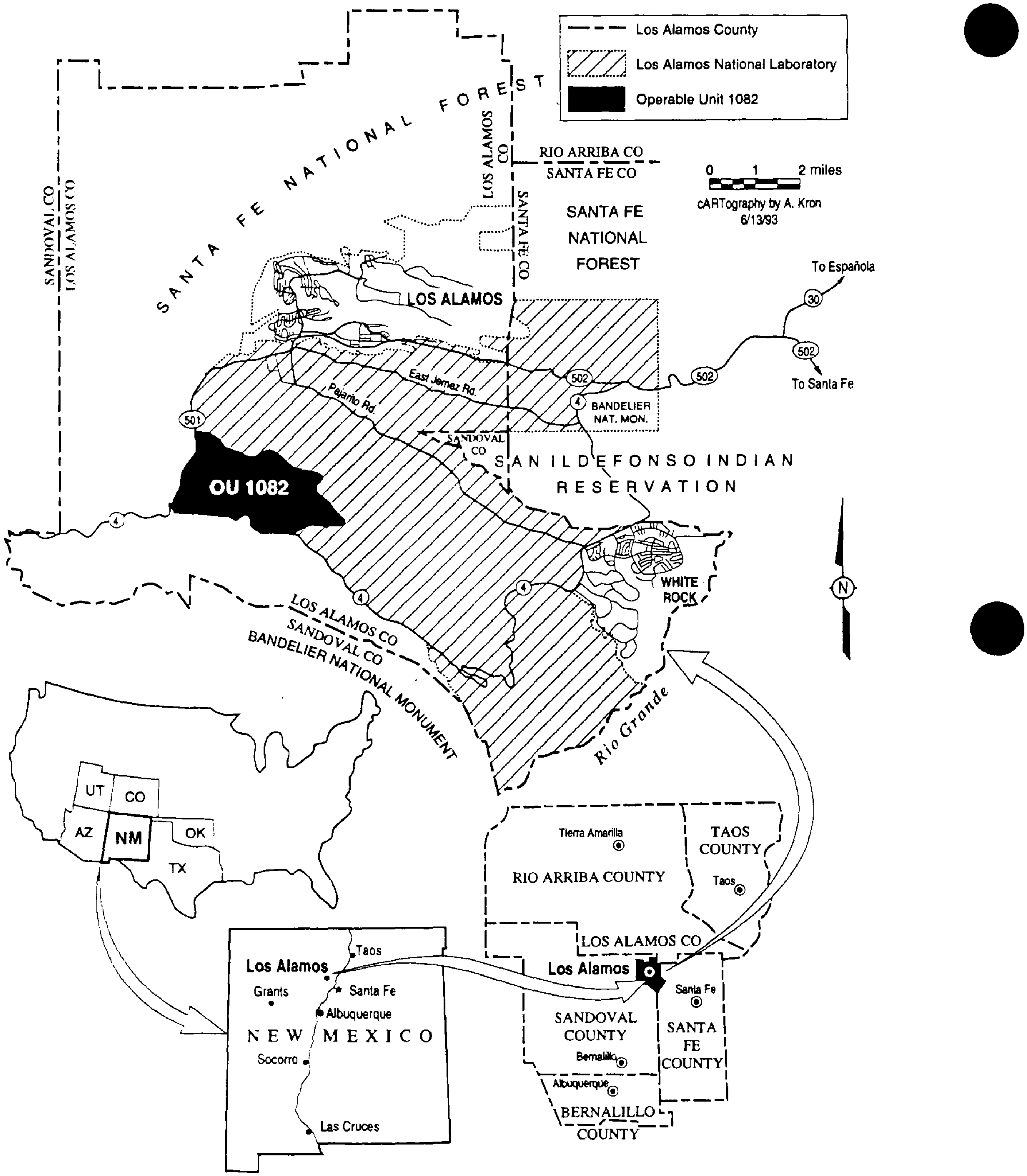

Fig. 1-1. Location of Operable Unit 1082.

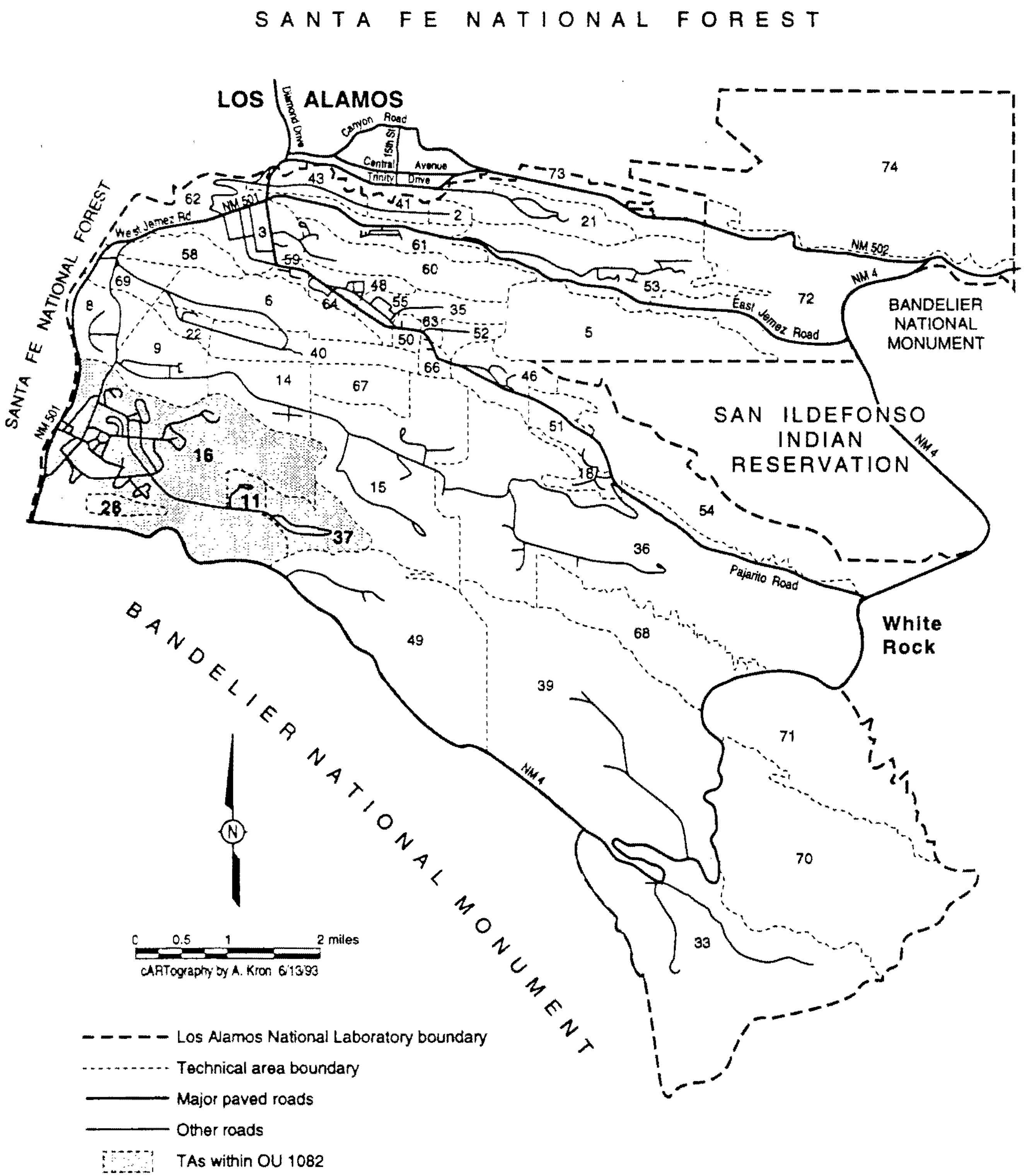

Fig. 1-2. Location of Operable Unit 1082 with respect to Laboratory technical areas and surrounding landholdings.

Because of the large number of PRSs (340 SWMUs and 75 AOCs) in OU 1082, the RFI work plan will be written in segments. The first segment will address all of the HSWA Module Table A and Table B SWMUs (Table-1-3) and is scheduled for delivery to the Environmental Protection Agency in 1993 (EPA 1990, 0432). A number of SWMUs not in the HSWA Module are also addressed as a matter of efficiency and cost containment (Table 1-3). The remaining SWMUs and AOCs will be covered in the additional segments that will be delivered as RFI addenda no later than July 1995. The portion of Cañon de Valle north of OU 1082 is treated in the first segment of the work plans; Water Canyon and the remainder of Cañon de Valle will be covered in the OU 1049 Work Plan, Canyons.

This work plan also addresses radioactive and other hazardous substances not regulated by RCRA, but defined in CERCLA, as well as other environmental laws. The goal of the Environmental Restoration Program at the Laboratory is to comply with primarily RCRA, but also address CERCLA, the Atomic Energy Act (AEA), the National Environmental Policy Act (NEPA) and other applicable regulations (LANL 1992, 0768).

The PRSs in OU 1082 are located on property owned by the Department of Energy (DOE).

A brief description of current activities follows:

TA-11, known as K-Site, is the location of the high explosives (HE) test area. Facilities in this technical area are used to test HE systems and components under a variety of conditions (Pava 1990, 0368).

TA-16 operations center around nuclear weapons warhead research (including design, development, prototype manufacturing, environmental testing, and stockpiling) and conventional weapons/chemical explosives research and processing. The area is also the principal waste treatment site for explosives and explosives-contaminated waste (Pava 1990, 0368).

TA-28 is a magazine area used for explosives storage (Pava 1990, 0368). Because of the historic care in storing HE at this site, no PRSs exist.

TA-37, called Magazine Area C, is used for explosives storage (Pava 1990, 0368).

TABLE 1-3

1993 WORK PLAN SWMU CROSS-REFERENCE LIST

HSWA PERMIT SWMUs		RENUMBERED SWMUs			CURRENT SWMUs
TABLE A AND B	TABLE B	OLD NUMBER	NEW NUMBER	NEW SWMUs	1990 SWMU REPORT
11-001(a–c)					11-001(a–c)
11-002					11-002
					11-003(a–b)[1]
11-004(a–f)	11-004(a–e)				11-004(a–f)
11-005(a–b)	11-005(a–b)				11-005(a–b)
				11-005(c)	11-005(c)[1]
11-006(a–d)	11-006(a–d)				11-006(a–d)
11-007					11-007
				11-008	11-008[1]
11-009					11-009
				11-010(a–b)	11-010(a–b)[1]
				11-011(a–d)	11-011(a–d)[1]
				11-012(a–d)	11-012(a–d)[1]
				13-001	13-001[1]
13-002					13-002
					13-003(a–b)[1]
13-004	13-004				13-004
16-001(a–e)					16-001(a–e)
16-003(a–o)					16-003(a–o)
16-003(p–v)		16-003(p–v)	16-029(a–g)		16-029(a–g)
16-004(a–f)					16-004(a–f)
		16-005(i)	16-005(g)		16-005(g)[1]
16-006(a)	16-006(a)	16-006(a)	16-005(n)		16-005(n)
16-006(b)	16-006(b)	16-006(b)	16-006(a)		16-006(a)
16-006(c)		16-006(c)	16-006(b)		16-006(b)
16-006(d)	16-006(d)	16-006(d)	16-006(c)		16-006(c)
16-006(e–f)	16-006(e–f)	16-006(e–f)	16-006(d–e)		16-006(d–e)
16-006(g)	16-006(g)	16-006(g)	16-005(o)		16-005(o)
16-006(h)	16-006(h)	16-006(h)	16-006(f)		16-006(f)
16-007	16-007	16-007	16-007(a)		16-007(a)
				16-007(b)	16-007(b)[1]
16-008(a–b)	16-008(b)				16-008(a–b)
16-009(a)		16-009(a)	16-009		16-009
16-009(b)		16-009(b)	16-019		16-019[2]
16-010(a–m)					16-010(a–m)
16-010(n)				16-010(n)	16-010(n)[1]
16-012(a–y)					16-012(a–y)
				16-012(a2)	16-012(a2)[1]
16-013(a)		16-013(a)	16-013		16-013
16-013(b)		16-013(b)	16-012(z)		16-012(z)
16-016(a–c)	16-016(a–c)				16-016(a–c)
16-018	16-018				16-018
16-019	16-019				16-019[2]
16-020	16-020				16-020
16-021	16-021	16-021	16-021(a)		16-021(a)
				16-021(c)	16-021(c)[1]
				16-026(b–e)	16-026(b–e)[1]
				16-026(h2)	16-026(h2)[1]
				16-026(j2,v)	16-026(j2,v)[1]
				16-030(d)	16-030(d)[1]
				16-030(g)	16-030(g)[1]
				16-030(h)	16-030(h)[1]
				16-035	16-035[1]
				16-036	16-036[1]
				37-001	37-001[1]

1 These SWMUs or SWMU subunits were not originally listed in either Table A or B of the HSWA Module but are now listed in the 1990 SWMU Report (LANL 1990, 0145).
2 Although the HSWA Module lists 16-009(b), the 1988 SWMU Report (International Technology Corporation 1988, 0329) says it is probably MDA R (SWMU 16-019), which is also in the HSWA Module. This work plan treats SWMU 16-009(b) as SWMU 16-019.

SWMUs that are similar in physical characteristics, use, or waste type are described in the SWMU Report as sub-SWMUs within a larger SWMU description. Sub-SWMUs were grouped to eliminate repetition of information. Each sub-SWMU is considered to be a SWMU for the purposes of corrective actions and this work plan. The 1990 SWMU Report (LANL 1990, 0145) identifies 32 SWMUs in TA-11, 5 in TA-13 (now part of TA-16), 301 in TA-16, 0 in TA-24, 1 in TA-25 (now part of TA-16), 0 in TA-28, and 1 in TA-37. Table 1-3 provides a SWMU cross-reference of HSWA Module tables and Laboratory SWMU Reports for those SWMUs covered in this work plan. As noted above, the remaining PRSs will be covered through RFI addenda no later than July 1995.

Laboratory activity and SWMU and AOC identification for those SWMUs and AOCs addressed in this work plan were verified during a series of tours conducted by the OU 1082 project team in late 1991 and early 1992.

All PRSs have been aggregated based on their common characteristics and/or the common approach that can be applied to them in the RFI work plan. The seventeen aggregates and their locations in Chapter 5 of the RFI work plan are tabulated in Table 1-4.

Subsection 3.5 of the IWP states that each OU work plan may contain an application for a Class III permit to modify Table A of the HSWA Module when it is determined that a PRS needs no further investigation. Table 1-3 includes the Tables A and B SWMUs to be addressed in this work plan. Table 1-5 lists the PRSs proposed for NFA or deferred action. Those SWMUs from Tables A and B of the HSWA Module proposed for NFA are listed in Table 1-6; EPA's approval of this work plan demonstrates EPA's concurrence with the Laboratory that these units are viable candidates for a permit modification to remove these units from the ER Program.

1.4 Organization of This Work Plan and Other Useful Information

This work plan follows the generic outline provided in Table 3-3 of the IWP (LANL 1992, 0768). Following this introductory chapter, Chapter 2 provides background information on OU 1082, which includes a description and history of the OU, a description of past waste management practices, and current conditions at technical areas in the OU.

TABLE 1-4

PRSs, PRS AGGREGATES, AND LOCATION IN CHAPTER 5

PRS, DESCRIPTION	PRS AGGREGATE	SUB-SECTION
16-001(a, b, d), dry wells/tank 16-001(c), dry well	Blowdown tanks and dry wells in administration area	5.1
16-001(e), dry well 16-003(a, b, d, e, f, g, h, i, j, l, m), active HE sumps 16-026(b, c, d, e, v, h2, j2), inactive outfalls 16-029(a, b, c, d, e, f, g), inactive HE sumps 16-030 (d, h, g), active outfalls 16-003(c, n, o), active HE sumps	High explosives (HE) sumps and outfalls	5.2
16-003(k), active HE sumps 16-021(c), operational release	HE sumps and outfall at TA-16-260	5.3
16-006(a, c, d, e), active/inactive septic systems 13-003(a, b), septic system 11-005(a, b), active septic systems	Septic tanks	5.4
16-021(a), operational release 16-020, silver recovery/outfall region	Operational releases (2 aggregates)	5.5 5.6
16-004(a), Imhoff tank 16-004(b), trickling filter 16-004(c), final tank 16-004(d), sludge drying bed 16-004(e), screen 16-004(f), sludge drying bed	Sanitary waste treatment plant	5.7
16-010(a, h, i, k, l, m, n), inactive burn and treatment area 16-016(c), surface disposal	Burning ground	5.8
Cañon de Valle	Cañon de Valle	5.9
16-019, Material Disposal Area R	MDA R	5.10
16-009, decommissioned burn area 16-016(a, b), landfill/surface disposal	Landfills, surface disposal, burn pit	5.11
16-007(a), decommissioned waste pond 16-008(a), inactive surface impoundment	Ponds	5.12
13-001, firing site 13-002, landfills 13-004, burn site 16-035, soil contamination from former control bunker 16-036, soil contamination from battleship bunkers	P-Site	5.13
11-001(a, b), firing pits 11-002, burn site 11-003(b), mortar impact area 11-004(a–f), drop tower complex 11-006 (a–d), sumps and catch basin systems C-11-001, soil contamination	K-Site Aggregate A	5.14
11-005(c), outfall and drain line 11-011(a, b), inactive outfalls 11-011(d), active outfall	K-Site Aggregate B	5.15
11-001(c), firing pit 11-012 (a–d), soil contamination C-11-002, soil contamination	K-Site Aggregate C	5.16
16-013, decommissioned waste storage area	Spill	5.17

TABLE 1-5

PRSs RECOMMENDED FOR NO CURRENT RCRA FACILITY INVESTIGATION

PRS AGGREGATE NUMBER(S), DESCRIPTION	SUBSECTION
16-010(b, c, d, e, f, j), interim status open burn/open detonation units; and 16-005(g), filter bed	6.1.1.1
16-008(b), inactive surface impoundment	6.1.2.1
16-010(g), filter/treatment unit	6.1.3.1
16-012(a2), interim storage area	6.1.3.2
16-012(d, i, j, l, m, n, t, u, and x), satellite storage areas	6.1.3.2
16-012(p), less-than-ninety-day storage area	6.1.3.2
16-018, MDA P	6.1.4.1
11-007, surface disposal	6.1.5.1
11-009, MDA S	6.1.5.2
16-005(n), decommissioned septic system	6.1.5.3
16-005(o), decommissioned septic system	6.1.5.4
16-006(b), active septic system	6.1.5.5
16-006(f), active septic system	6.1.5.6
11-010(a), container storage area	6.1.5.7
16-012(a, b, c, e, f, g, h, k, o, q, r, s, v, w, y, z), rest houses	6.1.5.7
11-010(b), container storage area	6.2.1.1
11-011(c), boiler discharge	6.2.1.2
16-007(b), decommissioned waste pond	6.2.2.1
11-003(a), mortar impact area	6.2.3.1
11-008, boneyard	6.2.3.2
37-001, septic system	6.2.3.3
C-11-003 (AOC), lanthanum spill	6.2.3.4
11-001(a, b), 11-002, 11-003(b), 11-004(a–f), C-11-001, drop tower complex	6.3.1

Chapter 3 describes the environmental setting. Chapter 4 presents the technical approach to the field investigation. Chapter 5 contains an evaluation of all the PRSs in OU 1082, which includes a description and history of each PRS, a conceptual exposure model, remediation alternatives and evaluation criteria, data needs and data quality objectives, and a sampling plan. Chapter 6 of this work plan provides a brief description of each PRS proposed for NFA and the rationale for that recommendation.

TABLE 1-6

SWMUS PROPOSED FOR DELETION FROM TABLES A AND B OF THE HSWA MODULE

SWMU, DESCRIPTION	SUBSECTION
16-010(b, c, d, e, f, j), interim status open burn/open detonation units	6.1.1.1
16-008(b), inactive surface impoundment	6.1.2.1
16-012(d, i, j, l, m, n, t, u, x), satellite storage areas	6.1.3.2
16-012(p), less-than-ninety-day storage area	6.1.3.2
11-007, surface disposal	6.1.5.1
11-009, MDA-S	6.1.5.2
16-005(n), decommissioned septic system	6.1.5.3
16-005(o), decommissioned septic system	6.1.5.4
16-006(b), active septic system	6.1.5.5
16-006(f), active septic system	6.1.5.6
16-012(a, b, c, e, f, g, h, k, o, q, r, s, v, w, y, z), rest houses	6.1.5.7
16-007(b), decommissioned waste pond	6.2.2.1

The body of the text is followed by five annexes, which consist of project plans corresponding to the program plans in the IWP: project management, quality assurance (LANL 1991, 0553), health and safety, records management, and community relations. Appendix A contains the cultural resource summary, Appendix B contains the biological resource summary, Appendix C contains a list of contributors to this work plan, Appendix D is an introduction to high explosives used at the S-Site Complex, and Appendix E contains contour maps with PRS locations. A separate reference list is included at the end of each chapter, annex, and appendix where appropriate.

The units of measurement used in this document are expressed in both English and metric units, depending on which unit is commonly used in the field being discussed (Table 1-7). For example, English units are used in text pertaining to engineering, and metric units are often used in discussions of geology and hydrology. When information is derived from some other published report, the units are consistent with those used in that report.

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

TABLE 1-7

APPROXIMATE CONVERSION FACTORS FOR SELECTED SI (METRIC) UNITS

MULTIPLY SI (METRIC) UNIT	BY	TO OBTAIN US CUSTOMARY UNIT
Cubic meters (m^3)	35	Cubic feet (ft^3)
Centimeters (cm)	0.39	Inches (in.) meters
Meters (m)	3.3	Feet (ft)
Kilometers (km)	0.62	Miles (mi)
Square kilometers (km^2)	0.39	Square miles (mi^2)
Hectares (ha)	2.5	Acres
Liters (L)	0.26	Gallons (gal.)
Grams (g)	0.035	Ounces (oz)
Kilograms (kg)	2.2	Pounds (lb)
Micrograms per gram (mg/g)	1	Parts per million (ppm)
Milligrams per liter (mg/L)	1	Parts per million (ppm)
Celsius (°C)	9/5 + 32	Fahrenheit (°F)

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2.0 BACKGROUND INFORMATION FOR OPERABLE UNIT 1082

This chapter of the Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) work plan provides background information on Operable Unit (OU) 1082, which consists of four operating technical areas (TAs), 11, 16, 28, and 37. Programmatic activities are described from the earliest-known Laboratory activity to the present. Four TAs, 13, 24, 25, and 29, are inactive. TA-13, TA-25, and TA-29 have been absorbed into TA-16. TA-24 was abandoned and has been decommissioned. Descriptions of activities provide the basis, not only for evaluation of present conditions and environmental impacts, but also for proposed characterization study plans.

This work plan addresses all solid waste management units (SWMUs) and areas of concern (AOCs) identified in the "Solid Waste Units Management Report," (LANL 1990, 0145). Only TAs 11, 16, and 37 contain potential release sites (PRSs). During the course of the site characterization, new PRSs may be identified that will be addressed as they are identified.

2.1 Description

OU 1082 is located in the southwest corner of the Laboratory (Fig. 2-1 and Fig. 2-2). The land is a portion of that which was acquired by the Department of the Army for the Manhattan Project in 1943; it was used prehistorically by the ancestral Indians of the Pajarito Plateau and, prior to World War II, for farming and a sawmill operation. OU 1082 is bordered by Bandelier National Monument along State Road 4 to the south and the Santa Fe National Forest along State Road 501 to the west. To the north and east, the OU is bordered by other Laboratory property; specifically, TAs 8, 9, 14, 15, and 49. The unit is fenced and posted along State Road 4. Water Canyon, a 200-ft-deep ravine with steep walls, separates State Road 4 from active sites in OU 1082. Security fences surround production activities.

OU 1082 occupies 2 410 acres, or 3.8 square miles. A contour map showing the technical area boundaries and SWMU locations is contained in Appendix E. The operable unit is under the jurisdiction of WX Division (Design Engineering) of Los Alamos National Laboratory (LANL), although Group M-1 (Explosives Technology) and the Laboratory's protective force have operations in several buildings.

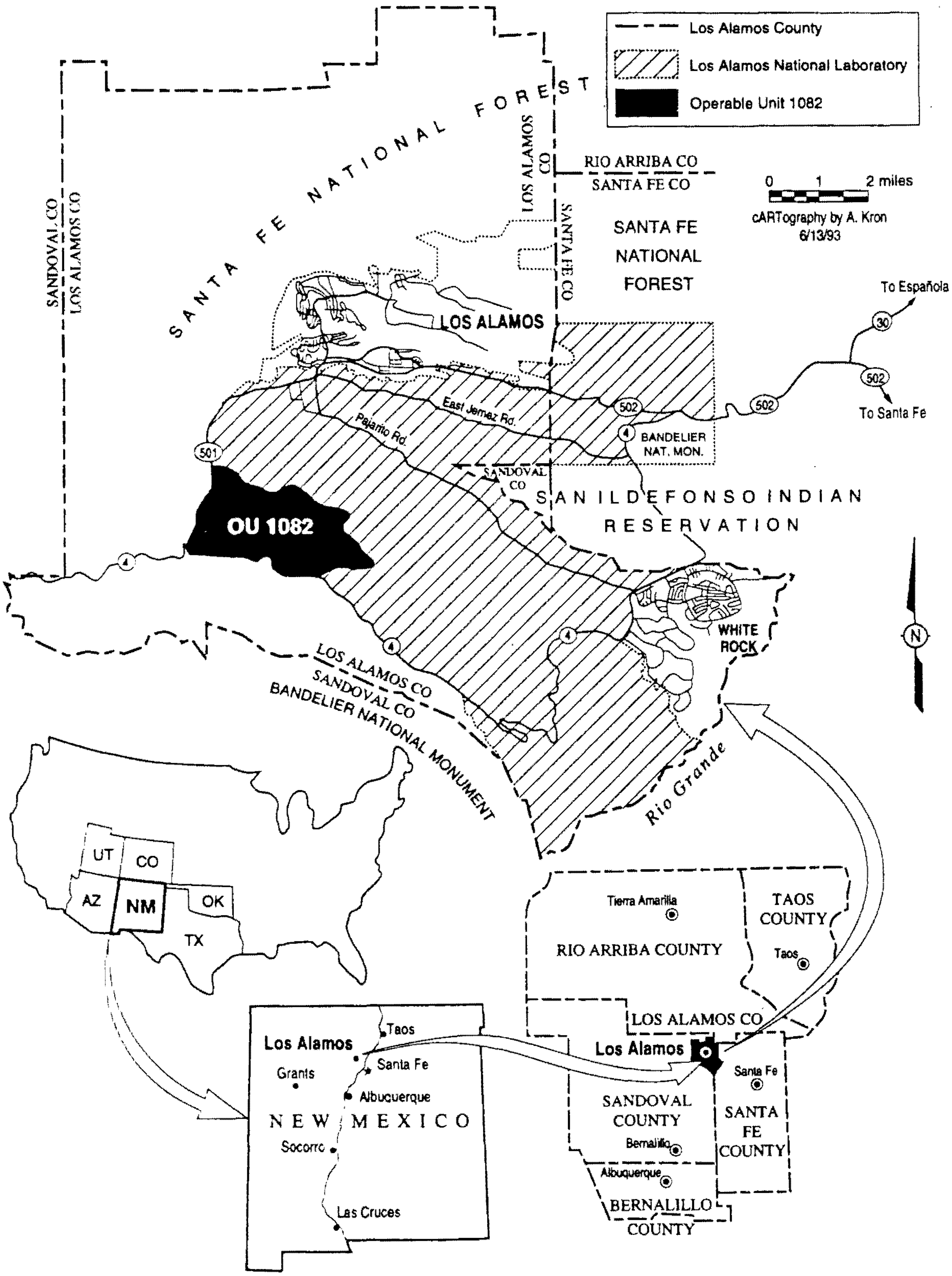

Fig. 2-1. Location of Operable Unit 1082.

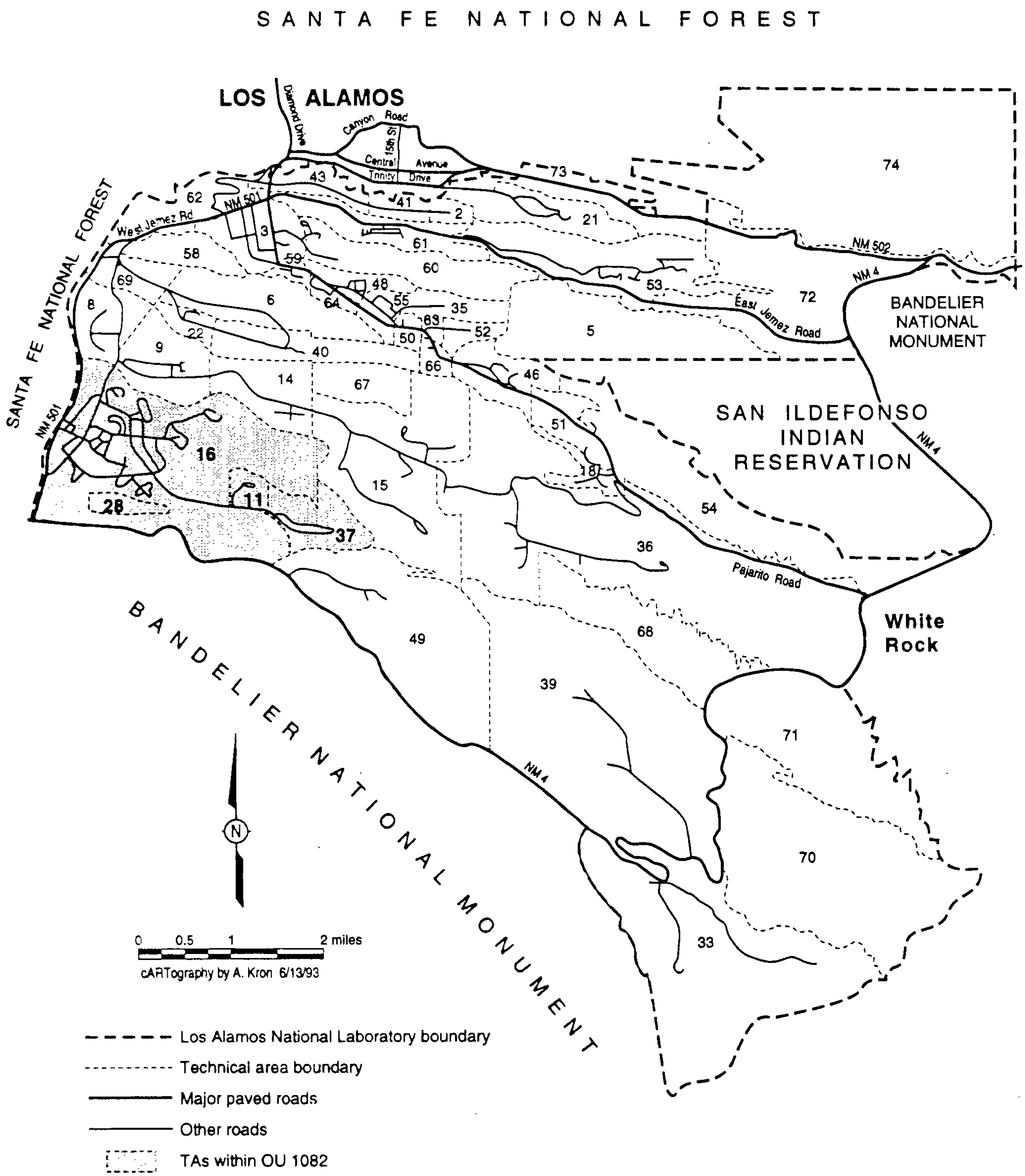

Fig. 2-2. Location of Operable Unit 1082 with respect to Laboratory technical areas and surrounding landholdings.

OU 1082 consists of eight technical areas, two of which were absorbed into TA-16 and two of which were decommissioned (Fig. 2-3 and Fig. 2-4). Those sites that have been absorbed into TA-16 or have been decommissioned and demolished are no longer shown on any figures or maps. The technical areas are listed below with their site designations given in parentheses. All facilities are located within or contiguous to the boundaries of TA-16 (S-Site). Thus, the area is commonly known as the S-Site Complex.

The technical areas that compose S-Site are as follows:

TA-11	(K-Site)	Active
TA-13	(P-Site)	Absorbed into TA-16
TA-16	(S-Site)	Active
TA-24	(T-Site)	Decommissioned
TA-25	(V-Site)	Absorbed into TA-16
TA-28	(MAA, Magazine Area A)	Active
TA-29	(MAB, Magazine Area B)	Decommissioned and absorbed into TA-16
TA-37	(MAC, Magazine Area C)	Active

2.2 Operational History

The technical areas composing OU 1082 were established during World War II to develop, fabricate (cast and machine), and test explosive components employed in the United States' nuclear weapons program. Almost all of the work conducted at OU 1082 during World War II was in support of developing, testing, and producing explosive charges for the implosion method. Present use of the technical areas is essentially unchanged. The facilities have undergone extensive expansion and upgrading as explosive and manufacturing technologies have advanced.

Development and testing of explosive formulations, fabrication of explosive charges, and assembly of weapons test devices continues to the present. A variety of explosives have been used at the S-Site complex (Gibbs and Popolato 1980, 15-16-369).

Technical Area 29, Magazine Area B. TA-29 was an abandoned Civilian Conservation Corps camp where two magazines were constructed in 1944 (Bradbury 1947, 15-16-320). All structures were removed in 1957 (Dunning

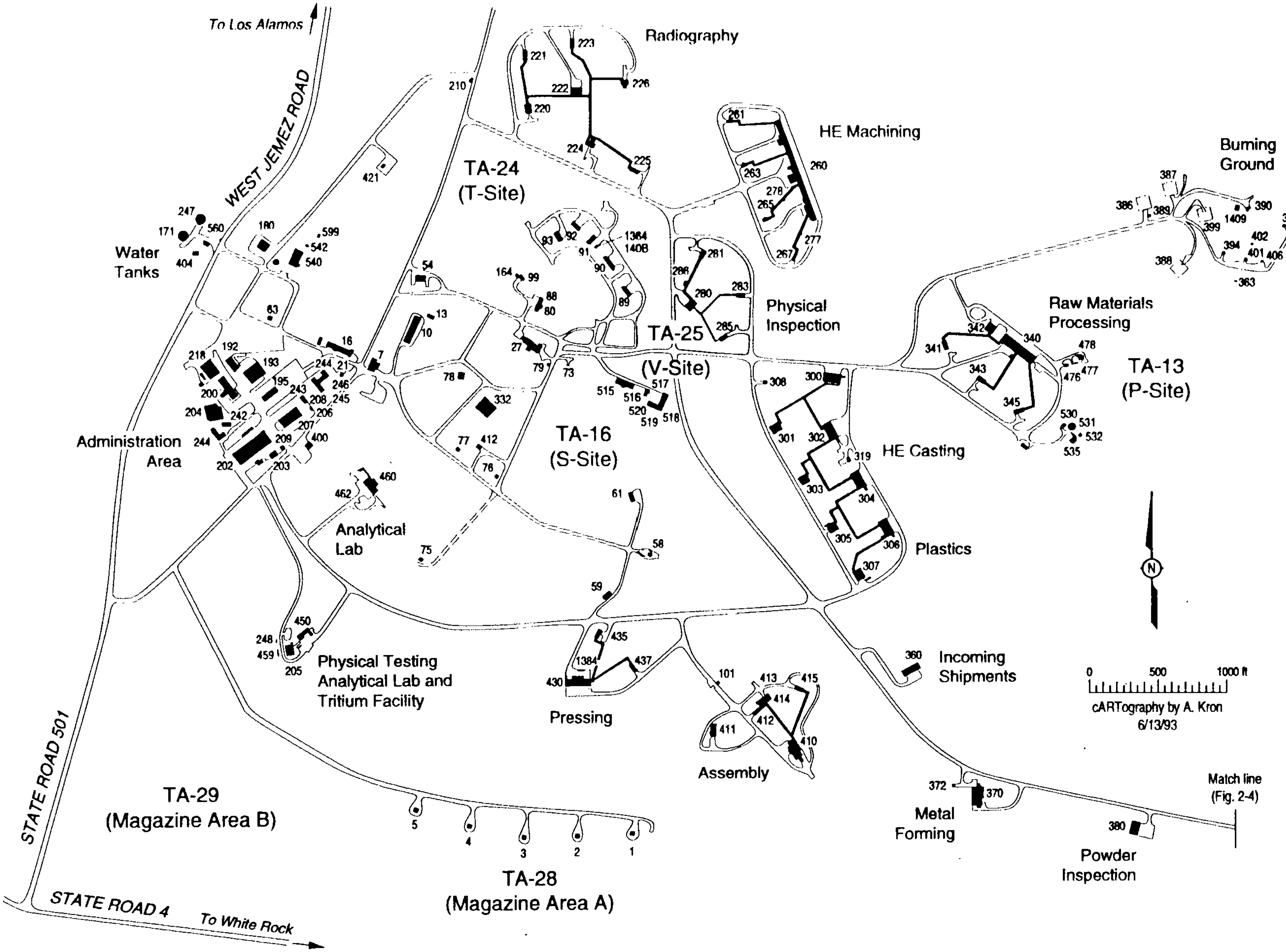

Fig. 2-3. Location map of TA-16 (S-Site) and TA-28 (Magazine Area A).

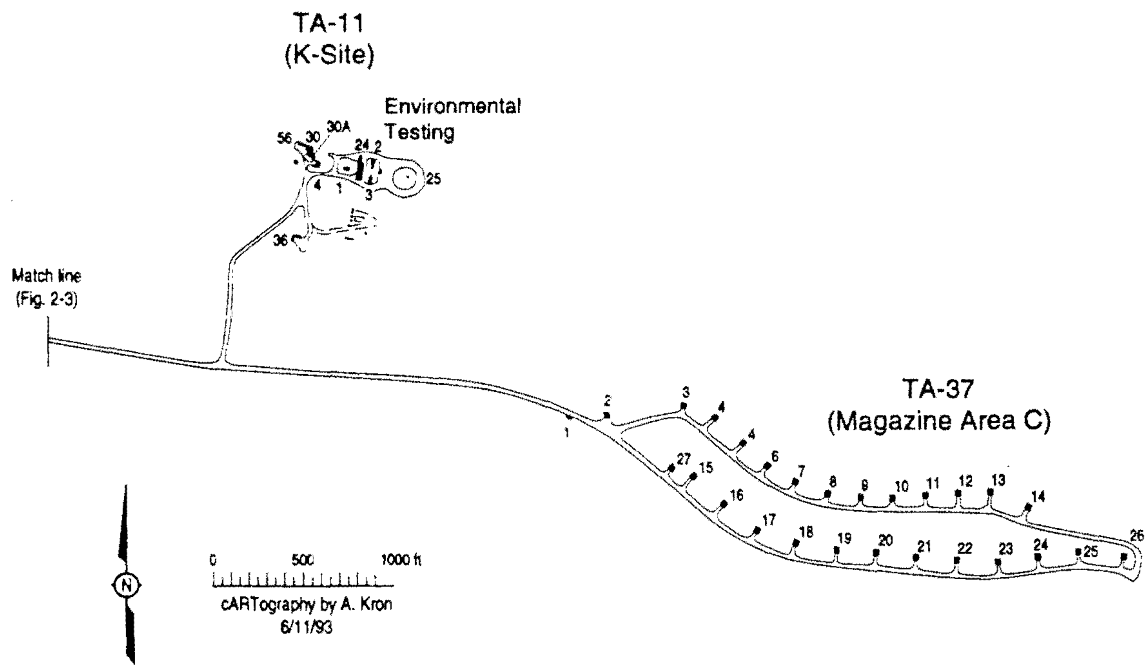

Fig. 2-4. Location map of TA-11 (K-Site) and TA-37 (Magazine Area C).

1957, 15-16-442). TA-29 was decommissioned in 1958-59 and absorbed into TA-16.

Technical Area 11 (K-Site). TA-11 was originally built to house a betatron and a cloud chamber used to study implosion symmetry of high-explosive charges. It has also contained photofission experiment facilities, a mortar impact area, an air gun firing facility, a burning ground, laboratories, storage buildings, sumps, and a material disposal area (MDA S). The major facilities currently at TA-11 are a drop tower and a vibration table that are used for conducting environmental and effects tests on high explosives (HE) systems and components. Drop tests to study impact initiation of explosives may cause HE to fracture or detonate, becoming scattered about the drop tower pad. The resulting debris in the immediate vicinity of the drop tower is picked up and removed for disposal at the TA-16 burning ground. In addition to explosives, radioactive materials, such as natural and depleted uranium, have been used in some drop experiments at the area.

A long-term test of explosive decomposition in soil is being conducted at MDA S. It includes burial of a series of high explosives, which are periodically examined to determine the degree of decomposition.

Technical Area 13 (P-Site). TA-13 was decommissioned and absorbed into TA-16. It was constructed in 1944 to conduct flash x-ray studies of the implosion of HE test devices. It consisted of an office and shop building, laboratory and test buildings, an experimental chamber, a magazine, and a storage building. By the 1950s, most of the buildings had been removed. The remaining buildings were absorbed into the S-Site Complex, and were renumbered TA-16-476, -477, and -478. These buildings are now used for HE machining safety studies.

Technical Area 16 (S-Site). Operations at TA-16 center around the production of HE for weapons and non-weapons research and development. TA-16 is a large complex, with over 200 buildings and structures divided into separate operational complexes or building groups, connected by roads. Operations include casting, pressing, and machining of HE; assembly of explosive test devices; fabrication of plastic components; development of new materials; and non-destructive examination. A new high-pressure tritium facility was recently constructed at TA-16. No PRSs are associated with this new facility. Material storage, division and group administration offices, and machine shop facilities are also located at the site. TA-16 includes the locations of former Technical Areas 13, 24, 25, and 29. HE magazines (TAs 28 and 37) are located within the boundaries of the S-Site Complex. TA-11 (K-Site) is also generally included as part of the S-Site Complex.

Technical Area 24 (T-Site). TA-24 has been decontaminated and decommissioned; the site now lies within TA-16. It was used for x-ray examination of HE charges during the 1940s. Explosives storage magazines and laboratories were part of the facility.

Technical Area 25 (V-Site). TA-25 is no longer operational. It was constructed in 1944 for experimental work in connection with special assemblies. In 1945, the site was altered and became part of TA-16 to allow process work on explosive charges. Structures at the site include an assembly bay, laboratory buildings, an equipment building, and a warehouse. A trial assembly of the Trinity device was conducted at TA-25 in 1945.

Technical Area 28 (MAA; Magazine Area A). TA-28 consists of five magazines used for the storage of HE.

Technical Area 37 (MAC; Magazine Area C). TA-37 consists of twenty-four magazines used for the storage of HE.

2.3 Waste Management Practices

2.3.1 Past Waste Management Practices

Historical waste management practices at the S-Site Complex conformed to standard procedures of the day. These procedures focused on safety and minimizing hazards to operating personnel.

The major emphasis was placed on safe disposal of HE and HE-contaminated material. To this end, an extensive system of HE sumps has been used to separate HE from process waste streams. Larger fragments of HE scrap generated by processes not directly associated with the waste stream are also carefully collected for disposal. A detailed description of HE sumps and their operation can be found in Chapter 5, Subsection 5.2.1, of this work plan. While this description is for current activities, the historic operations relied on the same principles.

As disposal quantities of HE or HE-contaminated materials were collected, the waste was taken to one of a number of burning grounds that have existed at S-Site over the years. A detailed description of burning activities, including estimates on typical throughputs, are included in Subsection 5.8.1. Residuals and noncombustible materials from the burning grounds were typically placed in a landfill adjacent to the burning ground or taken to another Laboratory disposal area.

Building drains and septic systems that may have received HE or chemically-contaminated wastes were often connected to outfalls, discharging into canyons either directly or through drain fields.

Many of the buildings at S-Site are equipped with fume hoods that are vented through stacks and blowers. However, no PRSs at OU 1082 are associated with stack emission.

2.3.2 Current Waste Management Practices

Waste-generating operations at S-Site conform to Laboratory waste management policies as described in Administrative Requirements AR-1 through AR-6 of the Laboratory Environment, Safety, and Health Manual (LANL 1990, 0335). These requirements provide for the minimization, segregation, and disposal of mixed waste, low-level radioactive waste, chemical waste, hazardous waste, sanitary landfill waste, and transuranic waste. These Laboratory waste policies are derived from and meet the requirements of appropriate DOE orders, RCRA, State of New Mexico Hazardous Waste Management regulations, and Laboratory practices.

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- Geology
- Conceptual Hydrologic Model
- 3-D Geologic/Hydrologic Model of OU 1082

3.0 ENVIRONMENTAL SETTING

This chapter provides a detailed description of the environmental setting at Operable Unit (OU) 1082. It is organized so that the solid waste management unit- (SWMU) specific sampling plans in Chapter 5 can be based on all available relevant information concerning environmental conditions at OU 1082. The environmental setting of the Laboratory as a whole is discussed in detail in Subsection 2.5 of the Installation Work Plan (IWP), Overview of the Environmental Setting (LANL 1992, 0768). This chapter makes specific reference to information contained in the IWP, where such information has relevance to this RCRA facility investigation (RFI) work plan.

Subsections 3.1 through 3.5 of this chapter provide a foundation for the conceptual geologic/hydrologic model in Subsection 3.6. This model pictorially summarizes environmental factors that are likely to influence contaminant migration in OU 1082. This model, hence, is a framework for consideration of remediation alternatives (Chapters 4 and 5), conceptual exposure models (Chapters 4 and 5), and SWMU-specific sampling plans (Chapter 5).

Chapter 2 of the IWP (LANL 1992, 0768) briefly covers regional data on surface water and groundwater quality, air quality, penetrating radiation levels, and chemical and radiation levels in soils where these data are required later in the RFI work plan. These data address environmental conditions beyond the immediate range of effects of TA-16 operations, but may be needed to provide a basis against which TA-16-specific data can be compared.

OU 1082-wide data needs required to understand the behavior of hazardous contaminants in the environment will be addressed in Chapter 5. One goal of the SWMU-specific sampling plans described within Chapter 5 is to identify the nature of environmental transport of hazardous contaminants in the TA-16 region. These results will be used to refine the risk-assessment models in an iterative fashion, and may be used to define the nature and scope of Phase II investigation, voluntary corrective actions, or corrective measures studies.

3.1 Physical Description

Operable Unit 1082 is the westernmost aggregation of technical areas (TAs) at Los Alamos National Laboratory. It is located on an unnamed mesa due east of the Jemez Mountains. The western TAs (13, 16, 24, and 25) within OU 1082 lie at an average elevation of approximately 7 500 to 7 600 ft. TA-11 (K-Site), the burning ground, and Magazine Area C (TA-37), which form the eastern part of the operable unit, lie at a slightly lower elevation (7 200 to 7 500 ft) (Fig. 3-1).

OU 1082 is bounded on the west by the fault scarp of the Frijoles segment of the Pajarito fault zone. This fault yields a fairly steep topographic break at the base of the Jemez Mountains of up to 200 ft. Further discussion of this fault zone is provided in Subsection 3.4 (Geology).

OU 1082 is bounded on the northeast by Cañon de Valle and on the south by State Highway 4. Water Canyon transects the southern half of OU 1082 from west to east. Cañon de Valle runs through OU 1082 south of TA-16-222. These canyons converge at the southeast end of the OU due east of the TA-37 magazines. Cañon de Valle also forms the southern boundary of TAs 9, 14, and 15; thus, sample contamination in this canyon may include contaminants from operations at these sites and TA-16. Bandelier National Monument lies due south of State Highway 4 abutting TA-16, and no other Laboratory operations have occurred up drainage from TA-16 in Water Canyon. Thus, any contamination of this canyon in the TA-16 area is likely to be from operations at TA-16.

Water Canyon extends from the Jemez Mountains to the Rio Grande. Cañon de Valle is a tributary canyon to Water Canyon that also heads in the Jemez Mountains. The former trends roughly from west to east and the latter trends northwest to southeast. Both canyons have steep walls; Water Canyon is as many as 200 ft deep in the TA-16 area (see large topographic map in Appendix E). Water Canyon cuts the Bandelier Tuff along much of its length, the Cerros del Rio basalts in its eastern portion, and Tschicoma Formation dacites in its western portion. Thus, natural metal background in the canyon drainages will reflect the variety of trace elements typical of volcanic tuffs, dacites, and basalts. The drainage area is estimated to be approximately 12.8 square miles of which TA-16 is a small fraction. Both

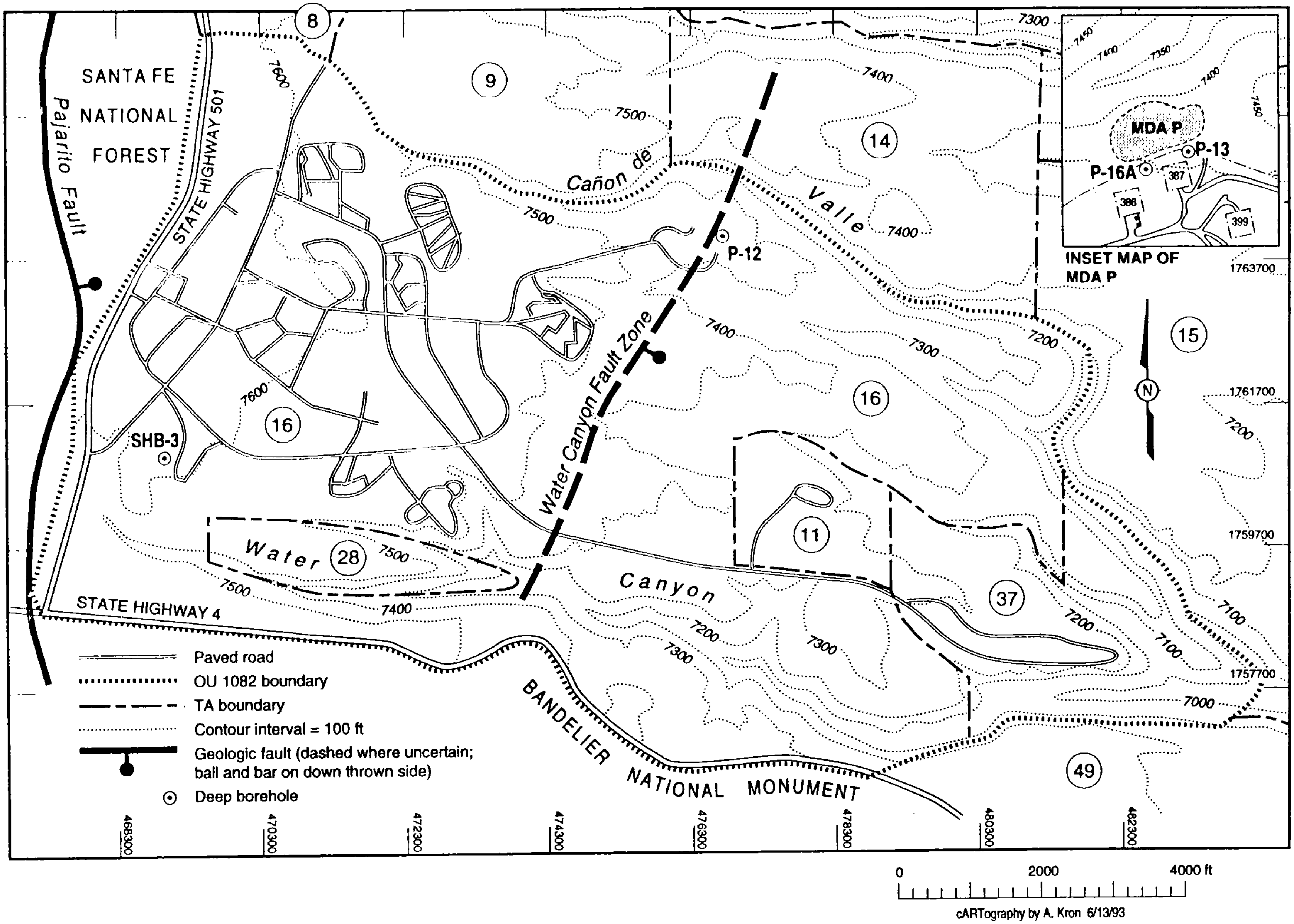


Fig. 3-1. **Structural geology and topography of OU 1082 and surroundings.**

Cañon de Valle and Water Canyon are characterized by ephemeral and intermittent runoff of both snowmelt and rainwater. Occasionally such runoff reaches the Rio Grande in Water Canyon. Smaller surface drainages on the TA-16 mesa top are generally oriented north, south, or east, and feed the two larger OU-bounding canyons.

Aerial photographs of the TA-16 area were taken in September 1991 at a scale of (1:7 200), and aerial orthophotographs (1:1 200) with two-foot contour resolution have recently been prepared for the site. This topographic map coverage should be adequate for the majority of investigations associated with this work plan.

3.2 Climate

Los Alamos County has a semiarid, temperate, mountain climate that is described in detail in Bowen (1990, 0033) and in Chapter 2 of the IWP (LANL 1992, 0768).

3.3 Cultural And Biological Resources

Summaries of cultural and biological resources are provided in Appendices A and B.

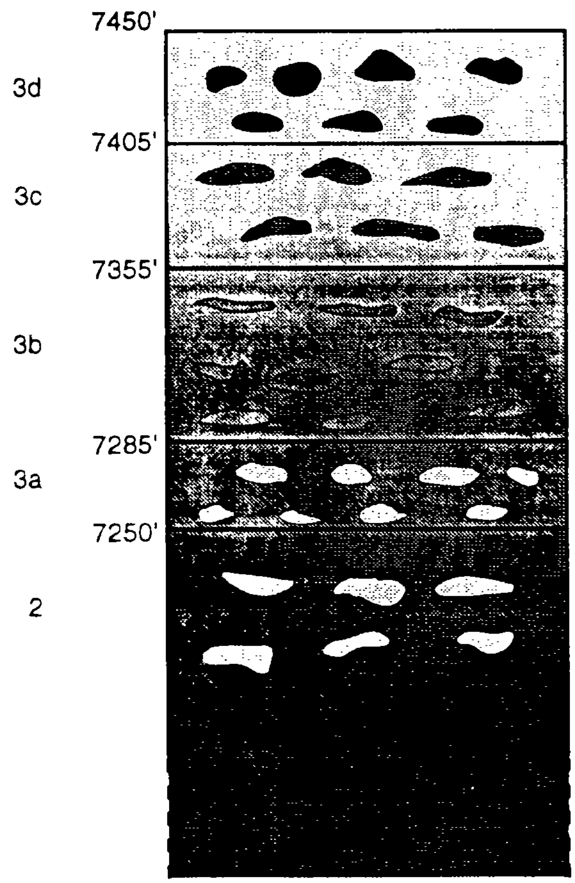
3.4 Geology

This subsection provides OU-specific information regarding the geology in OU 1082.

3.4.1 Bedrock Stratigraphy

The mesa surfaces of OU 1082 are immediately underlain by the Bandelier Tuff of Pleistocene Age, which outcrops in a few places on the mesa tops and is exposed in canyon walls. Stratigraphic relations within OU 1082 are inferred from shallow and deep core holes, logs of which are depicted in Fig. 3-2 and Fig. 3-3.

A series of 17 shallow boreholes was drilled in the vicinity of the Area P landfill (see Subsection 6.1.4.1) during the summer of 1987 (Brown et al. 1988, 0034). Drilling depths ranged from 35 to 205 ft. Borehole logging of lithologies was done based on four characteristics of the tuff: 1) color, 2) degree of welding, 3) shape and abundance of pumice lapilli, and,



Lithologic description

Moderately welded, yellowish-brown tuff with rare pebble-sized rhyolite lithic fragments and common pumice fragments

Moderately welded brownish-grey to yellowish-brown tuff with common grey pumice lapilli (noticeably flattened) and rare pebble-sized lithic fragments. Clay-filled fractures

Welded pale yellowish-brown tuff w/common grey & red pumice lapilli (noticeably flattened) and rare pebble-sized rhyolite lithic fragments. Weathers to dark brown with clayey pumice lapilli in northwest

Welded dark yellowish-brown tuff with rare pumice lapilli (slightly flattened) and abundant pebble-sized quartz latite

Welded to densely welded tuff, light grey to pinkish grey, common pumice lapilli and pebble-sized rhyolite fragments

Source: Brown et al., 1988 (0034)

Fig. 3-2. Composite lithologic log of Area P coreholes.

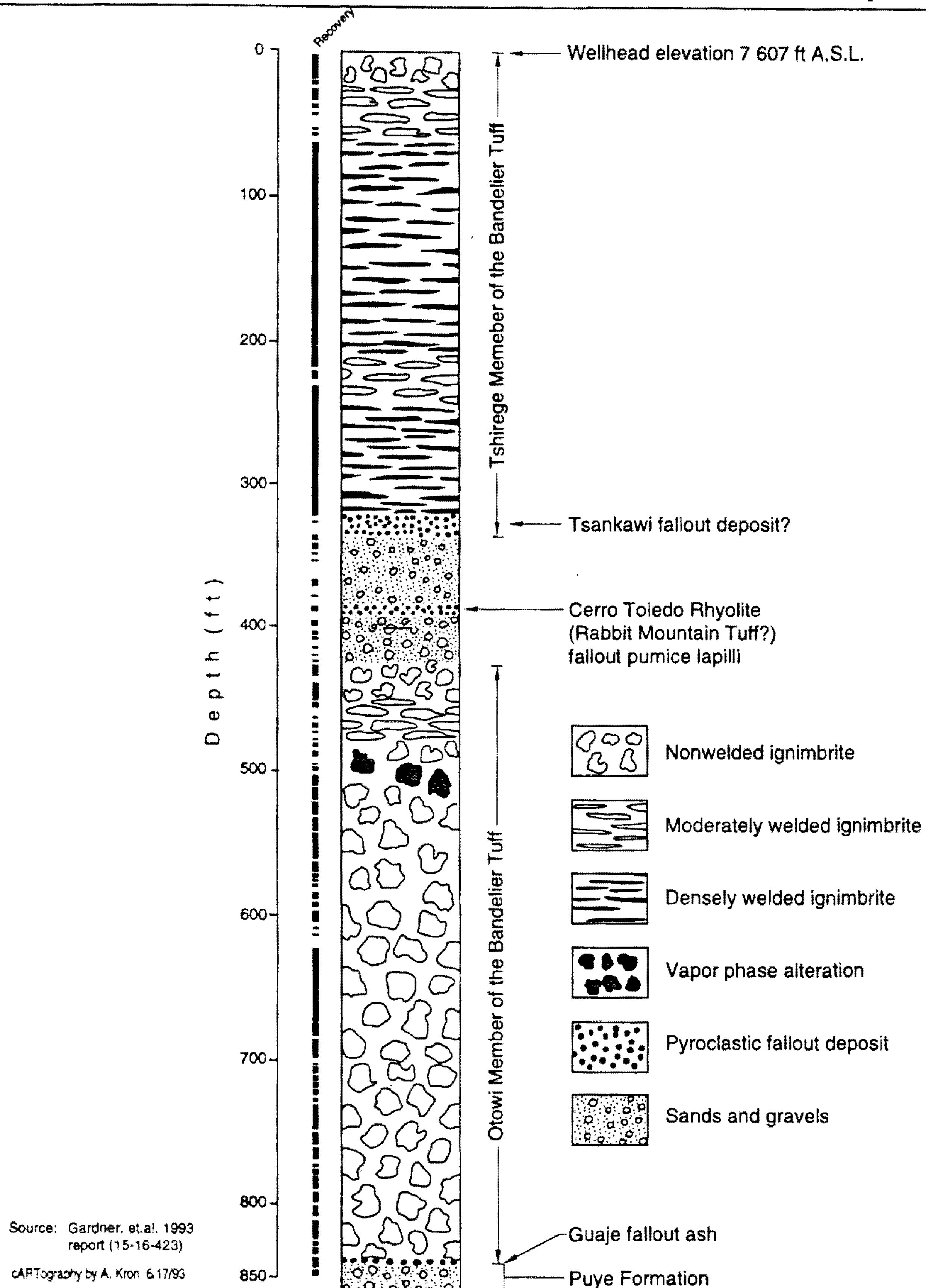


Fig. 3-3. Graphic lithologic log for corehole SHB-3.

4) distribution of lithic fragments. Two major units called Unit 3 and Unit 2 were logged, as were four subunits within Unit 3 (Brown et al. 1988, 0034). A composite stratigraphic log for the Area P landfill area is provided in Fig. 3-2. In general, Bandelier Tuff units surrounding and underlying Area P range from welded to moderately welded, yellowish-brown to gray tuff containing abundant porphyritic quartz latite, to gray to red rhyolitic lithic fragments. Mapped Unit 3d is overlain locally by El Cajete pumice.

A deep borehole (SHB-3) was drilled at TA-16 in November 1991 as part of the Laboratory's Seismic Hazards Program. The drilling site is located in the southwest corner of TA-16 (see Fig. 3-1) with a total accessible depth of 860 ft. Core recovery from this drill hole was nearly 70%. The stratigraphy of this hole is depicted in Fig. 3-3 and summarized below (Gardner et al. 1993, 15-16-423).

Borehole SHB-3 penetrates the Tshirege Member of the Bandelier Tuff in its uppermost 335 ft. At this locality the Tshirege Member is over 95% welded tuff, primarily densely welded material. Cooling breaks between subunits of the tuff are few, with one at a depth of 60 ft and another at a depth of 230 ft. Examination of the core of SHB-3 and lithologic descriptions of core drilled near the burning ground suggest that the cooling break at 230 ft in SHB-3 probably correlates with the top of Unit 3a (Brown et al. 1988, 0034). The lowermost 15 ft of the Tshirege Member in this hole apparently contains the non-welded base of this unit and an unknown thickness of Tsankawi pumice.

Underlying the Tshirege Member of Bandelier Tuff is an almost 100-ft-thick sequence of unconsolidated sands and sandy gravels. These units are lithologically identical to the older Puye Formation and represent epiclastic alluvial deposits shed off the Sierra de los Valles dacite highlands during the hiatus between eruption of the Otowi and Tshirege Members of the Bandelier Tuff. Interbedded with this epiclastic sequence is a coarse, sand-sized pumice fall deposit containing obsidian fragments. This unit is probably genetically related to the Rabbit Mountain Tuff of the Cerro Toledo rhyolite. An unconsolidated alluvial unit such as this would be a likely site for a perched aquifer.

The Otowi Member of the Bandelier Tuff extends from about 424 to 839 ft in SHB-3. It consists almost entirely of non-welded tuff with a zone of minor welding from 450 to 480 ft. The Guaje pumice unit is only one foot thick at the base of the Otowi Member in SHB-3.

Puye Formation sands and boulder-rich gravels underlie the Otowi Member from a depth of 839 ft to the bottom of the drill hole. Cobbles and clasts of these epiclastic alluvial deposits consist primarily of dacitic lithologies of the Tschicoma Formation in the Sierra de los Valles. The main aquifer lies within the lower Puye Formation and the Santa Fe Group at a likely depth of greater than 1 000 ft.

3.4.2 Structure

Two large, near-vertical faults, the Frijoles segment of the Pajarito fault zone and the Water Canyon fault, have been mapped within or near OU 1082. The former, located due west of the western boundary of OU 1082, is the largest segment of the Pajarito fault system in the Los Alamos area, with down-to-the-east displacement ranging up to 400 ft during the last 1.1 million years (Gardner and House 1987, 0110) (Fig. 3-1). The Laboratory's Seismic Hazards Program is currently investigating the nature and timing of movement along this fault system, including a trench near S-Site.

The Water Canyon fault, which is mapped as passing through the TA-16 burning ground (Fig. 3-1), is inferred in the subsurface from interpretation of seismic lines (Dransfield and Gardner 1985, 0082) and has been tentatively identified as offsetting units in the Bandelier Tuff (Brown et al. 1988, 0034) (Fig. 3-1). However, unpublished mapping south of TA-16 (Hickmott 1993, 15-16-402) suggests that the fault does not break the surface south of Water Canyon along its projected trace. Broad zones of intense fracturing superimposed on primary cooling joints are associated with major faults in the Los Alamos region (Vaniman and Wohletz 1990, 0541). Analogous clay-filled vertical fractures were mapped in Subunit 3c (Brown et al. 1988, 0034). Unlike cooling joints, such tectonic fractures are likely to cross flow units and may provide a deeply penetrating flow path for groundwater migration.

3.4.3 Surficial Deposits

3.4.3.1 Alluvium and Colluvium

A general description of alluvial and colluvial deposits around the Laboratory are provided in the IWP, Subsection 2.6.1.6 (LANL 1992, 0768).

Surficial deposits on the plateau surface of OU 1082 consist of coarse-grained colluvium on steep hill slopes and along the bases of cliffs, finer-grained alluvial and colluvial sediments with a thin cover of eolian sediments on the flatter parts of mesa surfaces, and alluvial to colluvial fan deposits at the mouths of steeper drainages or on escarpments related to post-Bandelier faulting. Deposits in the major canyons (Cañon de Valle and Water Canyon) consist of colluvial materials on and at the base of cliffs and canyon walls, representing large volume mass wasting, and fluvial sediments deposited by intermittent streams along the axes of canyon floors.

A more than 100 ft long by 10 ft deep trench was excavated within OU 1082 during June 1992 as part of the Laboratory's Seismic Hazards Program. The trench exposed colluvial wedges derived from the Sierra de los Valles west of the Pajarito fault system. At least four major colluvial deposits, each overlain by a soil horizon, are exposed in the trench. The underlying colluvial unit is 4 ft thick and tapers westward. It is overlain by a well-developed paleosol horizon, which is overlain in turn by a second, thinner (up to 3 ft) colluvial wedge consisting of coarse-grained poorly-sorted El Cajete pumice fragments.

3.4.3.2 Soil

The nature and thickness of soils at TA-16 may influence the transport of hazardous contaminants in the local environment. Soil mineralogy, permeability, grain size, organic content, and chemistry are all factors that may impede or enhance the movement and concentration of individual hazardous constituents within the operable unit.

Soils in Los Alamos County were mapped and described by Nyhan et al. (1978, 0161). The soils were all formed in a semiarid climate and include material derived from Bandelier Tuff bedrock. Table 3-1 and Fig. 3-4 show the spatial distribution and nature of soils at TA-16 (Nyhan et al. 1978, 0161).

TABLE 3-1

TA-16 SOILS

ABBRE-VIATION	NAME	LOCATION	PERMEABILITY	WATER HOLDING	THICKNESS
TC	Typic Eutroboralfs skeletal	Administration Area	Low	Low	46-122+ cm
TS	Typic Eutroboralfs fine	260-Line, 340-Line	Low/moderate	Medium	51-94 cm
TO	Tocal very fine sandy loam	Burning ground, WW II area	Low/moderate	Low	28-36 cm
TR	Typic Ustorthents	South TA-16	Moderate	Low	13-35 cm
PG	Pogna fine sandy loam	Scattered	Moderatė/high	Low	13-30 cm
TV	Totavi gravelly loam	Scattered	Very high	Low	0-152 cm
SA	Sanjue-Arriba complex	Rare-east	High/very high	Very low	46-153 cm
FR	Frijoles very fine sandy loam	East S-Site	Very high in subsoil	Very low	46-152+ cm
CR	Carjo loam	TA-37	Moderate	Medium	51-102 cm

All information from Nyhan et al. 1978, 0161.

A wide variety of soil types occurs at TA-16 (Table 3-1). These include: Typic Eutroboralfs (both clayey-skeletal and fine), Tocal very-fine sandy loam, Frijoles very-fine sandy loam, Pogna fine sandy loan, Totavi gravelly loam, Sanjue-Arriba complex, Carjo loam, and Rabbit-Tsankawi rock outcrop (Fig. 3-4). These soil units grade into outcrops of Bandelier Tuff along the margins of the mesa tops. Soils are generally thicker in the western portions of OU 1082 (Fig. 3-5).

Chapter 2 of the IWP (LANL 1992, 0768) states that an impermeable clay zone often forms at the soil-tuff interface on the Pajarito Plateau. Supposedly, this layer provides an effective barrier to the movement of groundwater from the soil into the underlying tuff (Weir and Purtymun 1962, 0228; Abeele et al. 1981, 0009). However, disturbed areas, where soils have been scraped off and bedrock exposed, would not effectively seal off infiltration of surface waters into tuff.

3.4.3.3 Erosional Processes

Erosion on the mesa tops in OU 1082 is caused primarily by shallow runoff on the relatively flat mesa surfaces, by deeper runoff in channels cut into the mesa surfaces, and by rock falls and colluvial transport from the steep

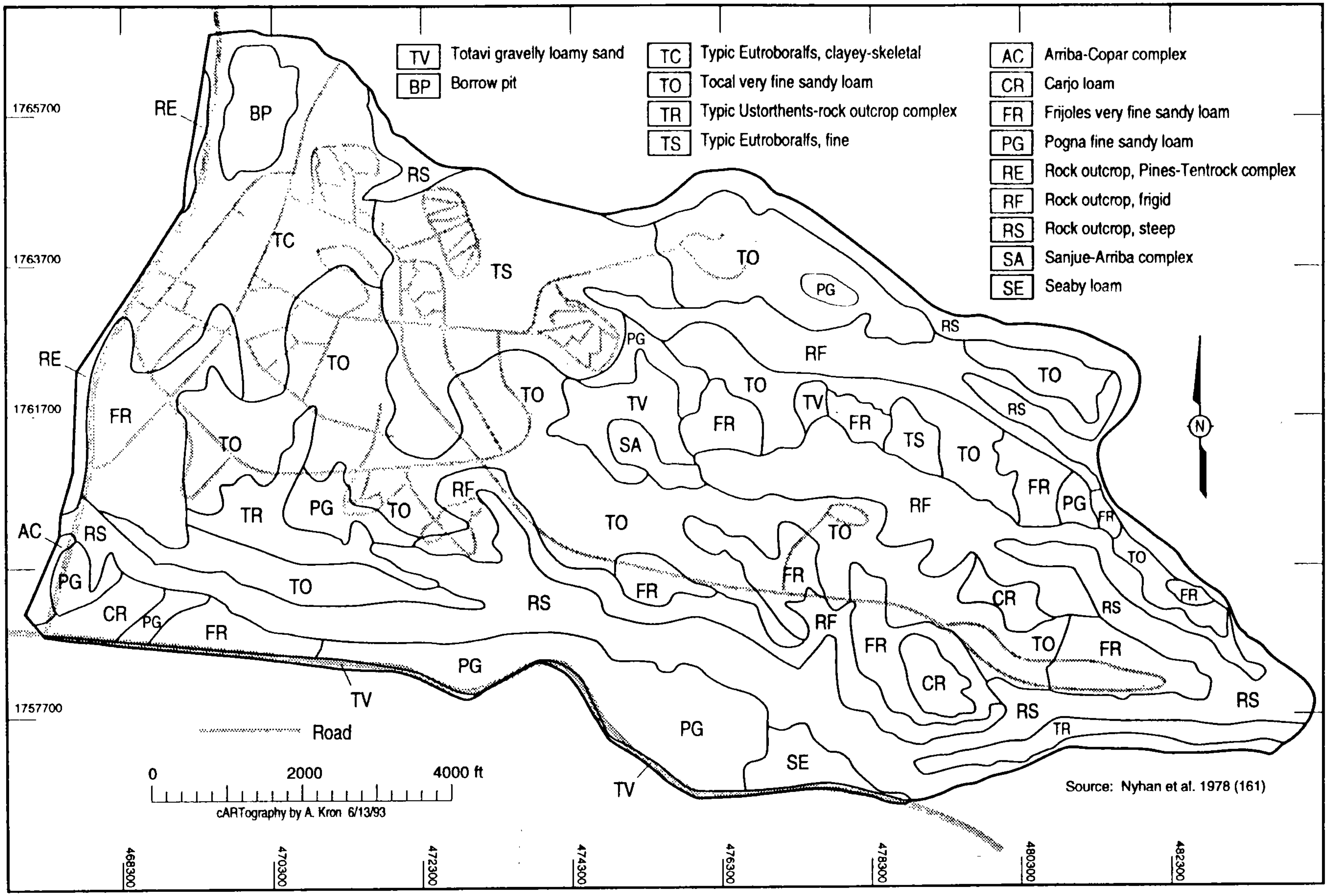


Fig. 3-4. Soil map for OU 1082.

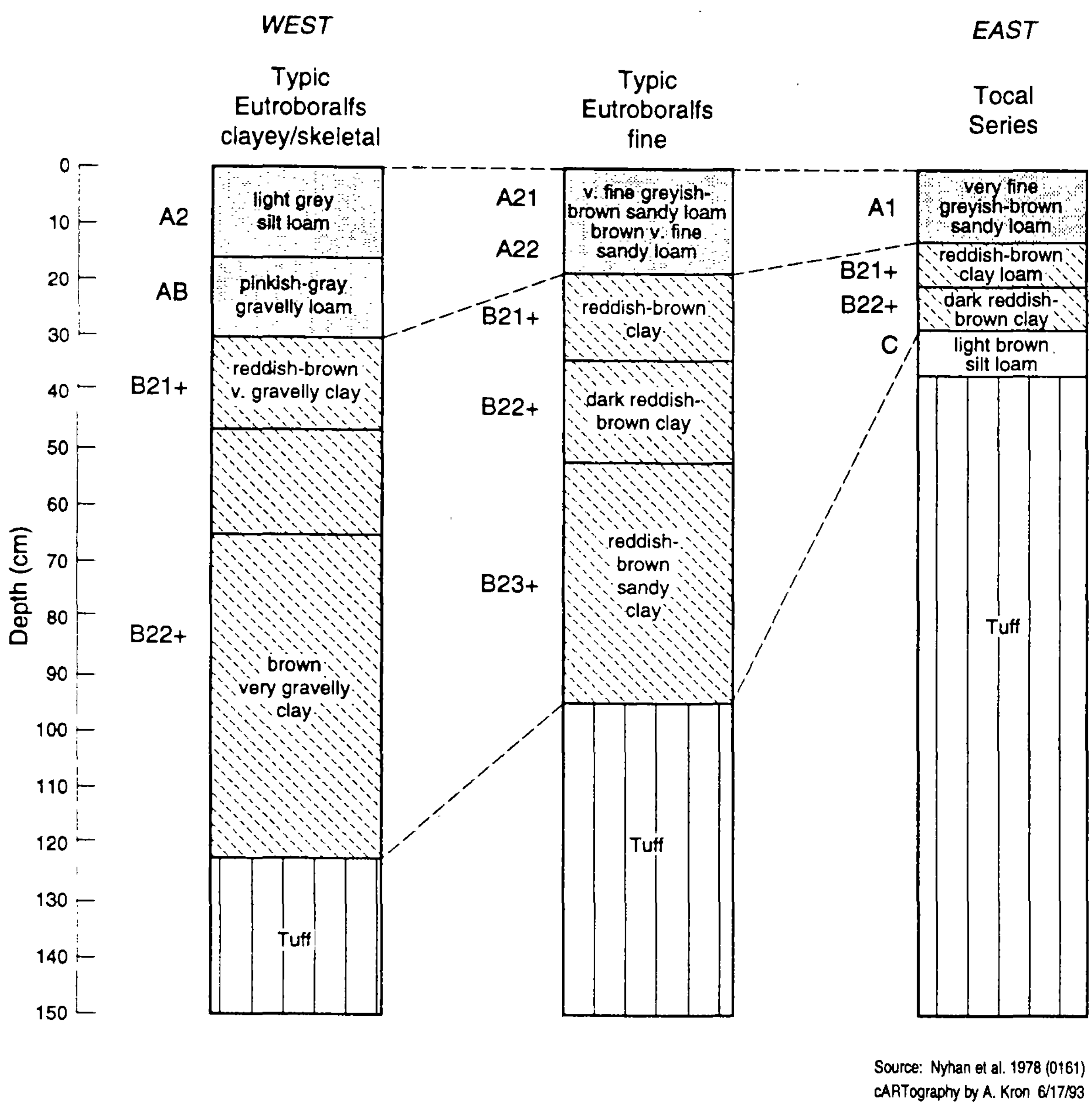


Fig. 3-5. Typical sections of common soils at TA-16 (S-Site).

canyon walls. Erosion within the canyon bottoms occurs primarily by channelized flow along stream courses on the canyon floors.

Erosion of colluvial materials may occur as: 1) small masses of material that tumble down canyon walls, 2) small debris flows that issue from the mouths of subsidiary channels to the main canyon drainages, or 3) slides of large, relatively coherent landslide blocks from the steeper mesa edges.

Contaminants stored in sediments on mesa tops may be transported into the canyons, and potentially off site, by large-scale runoff events on the mesa surfaces, or may be carried in large masses of rock and debris as they slide down valley walls into the canyon bottoms. Contaminated sediments in the canyon bottoms are most likely to be transported off site in major runoff events. Waste sites in OU 1082 most likely to be susceptible to off-site mobilization are those that lie close to the edges of mesas or near active channels in canyon bottoms.

3.5 Conceptual Hydrologic Model

The groundwater pathway is unlikely to be an important transport pathway at TA-16 because of the great depth to the main aquifer (>1 000 ft). However, surface and vadose zone hydrology may strongly influence the stability and movement of contaminants in the TA-16 area.

3.5.1 Surface Water Hydrology

Surface water runoff and infiltration into soil are the most important hydrologic transport pathways at TA-16. Both high explosives (HE) and barium, the principal contaminants at TA-16, are moderately to strongly soluble (Layton et al. 1987, 15-16-447; Brown et al. 1992, 15-16-389), and thus may be transported in surface water. Aspects of the surface hydrology at TA-16 that may be relevant to contaminant transport include: 1) the location of pathways of surface water runoff and associated sediment deposition; 2) rates of soil erosion, transport, and sedimentation; 3) the effects of operational disturbances on surface hydrology; 4) the relative importance of surface runoff versus infiltration as a transport pathway in different soil types; 5) the solubility behavior of TA-16 contaminants (particularly HE and barium) in surface aquifers; 6) the nature of interactions between soils and water-borne TA-16 contaminants; and, 7) the ultimate fate of surface water at TA-16.

3.5.1.1 Surface Water Runoff

Surface water runoff is an effective means of transporting many contaminants, particularly highly-soluble contaminants, in environmental media at TA-16. Runoff can mobilize contaminants and transport them off site or concentrate dispersed surficial contaminants through solution and reprecipitation or sorption processes. Surface water runoff from TA-16 flows from ephemeral streams on the mesa tops into Cañon de Valle and Water Canyon and ultimately into the Rio Grande, or infiltrates downgradient. There is no evidence for the hydraulic connection of surface water and the regional aquifer at TA-16 or elsewhere at the Laboratory (IWP, Chapter 2), although it is possible there is a connection between discharge sinks in canyon bottoms and the main aquifer east of OU 1082. Permanent alluvial aquifers are not known in Cañon de Valle or Water Canyon, but surface runoff may occasionally recharge short-lived alluvial systems.

As described in the IWP, the heaviest precipitation on the Pajarito Plateau occurs during summer thunderstorms. These thunderstorms can produce transient high discharge rates that may transport dissolved material, colloids, and contaminated sediments. Both these rain-induced events and snowmelt may yield ephemeral stream flows in the major canyons that could reach the Rio Grande.

No comprehensive study of surface runoff from the mesa tops and canyons constituting the surface watershed of the Pajarito Plateau has been completed. A recent experimental study (Nyhan et al. 1984, 0165; Nyhan and Lane 1986, 0159) suggests that runoff is up to three times greater from backfilled soil than from naturally vegetated areas. Much of TA-16 has been disturbed by construction, so that runoff will be a significant transport pathway in the operational section of this technical area.

Water quality data have been collected downstream from TA-16 in Water Canyon for the past 30 years. Water chemistry analyses over this period have generally shown that contaminant abundances are below levels of concern (Environmental Protection Agency, New Mexico Environment Department, and Department of Energy standards) for barium and other metals. It is interesting to note that soluble barium concentration at the confluence of Water Canyon with the Rio Grande is larger (0.187 mg/L) than in the other sampled Canyons: Pajarito, 0.043 mg/L; Ancho, 0.043 mg/L; and Frijoles, 0.015 mg/L (Environmental Protection Group 1992, 0740).

3.5.1.2 Surface Water Infiltration

Surface water infiltration is a potential mechanism for surface contaminants to move into subsurface soils and tuffs and eventually reach perched or regional aquifers. Surface water infiltration is considered to be a minor transport mechanism at the Laboratory because of the great depth to the regional aquifer, the high evaporative potential of the upper tuff, the likelihood of vegetative transpiration, and the resulting naturally low moisture content and high porosity of the tuffs (LANL 1992, 0768).

3.5.2 Hydrogeology

The hydrogeology of the Laboratory and the occurrence of surface water and groundwater are summarized in Subsection 2.6 of the IWP (LANL 1992, 0768). Canyon and mesa topography and the ash deposits of the Bandelier Tuff control the hydrogeology of OU 1082. The hydrology (occurrence and movement of water in surface and subsurface environments) of individual SWMUs in OU 1082 is controlled by the physiographic location of each SWMU in canyon bottoms, canyon rims, or mesa tops. The majority of OU 1082 SWMUs lie on the mesa tops, although a few SWMUs, such as SWMU 16-018 (MDA P), are located on the rims of the canyons. The following discussion presents site-specific information on the hydrologic conditions in Water Canyon and on the mesa top of OU 1082.

3.5.2.1 Vadose Zone

The mesa top of OU 1082 overlies at least 850 ft of unsaturated Bandelier Tuff, interbedded epiclastic sediments and pumice falls, and underlying Puye Formation sediments. The hydrology of the mesa top vadose zone is discussed in Subsection 2.6.3 of the IWP (LANL 1992, 0768). In general, the IWP suggests that the Bandelier Tuff is not saturated, except in very shallow and localized areas. The low moisture content and extensive thickness of unsaturated rock is believed to impede movement of fluids downward to the main aquifer (LANL 1992, 0768).

Hydrologic characteristics of unfractured Bandelier Tuff depend on degree of welding, with porosity and hydraulic conductivity generally decreasing with increased degree of welding. Brown et al. (1988, 0034) investigated hydraulic conductivity and gravimetric moisture for tuff samples recovered during 1987 drilling operations at Area P. Samples obtained during drilling at Area P were not saturated, according to these workers. At Los Alamos, saturated hydraulic conductivity for a moderately welded tuff ranges from 0.1 to 1.7 ft/day and for a welded tuff ranges from 0.009-0.26 ft/day (Abeele et al. 1981, 0009). However, because fracture density is generally greatest in welded tuffs, saturated hydraulic conductivities are often highest in the welded parts of ash flow deposits (Crowe et al. 1978, 0041).

Table 3-2 summarizes gravimetric moisture data collected for Unit 3 by Brown et al. (1988, 0034). Nyhan (1989, 0154) reports volumetric water content data for three of the monitoring wells at Area P (Fig. 3-1), which are summarized in Fig. 3-6. In Bandelier Tuff samples, Nyhan reports low volumetric water contents in the background well (P-12), and significantly higher (up to 36%) volumetric water contents in core holes nearer the landfill (P-13 and P-16). He ascribes these higher volumetric water contents to an unlined drainage ditch that traverses the southern landfill boundary.

TABLE 3-2

AVERAGE GRAVIMETRIC MOISTURE CONTENTS

SUBUNIT	MEAN (%)	STANDARD DEVIATION	RANGE (%)
3d	5.2	3.6	2.2-17.7
3c	6.1	3.5	1.9-24.7
3b	5.7	2.1	2.3-11.4
3a	3.8	1.4	2.3-5.8
Total unit	5.8	3.0	1.9-24.7

All data is from Brown et al. 1988, 0034

Although the range of 1.9% to 24.7% for background volumetric water content is considered low, these values exceed gravimetric moisture contents for technical areas further to the south and east (5 to 11% at TA-33, 2 to 20% for TA-54; Brown et al. 1988, 0034) and values reported in the IWP (5%).

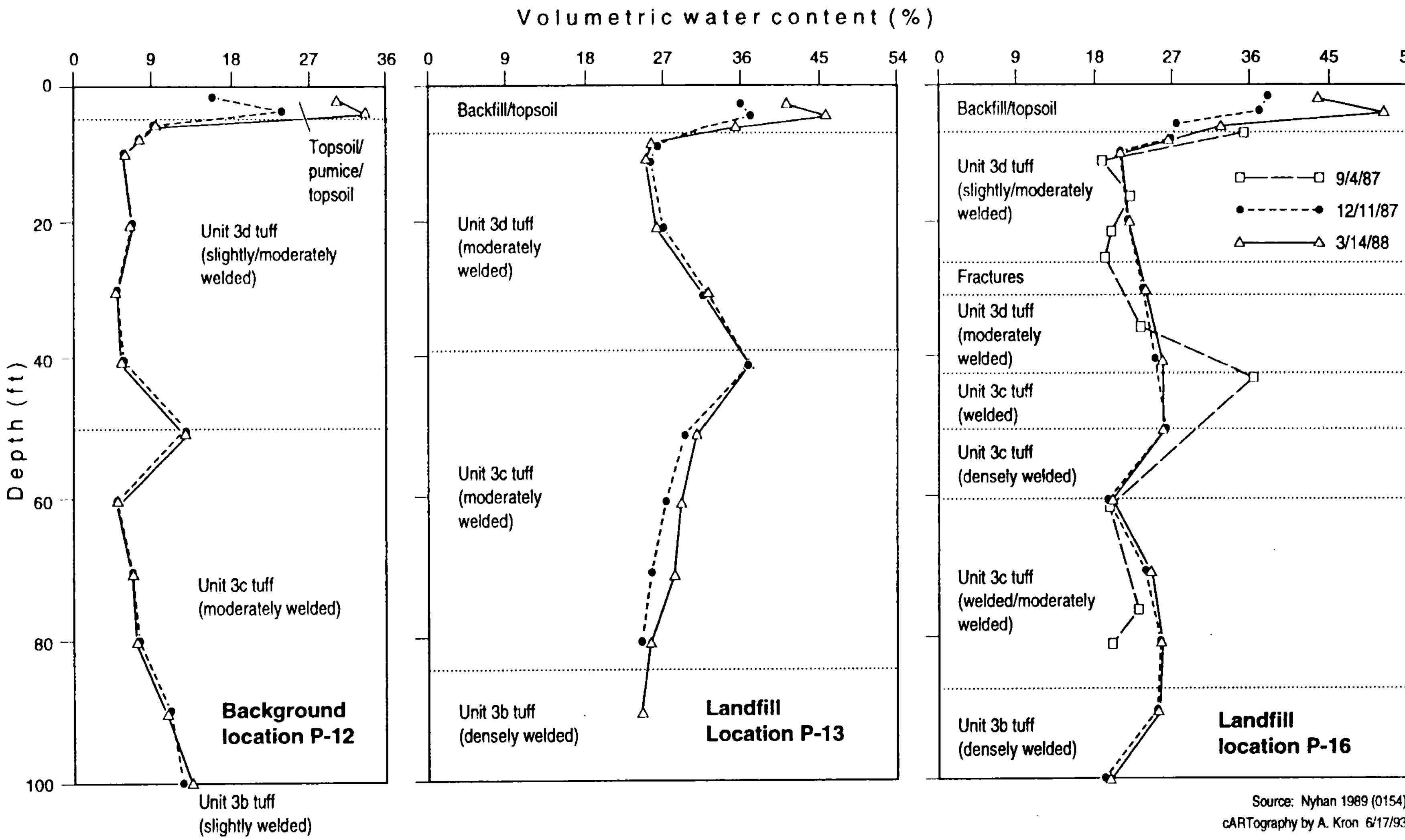


Fig. 3-6. Volumetric water content data from representative drill holes for the Area P landfill area.

This higher range may be a result of increased rainfall at TA-16 relative to the eastern portions of the Laboratory. Saturation of the Tshirege Member of the Bandelier Tuff, and thus groundwater, occurs at a gravimetric moisture content of 29% (Abrahams 1963, 0011). When moisture content is below 7%, there is no water movement; between 7 to 21% moisture is redistributed by diffusion; between 21 to 29% it is mobilized by gravity and capillarity; and above 29%, movement is by gravity drainage. Thus, at Area P the primary mechanism of moisture movement is by diffusion.

3.5.2.2 Alluvial Aquifers

Surface water in saturated alluvium within canyons is discussed in Subsection 2.6.4 of the IWP (LANL 1992, 0768). Surface water occurs primarily as ephemeral streams in the two major canyons adjacent to OU 1082, although perennial water flow occurs in parts of Cañon de Valle and Water Canyon because of spring discharge and process water discharged from TA-16-260 and other buildings. Stream flow moves downgradient into the alluvium for an unknown distance. Stream loss caused by infiltration into the underlying alluvium typically prevents water flow from discharging across the eastern boundary of the OU. During periods of voluminous stream runoff or snowmelt, surface flow may reach the Rio Grande. The possible existence of perennial aquifers in these canyons has not been investigated. Such aquifers occur in other canyons on the Pajarito Plateau (LANL 1992, 0768).

3.5.2.3 Perched Aquifer

Perched water may occur in epiclastic sediments and basalts in the Pajarito Plateau (IWP, Subsection 2.6.5) (LANL 1992, 0768). Seismic Hazards Well SHB-3 erupted large volumes of water following air injection at a depth of 750 ft (Gardner et al. 1993, 15-16-423). Either the main aquifer or a perched aquifer was reached at this depth. Analysis of these fluids suggests that they represent groundwater, based on the absence of drilling additives in the fluid. Calculations suggest that the top of the groundwater column filling SHB-3 could have been no deeper than 365 ft. This result implies that the groundwater system has sufficient head to drive water up natural conduits such as faults and fractures, potentially forming a perched aquifer. The possible nature and location of perched aquifers in and around OU 1082 is not known. Further investigation of fluids in SHB-3 is required to determine whether the fluids represent perched water or the main aquifer. Ongoing chemical and isotopic studies of fluids from this hole may provide information on the sources of these materials.

3.5.2.4 Main Aquifer

The depth to the main aquifer at OU 1082 has not been determined. The hydrology of the main aquifer beneath the Pajarito Plateau is described in Subsection 2.6.6 of the IWP (LANL 1992, 0768). According to the IWP, the main aquifer is located primarily in the Santa Fe Group and Puye Formation at depths of several hundred to greater than 1 000 ft below the mesa tops. Based on current knowledge of the hydrology of the Plateau as reflected in the IWP, the potential for impact on the main aquifer or the municipal drinking water supply from the SWMUs in OU 1082 is thought to be extremely low.

3.6 Conceptual 3-D Geologic/Hydrologic Model of OU 1082

A conceptual model for OU 1082 has been developed based on the discussion of environmental setting presented in Subsections 3.1 through 3.5 of this chapter. The conceptual model is presented in simplified diagrammatic form in Fig. 3-7. The physical processes and major pathways included in the model are based on current knowledge of the OU environment and the types of SWMUs present at OU 1082. The processes and pathways discussed below provide the basis for the SWMU-specific conceptual models for potential contaminant releases presented in Chapters 4 and 5. The primary release mechanisms and migration pathways of concern are:

- surface runoff and sediment transport,
- erosion and surface exposure,
- infiltration and transport in the vadose zone, and,
- atmospheric dispersal of particulates.

These pathways are believed to provide the greatest potential for release and transport of contaminants to the environment at OU 1082. Additional

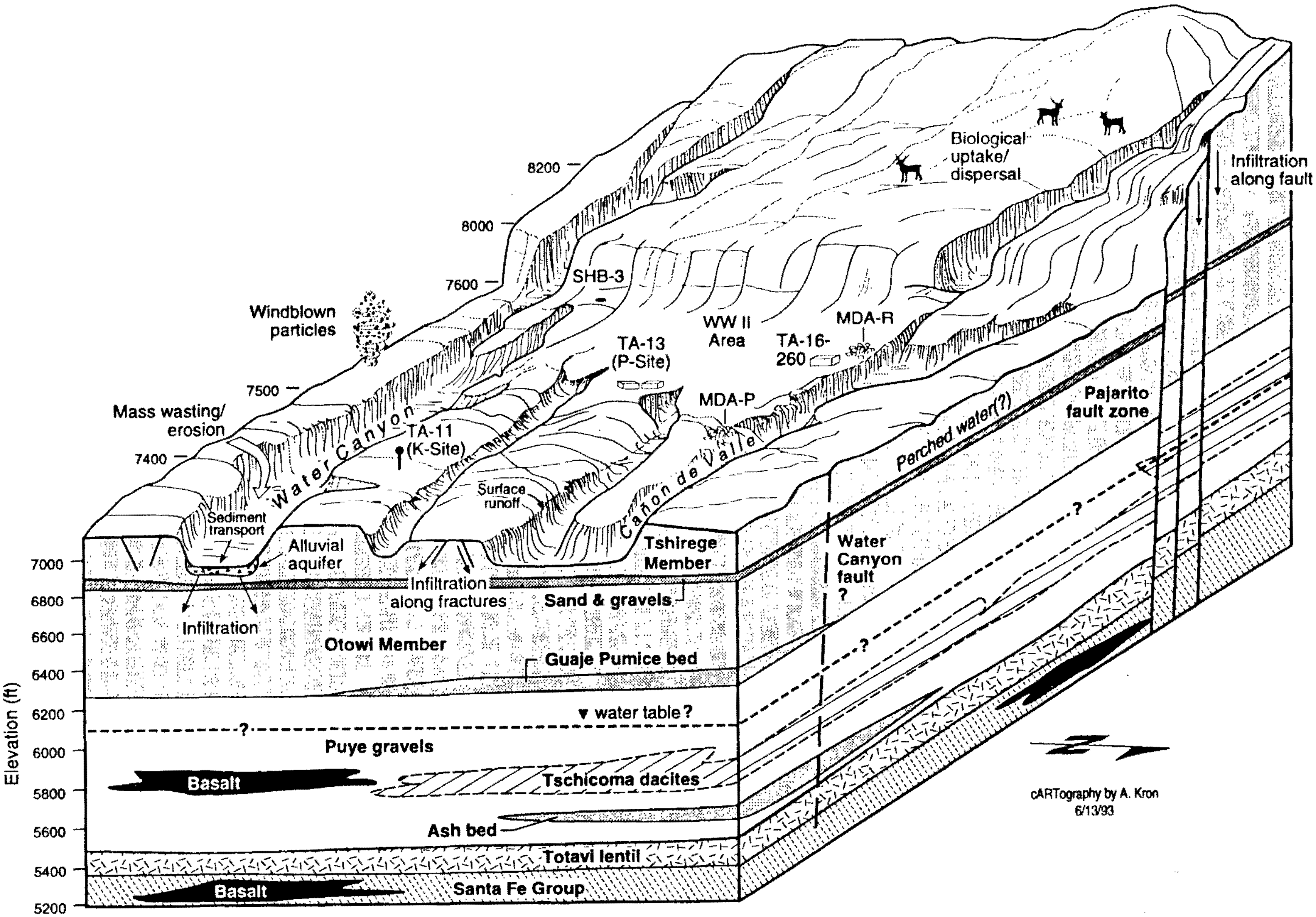


Fig. 3-7. **Conceptual hydrogeologic model of OU 1082.**

release migration pathways of lesser concern are fluid transport via alluvial aquifers, perched water, springs, and seeps.

3.6.1 Surface Water Runoff and Sediment Transport

Surface water runoff and sediment transport are the migration pathways of greatest concern for transport of contaminants to off-site receptors. Surface water runoff is concentrated by natural topographic features and man-made diversions, and flows toward the canyons. A topographic low can cause runoff to pond and infiltrate into the mesa top, or facilitate sorption of contaminants onto finer-grained clay-rich sediments or organic particles. Contaminant transport by surface water runoff can occur in solution, by adsorption on suspended colloids, or with movement of heavier bedload sediments. Surface soil erosion and sediment transport are functions of soil properties and runoff intensity. Contaminants transported in runoff can disperse or concentrate in sediment traps in drainages. Erosion of drainage channels can disperse contaminants downgradient in a drainage.

3.6.2 Erosion and Surface Exposure

Soil erosion and mass wasting are long-term release mechanisms that may expose subsurface contaminants or allow water to access previously contained wastes. Erosion of surface soils depends on soil properties, vegetative cover, slope, exposure, intensity and frequency of precipitation, and seismic activity. Mass movements of rock from canyon walls is a discontinuous process that generally proceeds at a slow rate, but can be an important mechanism for exposing subsurface contaminants located near canyon rims.

3.6.3 Infiltration and Transport in the Vadose Zone

Infiltration into surface soils and tuffs depends on the rates of precipitation and snowmelt, the amount of ponding, the nature of vegetation, *in situ* moisture content, and the hydraulic properties of soil and tuff. Joints and faults may provide pathways for infiltration and release of contaminants into the shallow subsurface. Movement of liquids in soil and tuff is dominated by transient, unsaturated flow processes influenced by infiltration and evapotranspiration. The movement of contaminants by liquids in the unsaturated zone can occur in a free-liquid phase, in solution, or by adsorbed particles on colloids. Contaminants may be retarded as a result of adsorption on tuff or on organic material present in soil or alluvium. Precipitation of insoluble, contaminant-rich minerals such as barite may also retard the mobility of specific contaminants. Lateral flow or perched water may occur at unit contacts, between layers whose hydraulic properties differ, and in alluvial aquifers. Saturated lateral flow may discharge as springs or seeps on canyon walls or in canyon bottoms. Vapor phase movement in the unsaturated zone is a potentially important transport mechanism for volatile contaminants. Movement of contaminants in the vapor phase is influenced by concentration gradients, temperature gradients, density gradients, and/or air pressure gradients. Fractures may enhance liquid-phase or vapor-phase contaminant transport in the subsurface.

3.6.4 Atmospheric Dispersion

Wind entrainment of contaminated particulates, detonation or burn products, material releases from point sources such as stacks, or volatile organic compounds is a potential pathway for atmospheric dispersal of contaminants. This dispersal mechanism is limited to HE detonation and combustion by-products, surface contaminants, and vapors released from soil pore gases, as well as point sources. Entrainment and deposition of particulates is controlled by soil properties, surface roughness, vegetative cover, terrain, and atmospheric conditions including wind speed, wind direction, and precipitation. Vapor dispersion is controlled by similar factors.

Not all release mechanisms and migration pathways discussed in this subsection are believed to be significant for all SWMUs. The generic conceptual models in Chapter 4 and the SWMU-specific conceptual models in Chapter 5 indicate for which SWMUs these contaminant dispersal processes may operate.

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Executive Summary

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4.0 TECHNICAL APPROACH

4.1 Aggregation of Potential Release Sites

Chapter 5, Evaluation of Potential Release Sites (PRSs), presents the conceptual models, data needs, data quality objectives, and sampling and analysis plans for all PRSs that will have a current RCRA facility investigation (RFI). In Chapter 5, PRSs are aggregated when it makes sense to address several of them as a unit in terms of characterization, risk assessment, and/or remediation. For example, the active firing site PRSs associated with Technical Area (TA) 11 are aggregated (Subsection 5.14) since only the potential for off-site hazards will be evaluated in this RFI and final investigations and corrective actions will be postponed until decommissioning. This may be considered to be a conditional remedy, consistent with proposed Subpart S guidance. Table 1-4 in Chapter 1 lists the aggregates and related PRSs and the section in Chapter 5 where these aggregates are presented. A detailed discussion of the rationale for aggregating the PRSs is given in the background subsection (Subsection 5.x.1) for each aggregate.

4.2 Approaches to Site Characterization

This work plan adheres to the Environmental Restoration (ER) Program technical approach for data collection and evaluation as documented in Chapter 4 of the Installation Work Plan (IWP) (LANL 1992, 0768). This technical approach adopts the philosophy of the Observational Approach (Appendix G, IWP) (LANL 1992, 0768), which bases decisions for action [e.g., collecting additional data vs. moving from the facility investigation to the corrective measures study (CMS)] on definitions for acceptable uncertainties that depend on the current phase of the investigation. Investigations are phased so that decisions remain closely tied to the ultimate goal of selecting an appropriate corrective action and so that they are formulated in light of what is already known about the site. The ER Program has adopted a risk-based approach to making corrective action decisions during the RFI/CMS process. In this work plan, the Data Quality Objectives (DQO) process [Chapter 4 and Appendix I of the IWP (LANL 1992, 0768)] is used to identify site-specific risk-based decisions or risk-related questions, to identify and, in some cases, quantify risk-based decision errors, and to specify sampling designs to support the risk-based decisions or risk-related questions. This RFI work plan emphasizes human risk; however, ecological risk will also be considered in the future.

Ecological risk assessment methodology is currently under development, and guidance on the measurement end points and spatial scales for determining significant ecological effects will be available in the next IWP. No further action (NFA) for individual PRSs will be proposed based on a comparison to human health risk-based screening action levels (SALs) or a baseline health risk assessment, but an ecological risk assessment will have to be conducted at the appropriate spatial scale to identify ecological effects. If unacceptable ecological effects are identified, then the NFA decisions will be revisited. The contribution of all PRSs, including those proposed for NFA, to the unacceptable ecological risk will be assessed so that an effective mitigation strategy can be developed.

Certain environmental criteria, as required by the National Environmental Policy Act (NEPA), endangered species act, wetlands executive orders, or historic preservation act will be evaluated before sampling or any other significant site activity. The purpose of these evaluations is to determine the impact of sample collection on components of the environment protected by these specific regulations. These regulatory drivers may be important in future ecological risk assessments, and include:

- State or Federal sensitive, threatened, or endangered plant or animal species that potentially occur in Operable Unit (OU) 1082,
- sensitive areas (e.g., flood plains or wetlands), and
- plants and wildlife of cultural importance.

4.2.1 Decision Model

A goal of this RFI is to detect the presence of contaminants of concern (COCs). COCs are defined as hazardous constituents or radionuclides whose levels are either above SALs and above background levels. SALs are media-specific concentration levels for potential contaminants derived using conservative criteria. SALs are discussed in Subsection 4.2.2.

The first step in the RFI is to evaluate archival information and make field reconnaissance visits to formulate a conceptual model for the site (Fig. 4-1). These data help develop a list of potential contaminants of concern (PCOCs).

As shown in Fig. 4-1, NFA or deferred action (DA) may be recommended after the first step of the RFI. Criteria for NFA based on archival information are discussed in Subsections 4.2.4 and 4.4.1 of the IWP (LANL 1992, 0768) and the details are described in Appendix I, Subsection 4.1 of that document. The PRSs recommended for NFA or DA based on archival information are presented in Chapter 6 of this work plan and are depicted on a fold-out map in Appendix E. Some of the DA PRSs are also discussed in Chapter 5 because they will have current investigations to evaluate off-site migration; for example, TA-11 Firing Site Aggregate (Subsection 5.14).

NFA or DA is based on human health concerns, but these decisions may be revisited based on an ecological risk assessment performed at a later date.

In some cases existing site data are adequate to identify the need for a corrective action. If there is an obvious, feasible, and effective remedy, then a voluntary corrective action (VCA) (Subsection 4.2.3) will be implemented; otherwise, a corrective measures study (CMS) will be required. Some sump outfalls (Subsections 5.2, 5.3) will have VCAs.

In other cases, PRSs may have known contaminants, but the historical data are inadequate to quantify the hazard associated with a site. These sites require Phase I data to support a baseline risk assessment. These data include the nature and extent of contamination. PRSs included in this category are the sanitary waste treatment plant (Subsection 5.7), the burning ground (Subsection 5.8), Cañon de Valle (Subsection 5.9), the ponds (Subsection 5.12), and TA-13 (Subsection 5.13).

For many PRSs in OU 1082 the archival information indicates that it is highly probable there are no COCs at the site, but there are no existing data and the archival information is not sufficient to recommend NFA. For these sites, and sites where virtually no information exists, a screening assessment will be conducted to determine the presence or absence of COCs. A primary goal of screening assessments (most Phase I investigations) is to identify those PRSs that pose no hazard to human health or the environment so that

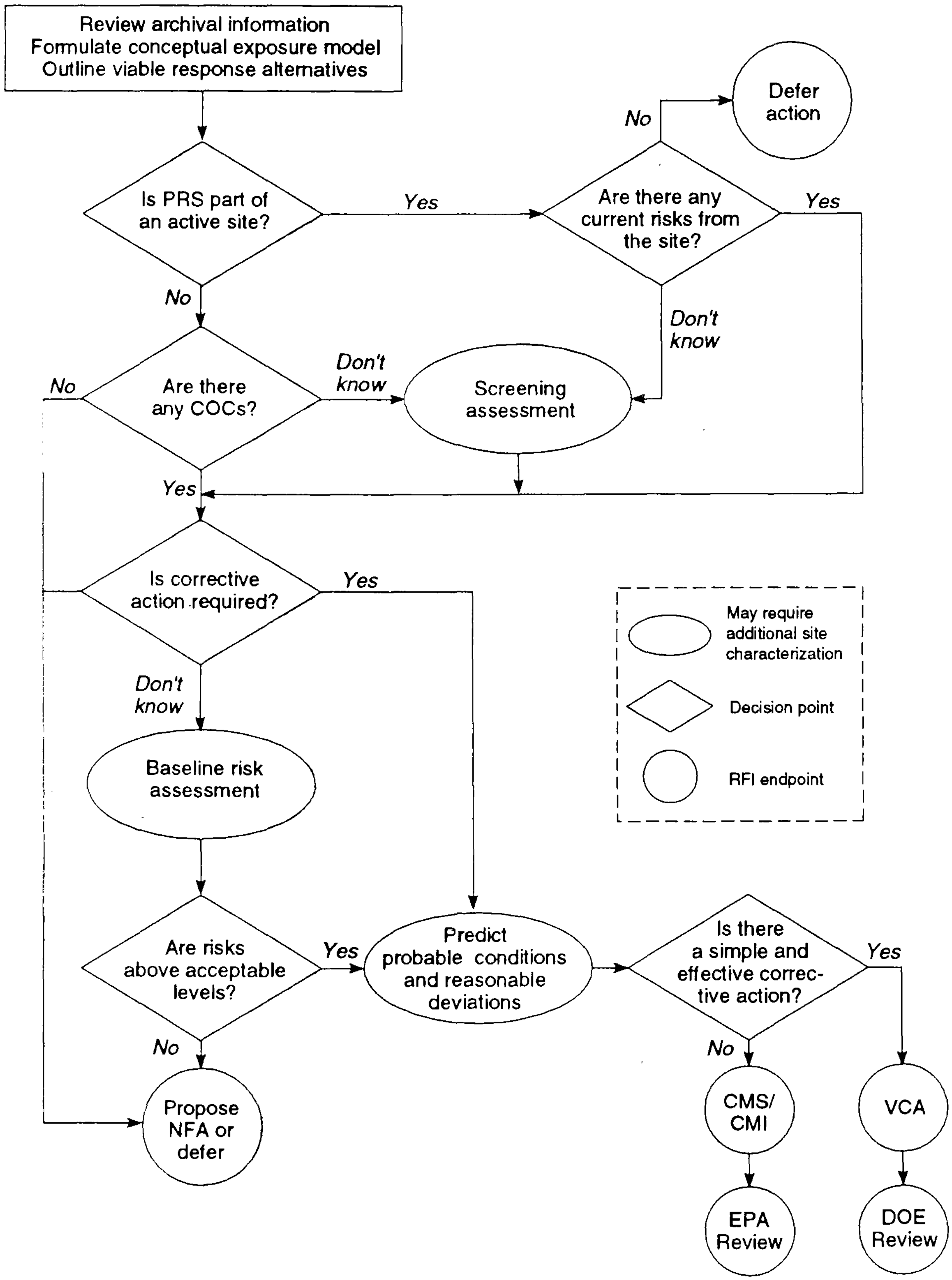

Fig. 4-1. Decision flow during the RFI.

they can be recommended for NFA. Eliminating non-problems through screening assessments allocates resources efficiently and effectively, and provides timely corrective actions for those PRSs that present the greatest hazard.

The generic logic flow for screening assessments is shown in Fig. 4-2. Descriptions of sampling strategies for screening assessments are given in Subsection 4.5. There are two principal kinds of sampling strategies used in a screening assessment: reconnaissance sampling and baseline risk assessment sampling, although in some cases reconnaissance sampling may eventually be used in a baseline risk assessment. The purpose of reconnaissance sampling is to determine if there are any COCs at a PRS where there is little or no historical information. The purpose of baseline risk assessment *sampling* is to collect data to support two decisions: 1) determine if there are any COCs by comparing concentrations to SALs, and 2) perform a baseline risk assessment. Baseline risk assessment sampling is used where data suggest that some potential contaminants will exceed SALs, and a baseline risk assessment is likely.

If COCs are detected in the screening assessment, then a decision will be made to either implement a VCA or perform a baseline risk assessment. Additional characterization data may be required for these phases. The baseline risk assessments for OU 1082 will be performed using the risk scenarios described in Subsection 4.3.

PRS or PRS aggregate-specific decision processes are described in the Remediation Decisions and Investigations Objectives sections of Chapter 5.

4.2.2 Screening Action Levels

SALs are media-specific concentration levels for potential contaminants derived using conservative criteria (IWP Appendix J) (LANL 1992, 0768). In most cases, SALs for non-radiological potential contaminants are based on the methodology in Proposed Subpart S of 40 CFR 264 to calculate action levels (EPA 1990, 0432). Radiological SALs are based on a 10 mrem per year dose using a residential-use exposure scenario. However, if a regulatory standard exists and is lower than the value derived by these methods, this lower value is used in place of the SAL. The derivation of SALs is discussed

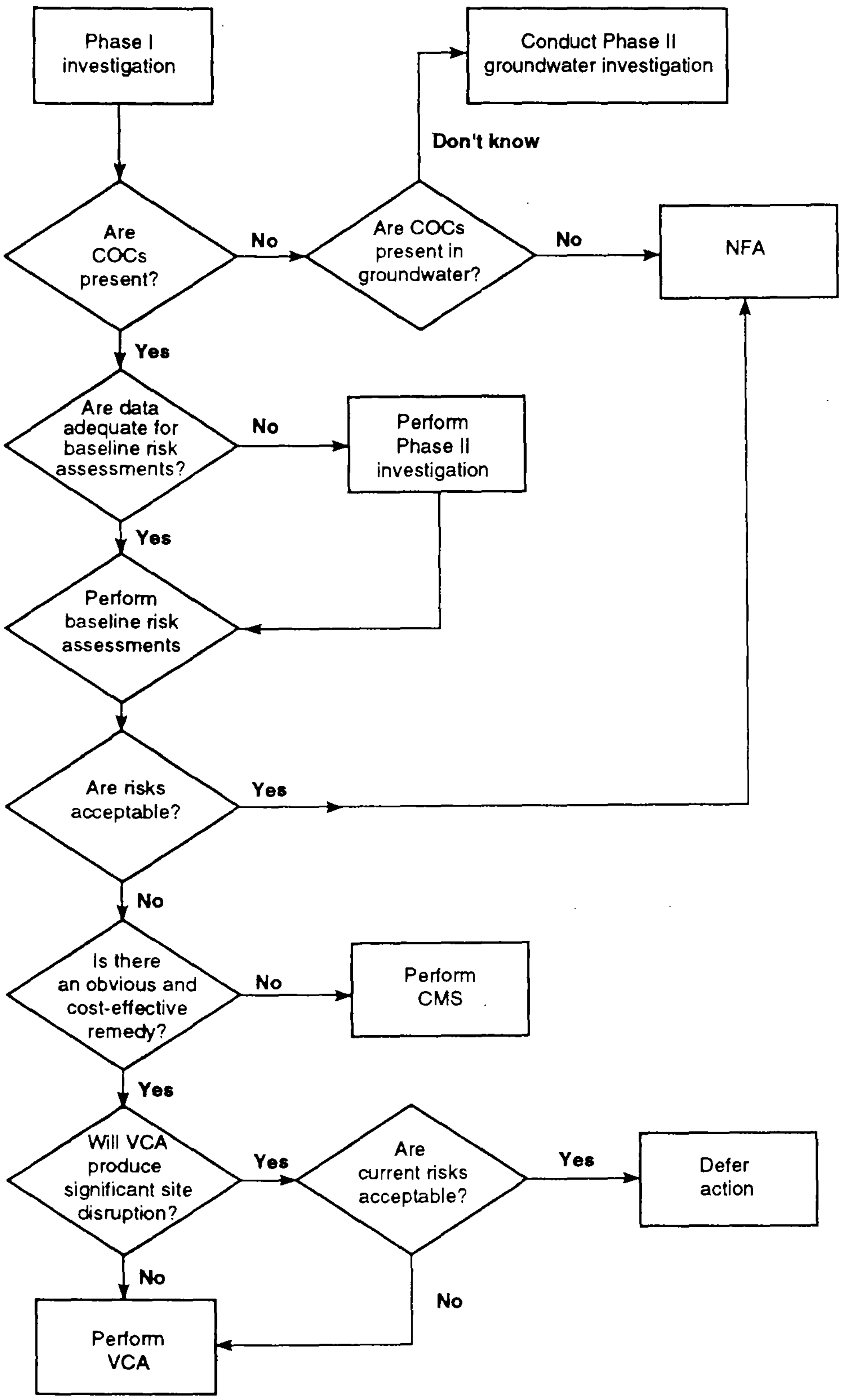

Fig. 4-2. Decision logic for actions subsequent to Phase I investigations.

in Chapter 4 of the IWP and the values for nonradiological constituents are given in Appendix J (LANL 1992, 0768). The motivation for developing SALs is to have a tool for effective discrimination between problem and non-problem sites so that resources are used effectively. SALs are not cleanup levels; cleanup levels will be based on site-specific risk evaluations and as low as reasonably achievable (ALARA) criteria. In some cases, cleanup levels may be higher than SALs. For example, if the site will never be used for residential use, the site-specific land-use scenario (e.g., recreational use) could allow higher levels of soil contamination than the conservative residential use scenario used to calculate SALs.

SALs for the primary PCOCs at OU 1082 are given in Table 4-1. These PCOCs were identified through the evaluation of archival information, historical data, and the literature on high explosives (HE) (see Appendix D). Many of the PCOCs listed in Table 4-1 do not have SALs available in the IWP, Appendix J. This is because many of the compounds are not target compound list (TCL) or target analyte list (TAL) analytes. For those compounds for which reference dose (RfD) and/or slope factors were readily available, SALs were calculated using the methodology of the IWP. These compounds include TNT, HMX, RDX, and DNT. If PCOCs without SALs listed in Table 4-1 are determined at finite concentrations in environmental samples using gas chromatography or high-pressure liquid chromatography (HPLC), then the following steps will be taken:

1. available literature sources will be screened in search of RfD and/or slope factors for these compounds in order to calculate SALs or perform baseline risk assessments; and,

2. if health-based SALs for these compounds cannot be calculated, cleanup levels will be negotiated with appropriate regulatory agencies.

If other PCOCs are detected, additional SALs will be provided.

4.2.3 Voluntary Corrective Actions

VCAs will be implemented at OU 1082 when a site presents unacceptable risks, or has contaminant levels greater than SALs and it is more cost-effective to implement a VCA than to perform the characterization necessary

TABLE 4-1

POTENTIAL CONTAMINANTS OF CONCERN AT OU 1082

POTENTIAL CONTAMINANTS OF CONCERN (1)	PRS AGGREGATE (2)	LAB METH. (3)	LAB PQL (WATER/ SOIL) (µg/L/ppm) (4)	MOBILE LAB METH.	MOBILE LAB PQL IN SOIL (ppm) (5)	FIELD SCREEN METH.	FIELD SCREEN PQL IN SOIL (ppm) (6)	LANL BACK-GROUND IN SOIL (ppm) (7)	SAL IN WATER (µg/L) (8)	SAL IN SOIL (ppm) (8)
Acetone	5.1, 5.2, 5.3, 5.12	8240	100 /100 ppb	GC/PID	50 ppb	PID	.2	0	3 500	8 000
ADNT (g)								0		
Amines (a)								0		
Ammonium nitrate (d)								0		
Ammonium sulfate	5.2							0		
Anthracene	5.2	8270	10/660 ppb	GC/FID	1			0	10 000	24 000
Anthranils (i.e. 2,6 dinitroanthranil) (a)								0		
Asbestos	5.10, 5.13, 5.14							0		
Barium	5.2 to 5.4; 5.7 to 5.17	6010	2/0.2	XRF	10	LIBS	< 100	120-810	1 000	5 600
Benzene	5.12	8240	5/5 ppb	GC/PID	10 ppb	PID	.2	0	1.2	0.67
Beryllium	5.2,5.7,5.12, 5.13,5.14	6010	0.3/0.03			LIBS	0.1	0.42-4.4	0.0081	0.16
BDNPA (d)								0		
BDNPF (d)								0		
Bromodichloromethane	5.2	8240	5/5 ppb	GC/PID	10 ppb			0	0.27	5.4
BTX (f)								0		
Butyl acetate, n-	5.2							0		
Cadmium	5.2,5.12	6010	4/0.4	XRF	2			0.03-1.70	5	80
Carbon disulfide	5.7	8240	5/5 ppb	GC/PID	10 ppb	PID	.2	0	3 500	7.4
Carbon tetrachloride	5.2	8240	5/5 ppb	GC/PID	10 ppb	PID	.2	0	0.27	0.21
Cesium-137		γ spec	20/pCi/L/ 0.1 pCi/g	Gross γ	4 pCi/g			0.01-0.82		4 pCi/g
Chlorobenzene	5.2,5.12	8240	5/5 ppb	GC/PID	10 ppb	PID	.2	0	100	67
Chloroethane	5.7	8240	10/10 ppb	GC/PID	10 ppb	PID	.2	0	NA	3 300
Chloroethene	5.1							0		
Chloroform	5.2	8240	5/5 ppb	GC/PID	10 ppb	PID	.2	0	5.7	0.21
Chloromaleic anhydride	5.2							0		
Chloromethane	5.7	8240	10/10 ppb	GC/PID	10 ppb	PID	.2	0	27	6.4
Chlorothene	5.2							0		
Chromium	5.1,5.2,5.12,5.15	6010	7/0.7	XRF	8	LIBS	2	1.17-136	50	400 (VI)
Copper	5.7, 5.14	6010	6/0.6	XRF	3			----	1 300	3 000
Cyanide	5.2,5.3,5.4, 5.5, 5.6, 5.7,5.8,5.9, 5.14, 5.15, 5.16	9010	0.01 mg/L/ 5 mg/L					0	200	1 600

TABLE 4-1 (continued)

POTENTIAL CONTAMINANTS OF CONCERN AT OU 1082

POTENTIAL CONTAMINANTS OF CONCERN (1)	PRS AGGREGATE (2)	LAB METH. (3)	LAB PQL (WATER/ SOIL) (µg/L/ppm) (4)	MOBILE LAB METH.	MOBILE LAB PQL IN SOIL (ppm) (5)	FIELD SCREEN METH.	FIELD SCREEN PQL IN SOIL (ppm) (6)	LANL BACK-GROUND IN SOIL (ppm) (7)	SAL IN WATER (µg/L) (8)	SAL IN SOIL (ppm) (8)
Cyanuric acid (c)								0		
DATB (c)								0		
Decyclgallophenone (f)								0		
Di(2-ethyl) sebacate (f)								0		
2-Amino-4,6-DNT (a)								0		
4-Amino-2,6-DNT (a)								0		
Dibromochloromethane	5.2	8240	5/5 ppb	GC/PID	10 ppb	PID	.2	0	4.2	83
Dichloroethane,1,2-	5.2	8240	5/5 ppb	GC/PID	10 ppb	PID	.2	0	0.38	0.2
Diethylene triamine	5.2, 5.5							0		
Dimethyldisulfide	5.7							0		
Dimethylformamide	5.2							0	3 500	8 000
1,1 Dimethylhydrazine (a)								0		
1,2 Dimethylhydrazine (a)								0		
Dimethylsulfoxide	5.1, 5.3							0		
1,3 DNB (a)		8330	4.0/0.25					0	1	8
Dinitroethylbenzene (f)								0		
Dinitroglycoluril (e)								0		
3,5 Dinitrophenol (d)								0		
2,4 DNT (a)	5.2	8330	5.7/0.25	GC/FID	1			0	0.05	1
2,6 DNT (a)	5.2	8330	9.4/0.26	GC/FID	1			0	0.05	1
Dipentaerythritol hexanitrate (a)								0		
Dioctyl phthalate		8270	10/660 ppb	GC/FID	1			0	700	1 600
EDD (d)								0		
Ethyl acetate	5.1, 5.2							0	31 500	72 000
Ethylene glycol	5.1, 5.2							0	70 000	160 000
Formaldehyde (a)								0		
Freon-PCA solvent	5.1							0		
n-Hexane	5.2							0	2 100	4 800
HMX	5.2, 5.3, 5.4, 5.7, 5.8,5.9,5.10,5.11,5.12, 5.13,5.14, 5.16	8330	13.0/2.2			HE spot		0	1800	4 000

TABLE 4-1 (continued)

POTENTIAL CONTAMINANTS OF CONCERN AT OU 1082

POTENTIAL CONTAMINANTS OF CONCERN (1)	PRS AGGREGATE (2)	LAB METH. (3)	LAB PQL (WATER/ SOIL) (µg/L/ppm) (4)	MOBILE LAB METH.	MOBILE LAB PQL IN SOIL (ppm) (5)	FIELD SCREEN METH.	FIELD SCREEN PQL IN SOIL (ppm) (6)	LANL BACK-GROUND IN SOIL (ppm) (7)	SAL IN WATER (µg/L) (8)	SAL IN SOIL (ppm) (8)
Hydrazines (a)								0		
Lead	5.2, 5.10, 5.13, 5.14	6010	42/4.2	XRF	10	LIBS	2	8-98	50	500
Lithium hydride	5.17							0		
MAN (e)		8270						0		
Mercury	5.2, 5.4, 5.15	7470		XRF	30			0.007-0.029	2	24
Methanol (a)								0		40 000
Methylcyclohexane	5.2							0		
Methyl ethyl ketone (2-Butanone)	5.2	8240	100/100 ppb	GC/PID	50 ppb	PID	.2	0	1 700	2 100
Methylene chloride	5.2, 5.7	8240	5/5 ppb	GC/PID	10 ppb	PID	.2	0	4.7	5.6
Methylnitramine (a)								0		
N-methylpicramide (a)								0		
Nickel	5.12	6010	15/1.5	XRF	4			2-19	700	1 600
Nitrate (a, f)	5.9	9200	1 mg/L/1 ppm					0	10 000	128 000
Nitriles (i.e. 2,4,6 trinitrobenzonitrile) (a)								0		
Nitrite (a)			0.02 mg/L/NA					0		
Nitrobenzene (d)		8330	NA/0.26					0	18	5.3
Nitrocellulose (d)	5.2							0		
Nitroguanadine (c)								0		
Nitromethane (c)								0		
2 NT (a)		8330	12/0.25					0	350	800
3 NT (a)		8330	7.9/0.25					0	350	800
4 NT (a)		8330	8.5/0.25					0	350	800
NTO (e)								0		
octyl	5.2							0		
PAH (h)	5.9, 5.10, 5.13, 5.14							0		
Pentaerythritol	5.2							0		
PETN (c)						HE spot	100	0	700	1 600
Picric acid (e)								0		

TABLE 4-1 (continued)

POTENTIAL CONTAMINANTS OF CONCERN AT OU 1082

POTENTIAL CONTAMINANTS OF CONCERN (1)	PRS AGGREGATE (2)	LAB METH. (3)	LAB PQL (WATER/ SOIL) (μg/L/ppm) (4)	MOBILE LAB METH.	MOBILE LAB PQL IN SOIL (ppm) (5)	FIELD SCREEN METH.	FIELD SCREEN PQL IN SOIL (ppm) (6)	LANL BACK-GROUND IN SOIL (ppm) (7)	SAL IN WATER (μg/L) (8)	SAL IN SOIL (ppm) (8)
Plutonium-238	5.7, 5.14, 5.15, 5.16	α spec	0.04 pCi/L/0.005 pCi/g	Gross α/β	25 pCi/g	FIDLER	> 100 nCi/m2	<0.01 pCi/g		27 pCi/g
Plutonium-239,240	5.7, 5.14, 5.15,5.16	α spec	0.04 pCi/L/0.005 pCi/g	Gross α/β	25 pCi/g	FIDLER	100 nCi/m2	<0.01-0.07 pCi/g		24 pCi/g
Polonium-210	5.13							---		
PYX (e)								0		
RDX (b)	5.2, 5.3, 5.4, 5.7, 5.8,5.9,5.10,5.11,5.12, 5.13,5.14, 5.16	8330	14.0/1.0			HE spot	100	0	0.32	64
Silver	5.4,5.5,5.6,5.7,5.9,5.14,5.15 ,5.16	6010	7/0.7	XRF	17			1.61	50	400
TAGN (f)								0		
TATB (c)						HE spot	100	0		
TCP (f)								0		
Tetryl (d)		8330	44.0/0.65					0	350	800
Thallium		6010		XRF	15			0	2.8	6.4
Thorium-232	5.7, 5.14			Gross α/β	25 pCi/g			---		0.88 pCi/g
1,3,5 TNB (a)		8330	7.3/0.25					0	5.7	13
2,4,6 TNT (b)	5.2, 5.3, 5.4, 5.7, 5.8,5.9,5.10,5.11,5.12, 5.13,5.14, 5.16	8330	6.9/0.25			HE spot	100	0	17.5	40
Toluene diisocyanate	5.2							0		
Toluene	5.2, 5.3, 5.7, 5.12	8240	5/5 ppb	GC/PID	10 ppb	PID	.2	0	750	890
Toluol	5.1							0		
Trichloroethane,1,1,1-	5.2	8240	5/5 ppb	GC/PID	10	PID	.2	0	60	1 000
Trichloroethylene	5.1,5.4,5.8,5.12							0	3.2	3.2
Trimethyl phenol	5.2							0		
Trinitroethylbenzene (f)								0		
Trinitrostilbene (f)								0		
Tripentaerythritol acetonitrate (a)								0		

TABLE 4-1 (continued)

POTENTIAL CONTAMINANTS OF CONCERN AT OU 1082

POTENTIAL CONTAMINANTS OF CONCERN (1)	PRS AGGREGATE (2)	LAB METH. (3)	LAB PQL (WATER/ SOIL) (μg/L/ppm) (4)	MOBILE LAB METH.	MOBILE LAB PQL IN SOIL (ppm) (5)	FIELD SCREEN METH.	FIELD SCREEN PQL IN SOIL (ppm) (6)	LANL BACK-GROUND IN SOIL (ppm) (7)	SAL IN WATER (μg/L) (8)	SAL IN SOIL (ppm) (8)
Tripicrylmelamine (e)								0		
Uranium - natural	5.2, 5.3, 5.4, 5.7, 5.8, 5.9,5.10,5.11,5.12,5.13, 5.14,5.15, 5.16.			XRF	10			1-13	100	240
Uranium-235	5.14, 5.15, 5.16	α spec	0.2 pCi/L/0.05 pCi/g	Gross α/β	25 pCi/g	Phos-wich	35 pCi/g			18 pCi/gm
Uranium-238	5.14, 5.15, 5.16	α spec	0.2 pCi/L/0.01 pCi/g	Gross α/β	25 pCi/g	Phos-wich	35 pCi/g			59 pCi/gm
Zinc	5.7	6010	2/0.2	XRF	34				10 000	16 000

Additional entries will be made in this table as they become available.

Note: All MDLs are extremely case specific because of varying sample matrices and geometries and count times.

(1) Potential contaminants of concern include all chemicals specifically listed in Chapter 5, potentially hazardous HE components (see Appendix D), and HE co-contaminants (see Appendix D).

(2) Potential Release Sites in which the PCOC is of concern based on archival research

(3) SW 846 Method unless otherwise indicated..

(4) Method detection limits for EPA methods are taken directly from those listed in the appropriate SW 846 method or from the QAPjP. ICP metals detection limits in soils estimated as 100x water MDLs.

(5) Estimated by EM-9.

(6) Beryllium, lead, and chromium from Han and Cremers 1990 (15-16-470). PID from manufacturers' specifications. Uranium and plutonium = HS-4 estimate. TNT from Baytos 1991, 0741. HMX, RDX, TATB, and PETN estimated by WX-12.

(7) Local metal and radionuclide values from Ferenbaugh et al. 1990, 0099, Purtymun et al. 1987, 0211, and Duffy and Longmire (1993 15-16-480).

(8) SALs for TCL and TAL materials from IWP. HE SALs calculated using method described in IWP Appendix J. Water SALS are the lowest of those calculated for IWP Table J-1, and those listed in IWP Table J-2 as Safe Drinking Water Act or State of New Mexico MCLs. Radionuclide SALs calculated using RESRAD assuming a 10 mrem/yr exposure limit.

(a) HE impurity or environmental breakdown product

(b) HE component used at TA-16 (est. > 500 000 lbs.; all estimates for 50 year timeframe 1944-1993 by L. Hatler of WX-3.)

(c) HE component used at TA-16 (est. 10 000 to 100 000 lbs)

(d) HE component used at TA-16 (est. 1 000 to 10 000 lbs)

(e) HE component used at TA-16 (est. 100 to 1 000 lbs)

(f) HE component used at TA-16 (est. < 100 lbs)

(g) HE component used at TA-16 (unknown, but low, quantities)

(h) HE burn products

Abbreviations

ADNT - 3,5-dintiro-1,2,4-triazole
BDNPA - Bis(dinitropropony!) acetal
BDNPF - Bis(dinitropropony!) formal
BTX - 5,7-Dinitro-1-picrylbenzotriazole
DATB - Diaminotrinitrobenzene
DNB - Dinitrobenzene
DNPA - 2,2-Dinitropropyl acrylate polymer
DNT - Dinitrotoluene
EDD - Ethylenediamine dinitrate
HMX - Cyclotetramethylenetetranitramine
MAN - Methylamine nitrate
NT - Nitrotoluene
NTO - 1,2,4-Nitro-triazole-5-one
PCB - polychlorinated biphenyls
PETN - Pentaerythritol tetranitrate
PYX - 2,6-Bis(picylamino)-3,5-dinitropyridine
RDX - Cyclotrimethylenetrinitramine
TAGN - Triaminoguanidine nitrate
TATB - Triaminotrinitrobenzene
TCP - Tricresylphosphate
TNB - Trinitrobenzene
TNT - Trinitrotoluene

to perform a baseline risk assessment. For a VCA to be implemented the remedy must be obvious, feasible, and effective. A VCA may be proposed during any phase of the RFI. The PRSs that are likely to have VCAs include: sump outfalls in Subsections 5.2 and 5.3, and a RCRA closure of MDA P, which is described in Subsection 6.1.4.1. Any VCAs that will produce mixed waste will be postponed until the mixed waste disposal facility is available, unless the site presents an immediate health hazard. VCAs will be described in technical quarterly reports to DOE, and the public will be informed of VCAs in quarterly public meetings.

4.2.4 Active Sites

Many PRSs or portions of PRSs in OU 1082 are integral components of active site operations or are buried under an active area (TA-16 sumps, Subsections 5.2, 5.3; TA-11 and TA-16 septic systems, Subsection 5.4; the materials testing outfall, Subsection 5.5; the photoprocessing outfall, Subsection 5.6; and TA-11 firing site aggregate SWMUs, Subsection 5.14). Portions of the burning ground (Subsection 5.8) are still active and operated under RCRA interim status, so only the inactive part will be sampled. Current on-site health and safety risks for active PRSs are the responsibility of the active operations and will not be addressed in this RFI. Furthermore, it is not appropriate to characterize active surface PRSs to evaluate corrective actions at this time because the active operational groups are continually changing site conditions. Subsurface PRSs at most active sites present no current health hazard and characterization of such PRSs would seriously disrupt active operations. Therefore, final investigations and permanent corrective actions for active PRSs or PRSs beneath active sites will be addressed when the site is decommissioned. However, it is appropriate to ascertain if off-site migration of contaminants from these PRSs is occurring or is likely to occur. If off-site migration of potential contaminants is occurring, then either a Phase II survey will be conducted or a VCA will be implemented. It is also prudent to evaluate subsurface contamination from active septic systems to potentially reduce costs of future remediation efforts.

More detailed discussions of the approaches for active PRSs and the methods used to evaluate off-site migration, subsurface contamination from septic systems, and public hazards are given in Subsections 5.2, 5.3, 5.4, 5.5, 5.6, 5.8, and 5.14.

4.3 Conceptual Exposure Models for OU 1082

A conceptual model was developed to identify potential contaminant migration pathways and any potential human receptors. This information helps to specify the location and magnitude of sampling and analytical methods needed to accurately characterize PRSs at OU 1082. A conceptual model includes four elements: 1) identification of PCOCs; 2) characterization of the release of COCs; 3) determination of migratory pathways; and, 4) identification of human receptors. Subsection 4.3.1 presents an overview of the selection of PCOCs at OU 1082. Subsection 4.3.2, Potential Environmental Pathways, discusses the potential contaminant release mechanisms and migration pathways for each category. Subsection 4.3.3, Potential Human Impacts, contains a detailed PRS-specific conceptual model for each PRS or PRS aggregate and describes potential current and future receptors and potential exposure to site-related chemicals.

4.3.1 Potential Contaminants of Concern

The objectives of the Phase I environmental data collection activities are to accomplish the following:

1. confirm the presence or absence of anticipated PCOCs from known past site activities,

2. use broad spectrum analytical methods that will allow for a reasonable determination that important additional PCOCs are not present (e.g., the evaluation of tentatively identified compounds from mass spectral scans),

3. select analytical methods primarily on the basis of sensitivity for anticipated PCOCs at their SALs and secondarily for broad-band-spectrum capability, and,

4. estimate if the concentration of each PCOC is greater than some method threshold.

These data will be used to determine if any site PCOC exceeds some specified, unacceptable concentration that would be considered a problem. If a site problem is determined, then these data will provide information needed to design a Phase II data collection survey that would further define the extent of the unacceptable area or volume of contaminated media and the potential risk to receptors from the site.

Table 4-1 lists the constituents of potential concern that have been identified through archival information as PCOCs for OU 1082. Any chemical or radiological substance considered hazardous to human health will be identified in the RFI work plan for characterization and eventual cleanup; however, chemicals that are essential human nutrients present at low concentrations and toxic at very high levels (e.g., potassium, magnesium) will not be quantified in a baseline risk assessment.

The PCOCs in Table 4-1 can be divided into three general categories: 1) substances determined to have been used in specific processes at TA-16 based on archival research, including VOCs and cyanide; 2) components used in HE formulations identified in WX Division SOPs; and, 3) environmental breakdown products and impurities of commercial HE (see Appendix D). Several plastic components and salts (e.g., potassium nitrate) used at TA-16 but deemed not to be hazardous to human health were not included in the table.

Many of the substances included in number one above are building or process specific. Aggregates in which these materials are known to have been used are listed in the second column of Table 4-1. A number of HE components are listed in Table 4-1. However, only a few of these are identified as having been used at TA-16 in quantities greater than 10 000 lbs (see Appendix D). These are barium nitrate, TNT, HMX, and RDX, all of which were used in quantities greater than 500 000 lbs over the past 50 years; nitroguanidine and TATB, which were used in quantities from 50 000 to 500 000 lbs; and cyanuric acid, DATB, nitromethane, and PETN, which were used in quantities from 10 000 to 50 000 lbs.

Similarly, a large number of compounds have been identified as environmental breakdown products, HE impurities, and other HE co-contaminants in the laboratory (see Appendix D). However, only DNT, DNB, and TNB are frequently identified in the field as contaminants at open burn/open detonation facilities.

The above discussion allows us to focus our efforts on PCOCs likely to present a significant risk. Laboratory analysis will focus on HE and HE by-products listed above. Certain of these HE constituents (nitroguanidine, TATB, DATB, and nitromethane) are not determined in standard EPA methods for HE by high-pressure liquid chromatography (SW-846 8330) or gas chromatography (GC)/mass spectrometry (MS) (SW-846 8270). These will be determined qualitatively using these methods.

To summarize, the main classes of chemicals potentially located at OU 1082 are explosive components, barium nitrate, and some volatile organic compounds (VOCs). Potentially hazardous explosive device components, by far the major PCOC group at OU 1082, include: HE, semivolatile organic compounds (SVOCs) (i.e. explosive impurities and polycyclic aromatic hydrocarbons), metals, cyanide, and asbestos.

4.3.2 Potential Environmental Pathways

The primary release mechanism of potential contaminants at OU 1082 is through operations associated with the manufacturing and testing of explosives. Potential contaminants may have been released to the environment through drains, outfalls, sumps, and landfills, as shrapnel from firing areas, through spills and spattering to surface soil, from storage areas and surface impoundments, or through burning in disposal operations.

After chemicals have been released at OU 1082 into the environment, they can potentially migrate via: 1) liquid infiltration into near-surface or subsurface soils; 2) organic volatilization into ambient air; 3) wind entrainment of contaminated dust and deposition onto surface soils or vegetation; 4) surface water overflow and then runoff resulting in the contamination of sediments in drainage channels (refer to Chapter 3); and, 5) uptake by plants and animals.

The major migration pathways and relevant environmental media through which human exposure to residual contaminants could occur are summarized in Table 4-2. Pathways that may be complete but are considered less significant include: 1) uptake by animals from ingestion and inhalation of contaminated media; and 2) root uptake by plants from contaminated soils. The contribution of these exposure is likely to be minor in comparison to pathways listed in Table 4-2.

TABLE 4-2

SUMMARY OF MAJOR MIGRATION PATHWAYS, CONTACT MEDIA, AND RESULTING POTENTIAL HUMAN EXPOSURE ROUTES

MIGRATION PATHWAYS	CONTACT MEDIA	RESULTING POTENTIAL HUMAN EXPOSURE ROUTES
Primary		
A. Liquid infiltration into near-surface or subsurface soils	1. Chemicals in subsurface soils	1. See F
B. Wind entrainment and dispersal of surface soil and atmospheric dispersion of volatiles	1. Chemicals deposited on surface soils and edible plant surfaces 2. Chemicals in air (particulate matter and volatile compounds)	1. Ingestion of soil, dermal contact with soil, and ingestion of plants 2. Inhalation of fugitive dust or volatile compounds
C. Surface water runoff carrying soil/sediment in suspension and in solution	1. Chemicals deposited in drainage sediments 2. Chemicals released to surface waters 3. Contaminated surface water infiltrating uncontaminated surface and subsurface soils	1. Ingestion of sediments and dermal contact with sediments 2. Ingestion of surface water and dermal contact with surface water 3. Ingestion of soil and dermal contact with soil
Secondary		
D. Root uptake by plants (from contaminated soils)	1. Edible portions of plants	1. Ingestion of plants
E. Uptake by animals (from ingestion and inhalation of contaminated media)	1. Contaminated meat	1. Ingestion of meat (e.g., elk)
F. Soil erosion, exposing subsurface contaminated soil to the surface	1. Feeds wind dispersal (B) and surface water runoff (C)	1. See B and C

The thickness of the unsaturated zone beneath OU 1082 suggests that migration of contaminants from the surface to the main aquifer is unlikely. Refer to Subsection 2.6.6 of the IWP for a discussion of the hydrology of the main aquifer beneath OU 1082. Groundwater transport in the main aquifer will, therefore, not be considered a viable transport pathway in this stage of the RFI. If the results of Phase I of the RFI indicate that contaminant migration has occurred, this decision will be re-evaluated.

Perched water, however, may be present in OU 1082. Potential contaminant movement into perched water, and through fractures or faults in the subsurface is possible subsequent to infiltration or leaching into the vadose zone. Perched water is not likely to be a pathway of major concern. However, this pathway may be considered during Phase II investigations if the vadose zone is shown to be contaminated during Phase I RFI investigations. Currently, there are no wells on site that are used as a source of drinking water.

4.3.3 Potential Human Receptors

This section discusses how people could potentially be exposed to site-related PCOCs in the absence of site remediation, and presents the conceptual site model. Currently, the land is used for Laboratory operations; therefore, workers at OU 1082 represent the only potentially-exposed population on site. In a few places, canyon bottoms could potentially be accessed for hiking. The nearest permanent residents to OU 1082 are in the town of Los Alamos, 6 miles to the northeast. Future land use at OU 1082 could encompass continued-Laboratory-operations and recreational users (i.e., on-site campers and hikers) both of which will be evaluated in a baseline risk assessment. Residential use is not considered a potential future land use scenario because OU 1082 is located in a rural area far from existing development; therefore, this scenario will not be evaluated in a baseline risk assessment.

4.3.3.1 Conceptual Site Model

The on-site conceptual models identify historical sources of potential contamination, historical migration and conversion, potential current sources of contamination, release mechanisms, contact media, and exposure routes for each PRS or aggregate. Conceptual exposure models are used to illustrate how chemicals can move in the environment from potential release sites to human receptors. They are used to help identify appropriate media and locations for sampling and to determine if the PRS poses a threat to human health or the environment. Generally, surface soil is defined as the upper 6 in. and subsurface soil is from 6 in. to 12 ft or bedrock. At TA-16, the A soil horizon is generally less than 6 in. thick, so this sampling domain will generally include part of both the A and B soil horizons. Infiltration on or leaching into the vadose zone is not a significant pathway unless contamination is located in subsurface soils. Elements of the conceptual models are presented in Table 4-3. These elements summarize the assumptions used to create aggregate-specific conceptual models. The aggregate-specific conceptual models are presented in Figs. 4-3 through 4-10.

The conceptual models for OU 1082 are formulated based on available PRS information only. Further refinement of the conceptual models, or development of separate models may be necessary based on data gathered through the RFI investigation.

Site specific information on PRS aggregates is presented in Chapter 5.

4.3.3.2 Potential Human Exposure

To identify the presence of COCs, sampling plans proposed for OU 1082 involve comparing analytical data from samples to SALs. As mentioned in Subsection 4.2.2, SALs are based on a conservative, residential exposure scenario. If measured concentrations exceed SALs or if several chemicals come close to SALs, then further investigation will be conducted, even though none of the individual chemicals exceed SALs. If contaminated media are found in Phase I or Phase II, the human exposure potential to these contaminants will be quantified in a baseline risk assessment. Human exposure is estimated through a model of the reasonable maximum exposed (RME) individual who is defined through assumptions of current and future land use (EPA 1989, 0305; EPA 1991, 0746; EPA 1992, 15-16-469). Two land use scenarios will be evaluated in baseline risk assessments for OU 1082: continued-Laboratory-operations (current and future) and recreational (current and future). Continued-Laboratory-operations is a scenario that encompasses two theoretical populations of potentially-exposed individuals; on-site workers and construction workers.

Refer to Subsection 4.3 of the 1992 IWP for ER Programmatic guidance on probable land use scenarios (LANL 1992, 0768). Depending on site-specific

TABLE 4-3

SUMMARY OF CONCEPTUAL MODEL ELEMENTS

PATHWAYS/MECHANISM	CONCEPT/HYPOTHESES
HISTORICAL SOURCES	• Operations/processes that contributed to the creation of the PRS (i.e., storage area, etc.)
PRS RELEASE MECHANISM	• Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, leaching, dumping, or disposing into the environment
MIGRATION PATHWAY/ CONVERSION MECHANISM	
Atmospheric dispersion	• Entrainment is limited to chemicals in surface soils
Particulate dispersion	• Entrainment and deposition are controlled by soil properties, surface roughness, vegetative cover and terrain, as well as atmospheric conditions
Volatilization	• Volatilization affects volatile organic compounds in surface soils, subsurface soils, and surface water
Surface water runoff	
Surface water	• Surface runoff is directed by natural topographic features or manmade diversions and flows toward 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
	• Chemical transport by surface runoff can occur in solution, sorbed to suspended sediments, or as mass movement of heavier bed sediments
	• Surface runoff may carry chemicals beyond the OU boundary
	• Contaminated surface runoff may infiltrate the canyon-bottom alluvium
Sediments	• Surface soil erosion and sediment transport is a function of runoff intensity and soil properties
	• Chemicals dispersed on the soil surface can be collected by surface water runoff and concentrated in sedimentation areas in drainages
	• Erosion of drainage channels can extend the area of contaminant dispersal in the drainage
Alluvial aquifers	• Surface runoff discharged to the canyons may infiltrate into sediments of channel alluvium
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
POTENTIAL RELEASE MECHANISM	
Leaching	• Storm water/snowmelt can dissolve chemicals from soil or other solid media, making them available for contact
	• Water solubility of chemicals and their relative affinity for soil or other solid media affects the ability of leaching to cause a release
	• Leaching and subsequent resorption can extend the area of contamination

TABLE 4-3 (continued)

SUMMARY OF CONCEPTUAL MODEL ELEMENTS

PATHWAYS/MECHANISM	CONCEPT/HYPOTHESES
Soil erosion	• The erosion of surface soils is dependent on soil properties, vegetative cover, slope and aspect, exposure to the force of the wind, and precipitation intensity and frequency • Depositional areas as well as erosional areas exist, and erosive loss of soil may not occur in all locations • Storm water runoff can mobilize soils/sediments, making them available for contact • Storm intensity/frequency, physical properties of soils, topography, and ground cover determine the effectiveness of erosion as a release mechanism • Erosion may also enlarge the contaminated area
Mass wasting	• The loss of rock from the canyon walls is a discontinuous, observable process • The rate of the process is extremely slow
Resuspension (wind suspension)	• Wind suspension of contaminated soil/sediment as dust makes chemicals available for contact via inhalation/ingestion • Physical properties of soil (e.g., silt content, moisture content), wind speed, and size of exposed ground surface determine effectiveness of wind suspension as a release mechanism • Wind suspension can enlarge the area of contamination and create additional exposure pathways, such as deposition on plants followed by plant consumption by humans/animals
Excavation	• Manual or mechanical movement of contaminated soil during construction, remediation, or other activities makes contaminated soil available for dermal contact, ingestion, and inhalation as dust • The method of excavation (i.e., type of equipment), physical properties of soil, weather conditions, and magnitude of excavation activity (i.e., depth and total area of excavation) influence the effectiveness of excavation as a release mechanism • Excavation can increase or decrease the size of the contaminated area, depending on how the excavated material is handled
EXPOSURE ROUTE	
Inhalation	• Vapors, aerosols, and particulates (including dust) can be inhaled and absorbed by the lungs and mucous membranes. • Physical and chemical properties of airborne chemicals influence the degree of retention in the body after being inhaled
Ingestion	• Ingestion of soil, water, food, and dust can lead to chemical intake via absorption in the gastrointestinal tract
Direct contact	• Some hazardous chemical constituents will absorb through the skin when in contact with contaminated surfaces of soil, tuff, or rubble • Physical and chemical properties of chemicals influence the degree of dermal absorption • Factors such as skin moisture and temperature affect the degree of dermal absorption
External penetrating radiation	• External, or whole body radiation, can occur through exposure to gamma-ray-emitting radionuclides that may be present in soil either directly through the soil or re-entrained dusts • Exposure to penetrating radiation can also occur through inhalation or ingestion when radionuclide-contaminated soil or tuff surfaces erode and/or dusts become re-entrained

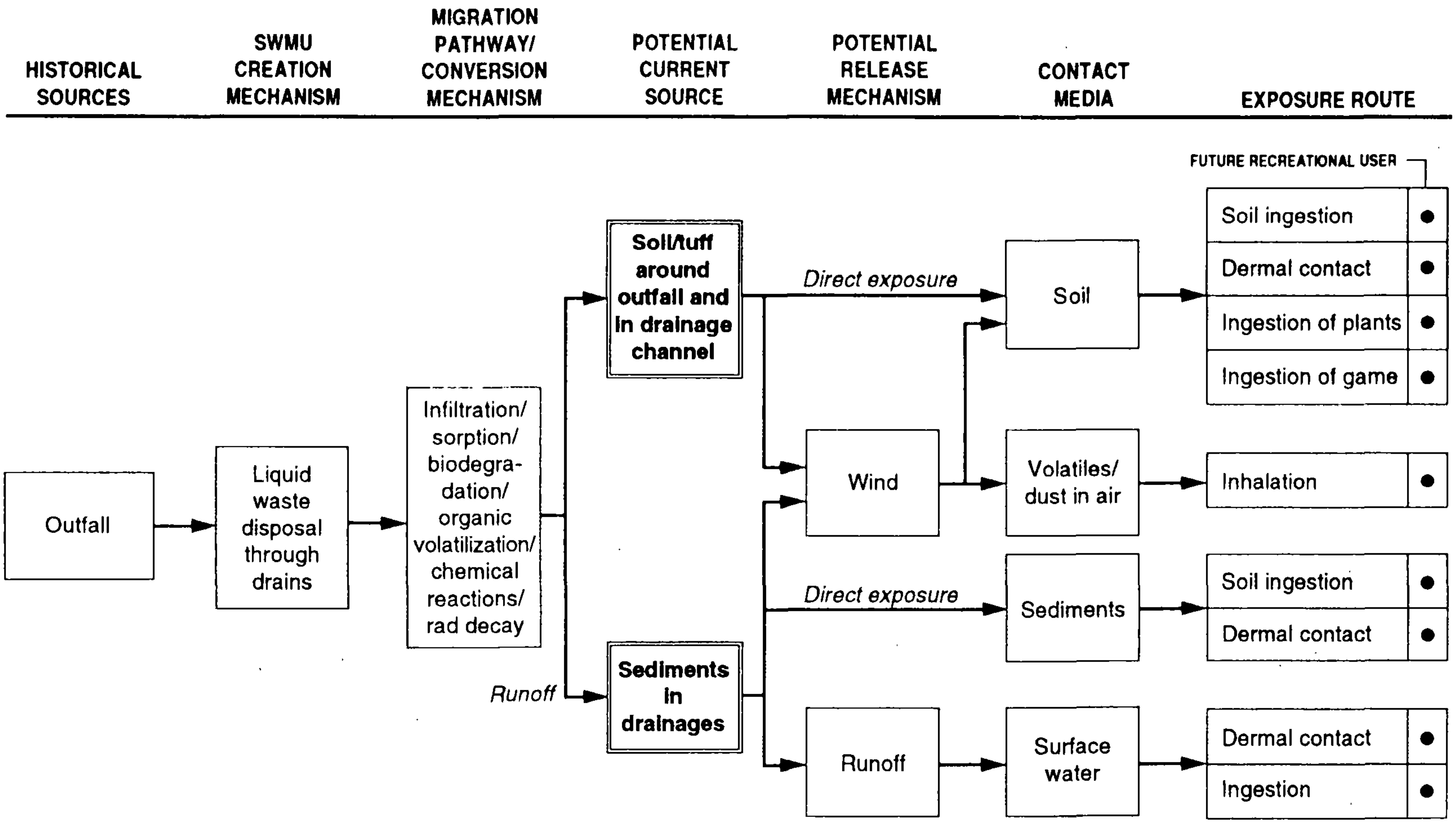

Fig. 4-3. Conceptual exposure model for operational releases (Subsections 5.5 and 5.6) and K-Site Aggregate B (Subsection 5.15): recreational scenario.

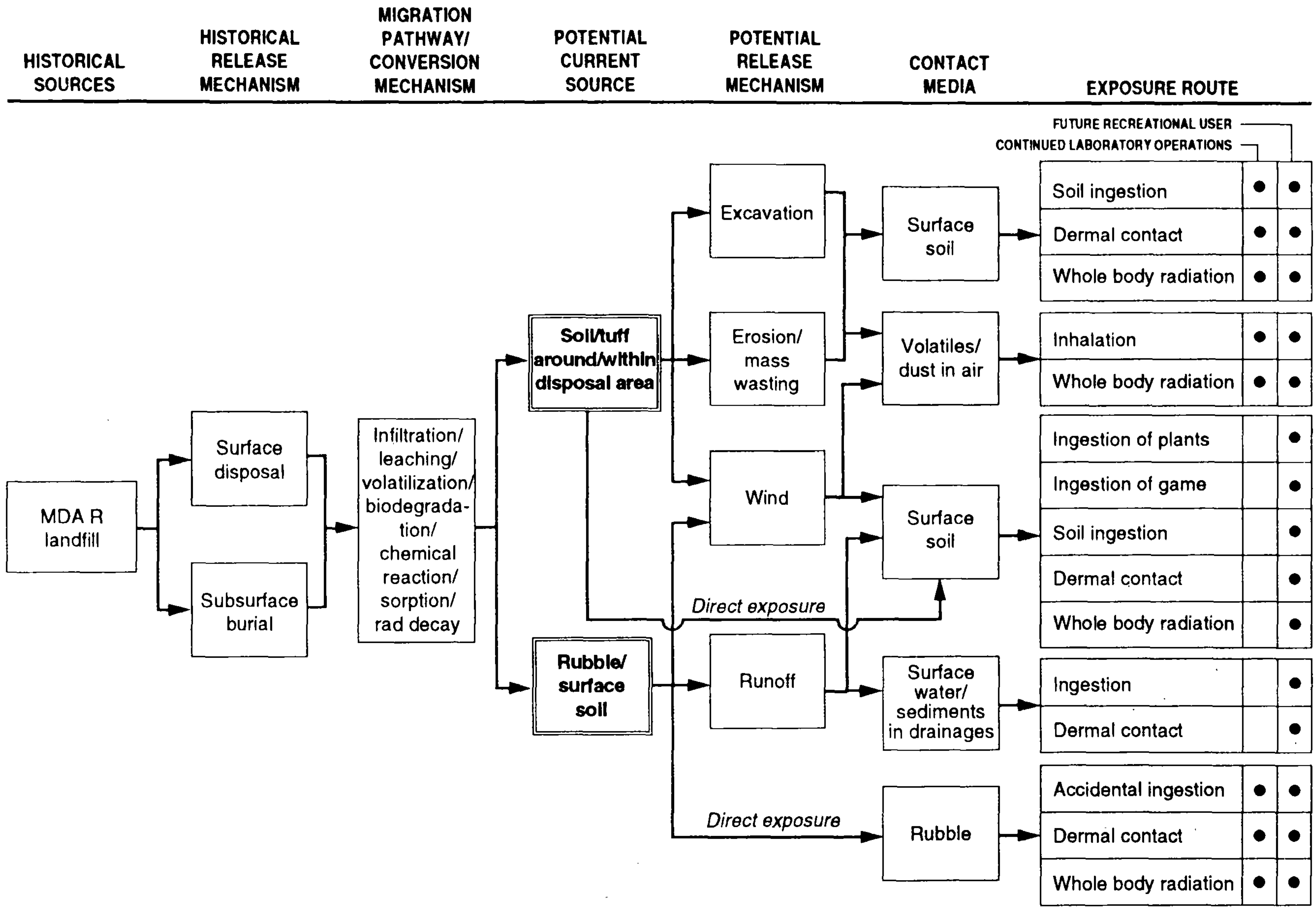

Fig. 4-4. **On-site conceptual exposure model for MDA R (Subsection 5.10) landfills: continued Laboratory operations scenario for subsurface and surface soils located on the mesa top; recreational scenario for surface areas located on canyon wall and bottom (erosion of subsurface soils, surface soil, sediment, and surface water pathways).**

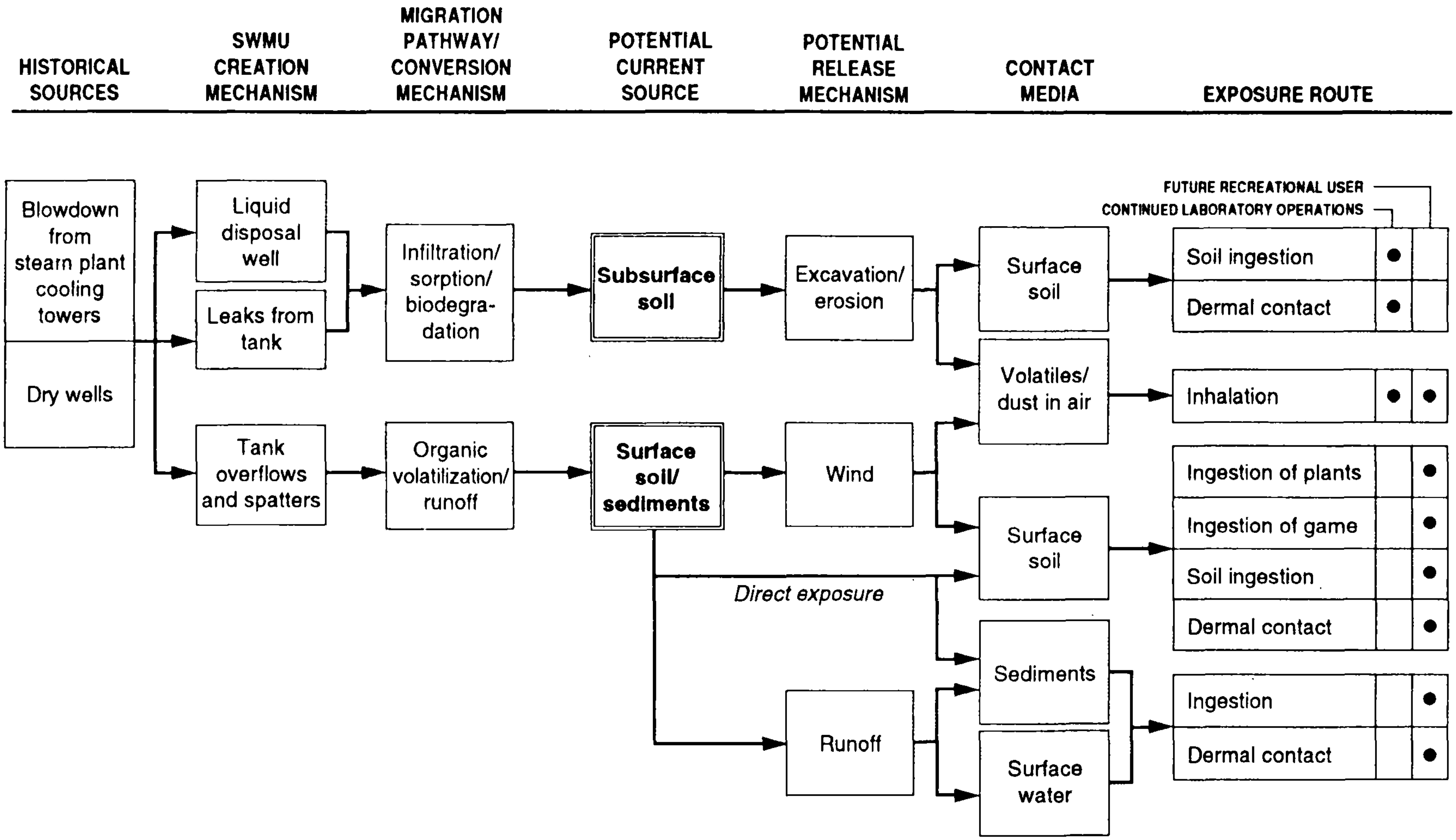

Fig. 4-5. On-site conceptual exposure model for PRSs 16-001(a-d) (Subsection 5.1) at TA-16: continued Laboratory operations scenario for subsurface and surface soil located on mesa top; recreational scenario for surface soil located on canyon wall and bottom (sediment and surface water pathways).

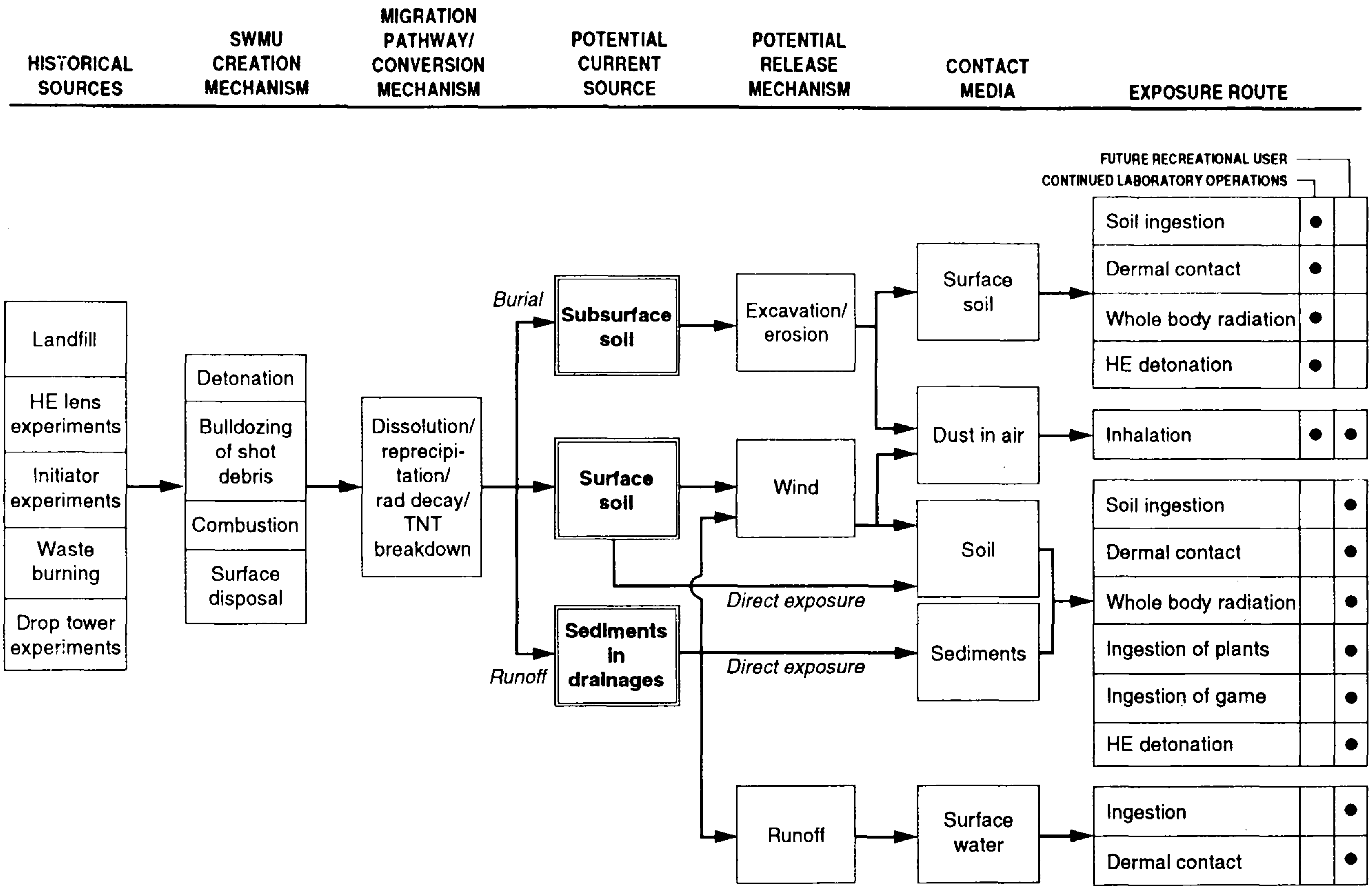

Fig. 4-6. On-site conceptual exposure model for SWMUs at TA-13 (P-Site; Subsection 5.13) and K-Site Aggregate A (Subsection 5.14): continued Laboratory operations scenario for subsurface and surface soil located on mesa top; recreational scenario for surface areas located on canyon wall and bottom (surface soil, sediment, and surface water pathways).

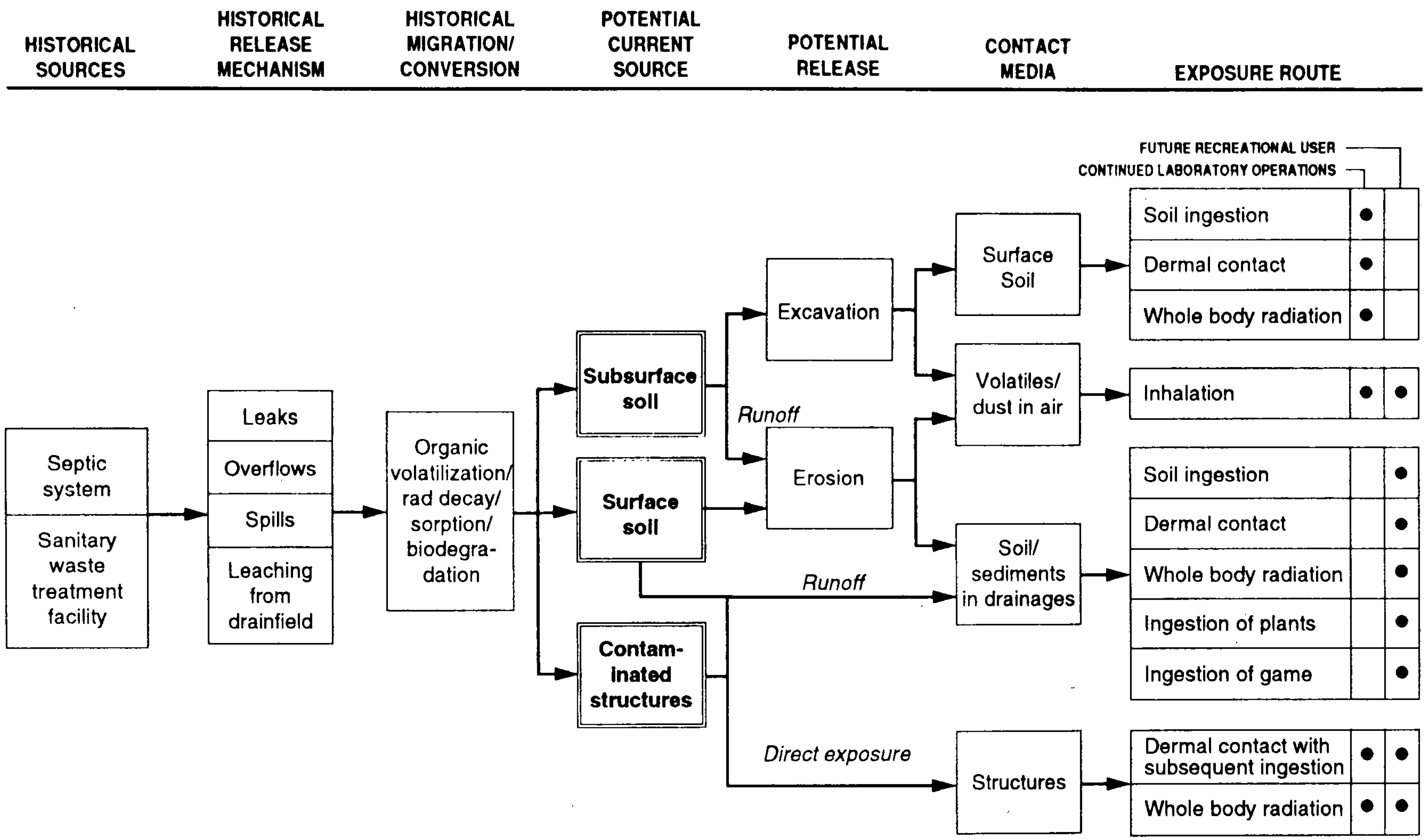

Fig. 4-7. **On-site conceptual exposure model for septic system (Subsection 5.4) and the sanitary waste treatment facility (Subsection 5.7): continued Laboratory operations scenario for subsurface and surface soils located on mesa top; recreational scenario for surface area on canyon wall and bottom (surface soil, sediment, and surface water pathways).**

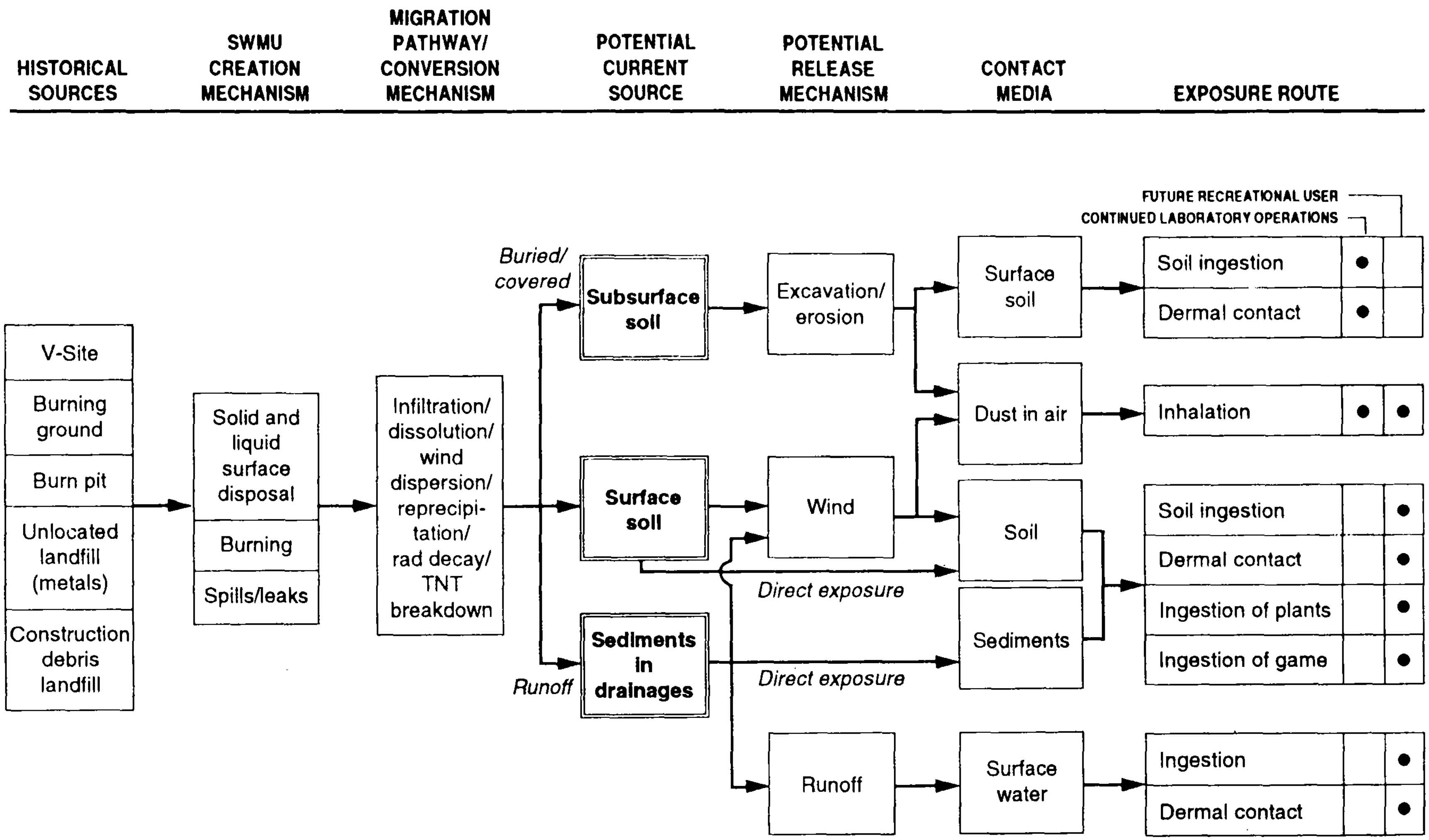

Fig. 4-8. **On-site conceptual exposure model for burning ground aggregate (Subsection 5.8), surface waste disposal areas [SWMUs 16-009, 16-016(a,b)] (Subsection 5.11), K-Site Aggregate C (Subsection 5.16), and spill (Subsection 5.17): continued Laboratory operations scenario for subsurface and surface areas located on mesa top; recreational scenario for surface areas on the canyon wall and bottom (surface soil, sediment, and surface water pathways).**

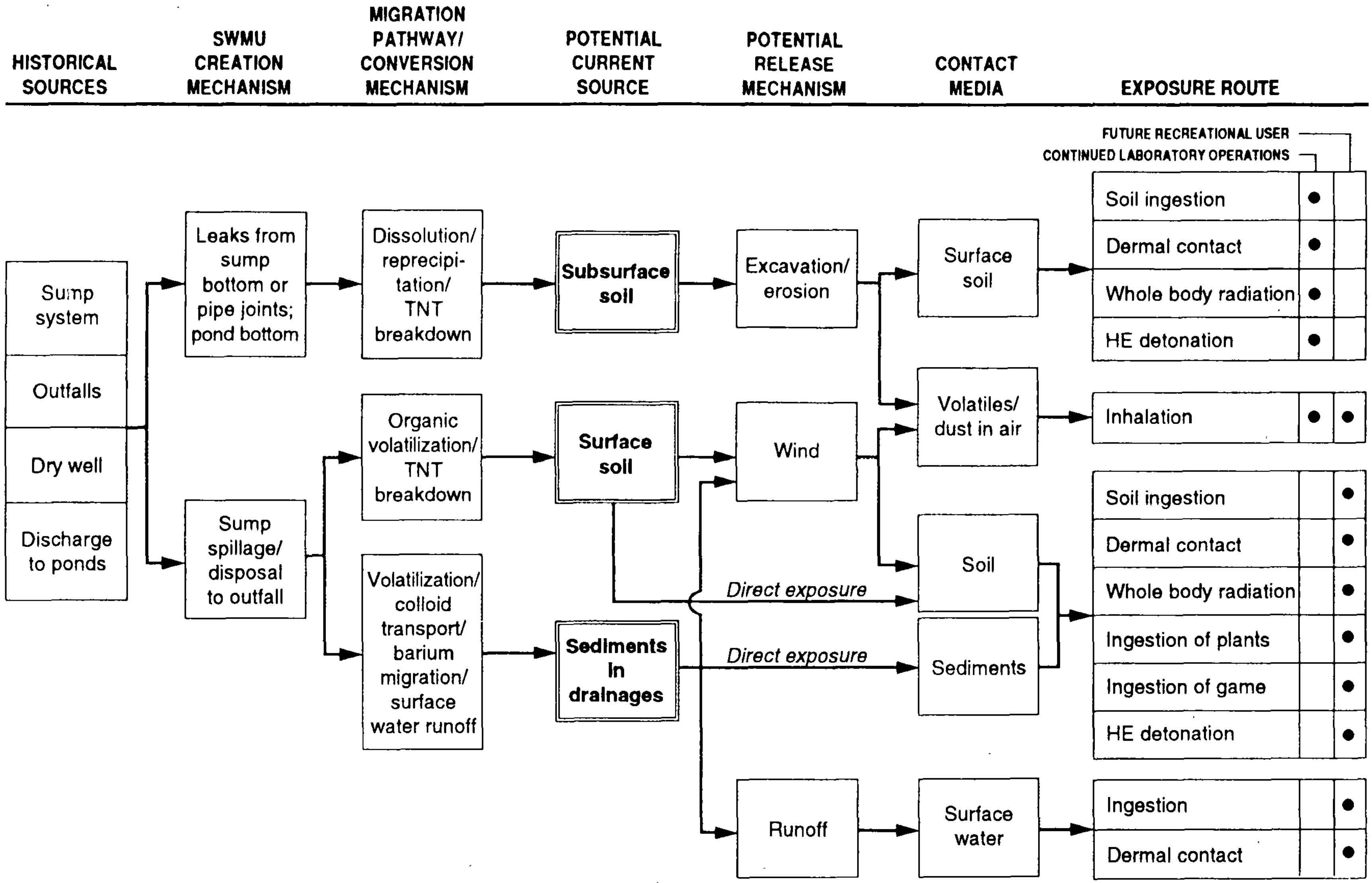

Fig. 4-9. **On-site conceptual exposure model for HE sumps, drain lines, and outfalls (Subsections 5.2 and 5.3) and ponds (Subsection 5.12) at TA-16: continued Laboratory operations scenario for subsurface and surface soils on mesa top; recreational scenario for surface soil areas on canyon wall and bottom (sediment and surface water pathways). Radionuclide contamination potentially present in sumps SWMUs 16-003(a-e,h-k,n,o) and associated outfalls, but not in SWMUs 16-003(f,g,l,m) or SWMUs 16-029(a-g).**

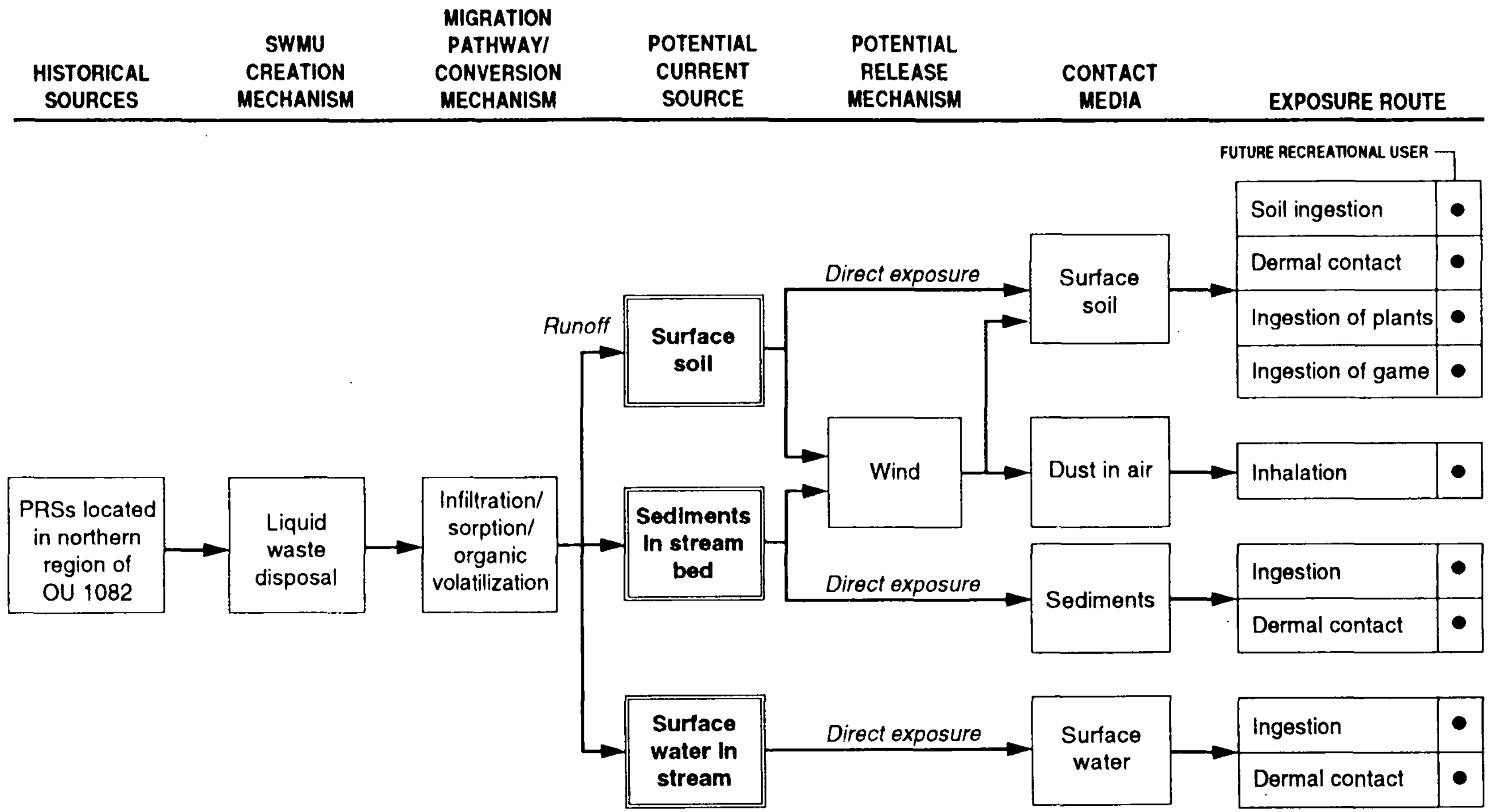

Fig. 4-10. Conceptual exposure model for Cañon de Valle (Subsection 5.9): recreational scenario.

parameters (e.g., types of contaminants present or migration potential), the worst-case exposure scenario (i.e., the RME individual) may vary. For those PRSs where two scenarios may be applicable, two baseline risk assessments will be calculated to determine the worst case. For any baseline risk assessment, the 95% upper confidence limit on the arithmetic average concentration of COCs in exposure areas, either surface or subsurface soils, is sufficient to determine receptor exposures. The continued-Laboratory-operations and recreational scenarios are developed below.

Unlike most other operable units at the Laboratory, a contact with HE pathway is relevant for OU 1082. Under both continued-Laboratory operations and recreational scenarios, detonation of residual HE in the environment could present substantial human risk. The Department of Defense has developed guidelines that describe when soil may potentially detonate, 10% HE is typical for eastern ordnance sites (US Army Corps of Engineers 1991, 15-16-471). Site-specific safety levels for HE in soils will be developed in consultation with the Design Engineering Division (WX). However, based on existing data, only two PRS aggregates contain either raw HE or soil HE at levels greater than 2 wt %; these aggregates are described in Subsection 5.3, the TA-16-260 outfall, and Subsection 5.14, K-Site Aggregate A. Thus, this pathway is likely only to be relevant for a subset of the aggregates described in Chapter 5. Rigid WX operating procedures preclude site-worker contact with HE in either of these areas.

4.3.3.2.1 Continued Laboratory Operations

Land use in the foreseeable future is likely to continue to be similar to current Laboratory operations. Most areas of OU 1082 are active sites for the WX Division of the Laboratory and construction of new buildings and other facilities in the area is possible. Populations of on-site workers (individuals who work on or near the site) and construction workers (individuals who would be exposed to near-surface and subsurface soils through various activities including excavation) are estimated to be the most likely RME individuals. They are therefore used in the exposure scenarios that will be evaluated under the land use scenario of continued-Laboratory operations.

On-site workers (i.e., maintenance workers, on-site workers) are expected to be routinely exposed to contaminated media. Therefore, this scenario is considered the most conservative exposure scenario for PRSs in OU 1082 that consist of potential surface contamination on the mesa top. If PCOCs in surface soils are above SALs, then a baseline risk assessment using the on-site worker scenario will be evaluated. The PRS aggregates that include potential surface contamination of the mesa top are: blowdown tanks (Subsection 5.1); sumps (Subsections 5.2 and 5.3); septic tanks (Subsection 5.4); operational releases (Subsection 5.5); burn and treatment area (Subsection 5.8); MDA R (Subsection 5.10); surface waste disposal areas (Subsection 5.11); firing sites (Subsections 5.13 and 5.14); potential surface contamination (Subsection 5.16); and, waste storage areas (Subsection 5.17).

The construction worker is expected to be exposed to subsurface contamination during excavation. Once subsurface soil is excavated and brought to the surface, on-site workers could also be exposed. Therefore, for PRSs in OU 1082 that consist of subsurface contamination above SALs, a baseline risk assessment using the construction worker and on-site worker scenario will be evaluated. PRS aggregates with potential subsurface contamination include dry wells (Subsection 5.1); sumps (Subsection 5.2); TA-16-260 sumps and outfall (Subsection 5.3); septic systems (Subsection 5.4); sanitary waste treatment facility (Subsection 5.7); burn and treatment area (Subsection 5.8); MDA R (Subsection 5.10); waste water ponds (Subsection 5.12), and the TA-13 firing site (Subsection 5.13).

Exposure pathways relevant to continued-Laboratory operations include: 1) inhalation of fugitive dust or volatile compounds; 2) incidental ingestion of contaminated soils; 3) direct dermal contact with contaminated soils; 4) whole body radiation; and, 5) contact with HE (see Table 4-4).

4.3.3.2.2 Recreational

OU 1082 is adjacent to Bandelier National Monument and US Forest Service lands. When this site is decommissioned in the future, OU 1082 could potentially be released for recreational use. The recreational scenario is the most probable scenario for PRSs consisting of surface contamination on the canyon walls and/or the canyon bottoms. Although in the future, the

TABLE 4-4

SUMMARY OF EXPOSURE ROUTES IN THE CONTINUED LABORATORY OPERATIONS SCENARIO

EXPOSURE ROUTE	ASSUMPTIONS
1. Inhalation of ambient air (fugitive dust or volatiles)	• Fugitive dust is generated by the soil disturbances (i.e., bulldozers, trucks and other earth moving equipment, and during construction activities) • Construction activities may expose subsurface chemicals to the surface • There may be volatile organic compounds in near-surface and subsurface soils that would contribute to the inhalation exposure • For dust transport indoors, it can be assumed that indoor concentrations are less than those outdoors • For vapor transport indoors, concentrations indoors and outdoors can be assumed to be equivalent, except at sites where subsurface soil gases are entering indoors; in this case, vapor concentrations inside could exceed those outdoors
2. Incidental ingestion of soil	• Incidental soil ingestion of surface or subsurface soils may occur as a result of construction activities • Office workers would be expected to contact much less soil and dust than construction workers
3. Dermal contact with soil	• Skin surface area available for contact with soil includes arms, hands, face, and head
4. Whole body radiation	• Irradiation from radionuclides on the ground surface may occur
5. Contact with HE	• This pathway is considered a "safety" effect of potential contaminants unless concentrations in soils are low. Exposure to HE is through inhalation and soil exposures (above)

recreational scenario may also apply to mesa tops, this scenario will not be evaluated because the worker scenario has been identified as the future RME for mesa tops. Workers are not expected to come into direct contact with contaminated media on walls or on canyon bottoms because of limited development in these areas. The recreational scenario excludes agriculture, but considers short-term camping, daily hiking, hunting, and possibly limited construction.

PRSs in OU 1082 that consist of surface contamination on canyon walls and/or canyon bottoms above SALs will be evaluated in a baseline risk assessment using the recreational scenario. Those PRSs include: outfalls (Subsections 5.1, 5.2, 5.3, 5.4, 5.7, and 5.8); materials testing lab outfall (Subsection 5.5); photo processing facility outfall (Subsection 5.6); Cañon de Valle (Subsection 5.9); surface water runoff for MDA R (Subsection 5.10) into drainage channels; and, TA-11 outfalls (Subsection 5.15).

Recreational users of the area could potentially come into contact with contaminants through ambient air, surface soil, sediments in drainage, and pooled surface water. Campers or hunters could also be exposed to contaminants via ingestion of game, such as elk. Game are subject to accumulation of contaminants originating from OU 1082 via ingestion of contaminants in the surface water, ingestion of contaminated plants, and inadvertently through the ingestion of contaminated surface soil.

Exposure pathways for the recreational scenario include: 1) inhalation of fugitive dust; 2) soil ingestion; 3) dermal contact with soil; 4) contact with high explosives; 5) whole body radiation; 6) dermal contact with surface water; 7) accidental ingestion of surface water; 8) ingestion of game; and, 9) ingestion of edible plants (piñon nuts, berries, etc.) (see Table 4-5). No body of water in the immediate vicinity is large enough to produce a consistent supply of game fish; therefore, exposure to contaminants by consuming contaminated fish is not a viable pathway for this site.

4.4 Potential Response Actions

Table 4-6 summarizes the potential response actions for each PRS aggregate. Remediation alternatives must achieve acceptable risk levels; however, choosing between alternatives that meet human health risk requirements will be based on factors such as ecological impact, cost, regulatory concerns (in addition to risk), impact on Laboratory operations, socioeconomic impacts, and public concern (Appendix I, IWP) (LANL 1992, 0768). Note that all actions refer to potential or known surface soil problems that represent the contaminants of greatest concern at the site. Subsurface contaminants could require other technologies (e.g., steam injection for vadose zone contaminants).

4.4.1 Criteria for Recommending NFA

Chapter 6 presents the PRSs recommended for NFA or DA based on archival information and field visits. Fig. 4-1 shows the decision logic for these recommendations. Appendix I, Subsection 4.1 of the IWP

TABLE 4-5

SUMMARY OF EXPOSURE ROUTES IN THE RECREATIONAL SCENARIO

EXPOSURE ROUTE	ASSUMPTIONS
1. Inhalation of ambient air (fugitive dust or volatiles)	• Fugitive dust is generated by the wind and during recreational activities (e.g., dirt biking) • There may be volatile constituents on site that would contribute to the inhalation exposure
2. Incidental ingestion of soil	• Incidental soil ingestion of surface or sediments may occur as a result of recreational activities
3. Dermal contact with soil	• Skin surface area available for contact with soil includes arms, hands, face, legs, upper body, and head (the camping event occurs in warm weather).
4. External radiation	• Irradiation from radionuclides on the ground surface may occur
5. Dermal contact with surface water	• Ephemeral streams may be present as a result of snowmelt and summer rainfall • Rainfall events result in pooled water • Standing water occurs after the rainfall event before it seeps into the ground
6. Accidental ingestion of surface water	• Ephemeral streams may be present as a result of snowmelt and summer rainfall • Rainfall events result in pooled water • Standing water occurs after the rainfall event before it seeps into the ground
7. Ingestion of game	• Chemicals may bioaccumulate in game animals (e.g., elk). Subsequently, human exposure may occur via ingestion of game.
8. Contact with HE	• This is mainly a safety model, rather than a toxicology model; assumptions are to be obtained.
9. Ingestion of edible plants	• Root uptake of chemicals by plants may result in human exposure via ingestion of plants.

(LANL 1992, 0768) presents a detailed discussion of the rationale for NFA or DA based on archival information.

NFA recommendations based on screening assessments (Fig. 4-2) will include an evaluation of combined effects from multiple contaminants and ALARA criteria for radioactive contaminants.

NFA recommendations after baseline risk assessments will be based on acceptable risks, 10^{-6} to 10^{-4} for carcinogens, and a hazard index less than

TABLE 4-6

POTENTIAL RESPONSE ACTIONS FOR EACH PRS AGGREGATE*

SUB-SECTION	DESCRIPTION	NO FURTHER ACTION OR DEFERRED ACTION	REMOVAL/ TREATMENT		MIXED WASTE	INCIN-ERATION/ REMOVAL	DECON/ REMOVAL	CONDI-TIONAL CAP/ MONITOR	IN-STREAM BARRIERS	ACCESS RESTRIC-TION	*IN SITU* BIOREME-DIATION
			HAZ-ARDOUS ONLY	RADIO-ACTIVE ONLY							
5.1	Blowdown tanks/dry wells	x	x				x				
5.2	HE sumps and outfalls	x	x		x	x	x		x	x	x
5.3	260-Line HE sumps and outfall	x	x		x	x	x		x	x	x
5.4	TA-11 and TA-16 septic systems	x	x				x				
5.5	Material processing	x	x				x				
5.6	Photoprocessing	x	x				x		x	x	
5.7	Sanitary waste treatment plant	x	x		x		x				
5.8	Burning ground	x	x		x	x	x				
5.9	Cañon de Valle	x					x	x	x	x	
5.10	MDA R	x	x		x		x	x		x	x
5.11	Landfills	x	x				x				
5.12	Ponds	x	x		x		x	x			x
5.13	P-Site	x	x		x		x	x		x	
5.14	K-Site firing site	x	x	x					x		
5.15	K-Site outfalls	x	x	x			x				
5.16	K-Site potential surface contamintion	x	x	x			x				
5.17	Decomissioned waste storage area	x	x				x				

* Note that this table is not meant to be all-inclusive.

one for non-carcinogens. These NFA recommendations will also consider ALARA criteria for radioactive contaminants.

4.4.2 Disposal and Treatment Options

Disposal and treatment options for contaminated materials at OU 1082 include: removal to a RCRA-permitted treatment, storage, and disposal (TSD) facility, removal to the Laboratory mixed waste facility when it is in operation, incineration and removal, or decontamination (burning or treatment by supercritical water), bioremediation, and recycling. This list is not all-inclusive. New technologies will be considered as they develop.

4.4.3 Conditional Remedies

Conditional remedies for PRSs at OU 1082 include: capping and monitoring of surface soil or installation, maintenance, and monitoring of in-stream barriers. Conditional remedies are most appropriate for active sites.

4.4.4 Access Restrictions

All PRS are within a secured portion of the Laboratory, with security fences or no trespassing signs posted. Access restrictions to all PRS will continue for the foreseeable future.

4.4.5 *In Situ* Remediation

While bioremediation of HE is the most likely *in situ* remediation option for some PRSs in OU 1082, at the time of actual field remediation all *in situ* options for all PCOCs will be evaluated for applicability.

4.5 Sampling Strategies and Sampling Methods

Three sampling strategies will be taken for the RFI Phase I surveys: reconnaissance, baseline risk assessment, and VCA. Reconnaissance sampling is biased toward collecting material that is representative of the maximum contaminant concentration in a PRS, where there is little or no historical data. Baseline risk assessment sampling collects material that reflects the most likely exposure scenario for the PRS, and is appropriate where there is a high probability that a baseline risk assessment will be performed. VCA sampling is used to guide corrective actions for PRSs where there is a known hazard. Sampling SOPs used in the RFI Phase I are summarized in Table 4-7, and are discussed below.

4.5.1 Sampling Strategies

Sampling strategies for OU 1082 aggregates are summarized in Table 4-8. Note that for some aggregates, more than one sampling strategy is planned within different parts of the same aggregate. For example, VCA sampling is proposed at the sumps (Subsection 5.2) to bound HE contamination, and reconnaissance sampling is proposed downstream from that contaminated region.

4.5.1.1 Reconnaissance Sampling

The premise of reconnaissance sampling is that samples can be taken that represent the maximum contaminant concentration in a PRS. Sample locations are biased by either knowledge of the physical process responsible for the potential contaminant distribution in space (or time) or by preliminary field screening and/or mobile laboratory methods. If field screening is used to select sample locations, then it is critical that methods are available for all potential contaminants, or that a smaller set of potential contaminants can be used as surrogates for the remaining PCOCs. In the OU 1082 RFI, the PCOCs barium and HE (HMX, RDX, and TNT) are generally used to guide the selection of biased reconnaissance samples. These PCOCs are by far the most significant at TA-16 based on historical information and existing data.

Reconnaissance sampling data will provide an estimate of the upper bound on the concentration of PCOCs. The measured values will be compared to SALs (Fig. 4-2), which are based on a conservative residential exposure scenario.

Reconnaissance sampling results could also be used in support of a baseline risk assessment. Most reconnaissance sampling plans will have at least three full laboratory analyses, which is the minimum number required for a baseline risk assessment. Data from neighboring PRSs may be combined into a single baseline risk assessment, which is possible if these PRSs fall within an exposure area for the risk scenario and the list of COCs are similar. It is important to note that using positively-biased data creates

TABLE 4-7

STANDARD OPERATING PROCEDURES (SOPs) FOR OU 1082

TITLE	NUMBER
General Instructions for Field Investigations	LANL-ER-SOP-01.01
Sample Containers and Preservation	LANL-ER-SOP-01.02
Handling, Packaging, and Shipping of Samples	LANL-ER-SOP-01.03
Sample Control and Field Documentation	LANL-ER-SOP-01.04
Field Quality Control Samples	LANL-ER-SOP-01.05
Management of RFI-Generated Waste	LANL-ER-SOP-01.06
Drilling Methods and Drill Site Management	LANL-ER-SOP-04.01
Sampling for Volatile Organics	LANL-ER-SOP-06.03
Soil Water Samples	LANL-ER-SOP-06.05
Spade and Scoop Method for Collection of Soil Samples	LANL-ER-SOP-06.09
Hand Auger and Thin-Wall Tube Sampler	LANL-ER-SOP-06.10
Stainless Steel Surface Soil Sampler	LANL-ER-SOP-06.11
Surface Water Sampling	LANL-ER-SOP-06.13
Sediment Material Collection	LANL-ER-SOP-06.14
Coliwasa Sampler for Liquids and Slurries	LANL-ER-SOP-06.15
Collection of Sand, Packed Powder, or Granule Samples Using the Hand Auger	LANL-ER-SOP-06.18
Volatile Organic Sampling Train	LANL-ER-SOP-06.21
Canister Sampling for Organics EPA Method T0-14	LANL-ER-SOP-06.22
Screening of PCBs in Soil	LANL-ER-SOP-10.01
Measurement of Bulk Density, Dry Density, Water Content and Porosity in Soil	LANL-ER-SOP-11.01
Particle Size Distribution of Soil/Rock Samples	LANL-ER-SOP-11.02
Permeability of Granular Soils	LANL-ER-SOP-11.03
Soil and Core pH	LANL-ER-SOP-11.04
Total Organic Carbon	LANL-ER-SOP-11.05
Cation-Exchange Capacity	LANL-ER-SOP-11.06

TABLE 4-8

SAMPLING STRATEGIES USED IN OU 1082 AGGREGATES

SUBSECTION	DESCRIPTION	RECONNAISSANCE SAMPLING	BASELINE RISK ASSESSMENT SAMPLING	VOLUNTARY CORRECTIVE ACTION SAMPLING
5.1	Blowdown tanks/dry wells	x		
5.2	HE sumps/outfall	x		x
5.3	HE sumps/active outfall	x		x
5.4	Septic systems • active systems • inactive systems	 x [1]		x
5.5	Materials testing laboratory	x		
5.6	Photoprocessing laboratory		x	
5.7	Sanitary waste treatment plant • pond • structures	 x		 x
5.8	Burning ground	x [1]		
5.9	Cañon de Valle		x	
5.10	MDA R	x		
5.11	Surface disposal	x		
5.12	Ponds		x	
5.13	P-Site	x [1]		
5.14	TA-11 firing site (active site) • drainages • Water Canyon		 x	 x
5.15	TA-11 outfalls	x [2]		
5.16	TA-11 surface contamination	x [1]		
5.17	Waste storage	x [1]		

1 Baseline risk assessment planned using reconnaissance samples (these may be biased)
2 Baseline risk assessment planned for aggregate

a conservative risk assessment, but is one step closer to a representative risk assessment compared to the assumptions used to derive the SALs.

The portion of the field sample that is submitted for laboratory analysis will also be biased by field screening or mobile laboratory results. Thus, reconnaissance sampling may have two levels of biasing to increase the chance of sampling the maximum potential contaminant concentration in a PRS. Deep borings (>12 in. length) will often be field screened every 6 in. for potential contaminants (e.g., radioactivity, HE, volatile organics, metals).

For some reconnaissance surveys, the number of samples is based on quantitative statements of error tolerances. These are stated as the desired probability of detecting potential contamination when a certain per cent of the site is expected to be contaminated. For example, the decision maker may state that he wants to detect contaminants above SALs at least 90% of the time, if 25% of the site is contaminated. The binomial presence-absence sampling model (also known as the "nomogram" approach in the IWP) supplies the number of independent analyses of the PRS that must be taken to meet this performance goal (Table 4-9) (LANL 1992, 0768). For the above example, nine independent analyses are required to meet the decision maker's uncertainty tolerances. As noted above, these samples will be biased by field screening and do not assume a grid sampling pattern. The derivation of the binomial presence-absence sampling approach is given in Appendix H of the IWP (LANL 1992, 0768). The reconnaissance sampling approach uses biasing techniques to assure that the samples sent for laboratory analysis represent the maximum for a PRS. This biasing provides a probability statement that is conservative (i.e., the probability of detecting contamination is greater than 90%).

False negative errors are controlled in reconnaissance surveys, but false positive errors are not controlled. However, the consequences of a false negative decision are more serious (propose NFA for a contaminated PRS) than are the consequences of a false positive error (collect additional data). Reconnaissance sampling is most appropriate where there is reliable historical or archival data that indicate that the PRS is not known to be a problem based on existing data (a true negative) and biased sampling is possible. For PRSs where it is likely that potential contaminants are above SALs, then baseline risk assessment sampling is more appropriate.

TABLE 4-9

SAMPLE SIZES FOR RECONNAISSANCE SAMPLING

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

4.5.1.2 Baseline Risk Assessment Sampling

Baseline risk assessment sampling is recommended for PRSs where archival data or existing analytical data indicate that PCOCs are likely to be above SALs. The main difference is that in addition to providing data for a screening assessment, these data must be suitable for a baseline risk assessment. Data used in a baseline risk assessment must be representative of the heterogeneity within the exposure area and have adequate QA/QC measures. The absolute minimum number of samples that could be adequate for a baseline risk assessment is three laboratory analyses, but the actual number for any PRS is based on the heterogeneity of the PCOCs and the exposure scenario. Field screening or mobile laboratory results may help determine the spatial or temporal extent of the potential contaminants, but these data will not be used to bias sampling.

The most important difference between baseline risk assessment sampling and reconnaissance sampling is the lack of biasing, which yields a set of samples that is more representative of the exposure scenario. The likely exposure scenarios for these PRSs or PRS aggregates are a construction worker or recreational user scenario. A construction worker excavation scenario assumes that exposure occurs from the average concentration in 5-ft-depth increments. Thus, the sample should be collected to represent the average concentration in a 5-ft soil core.

A statistically-based sampling design should be developed for baseline risk assessment surveys. Key design inputs for a statistically-based survey are the spatial variation of the PCOCs and the laboratory measurement performance for these PCOCs. In some cases, such information for the PCOCs and the PRS will not be available, the baseline risk assessment survey will be designed based on professional judgment. All baseline risk assessment surveys will include a sufficient amount of QA/QC so that these design inputs will be known and a post-hoc assessment of data sufficiency can be made.

4.5.1.3 Voluntary Corrective Action Sampling

VCA sampling results will not be used in a screening assessment. The purpose of VCA sampling is to bound the extent of contamination and to collect other information to guide site remediation. Media characteristics (e.g., organic material content) and the lists of COCs are important factors used to guide remediation. Thus, VCA sampling plans will vary based on the extent of the historical information on the PCOCs and other site characteristics. The verification sampling (post-remediation) is not considered as part of VCA sampling, and will be described in the VCA plan.

4.5.2 Sampling Methods

For a complete list of SOPs used in the RFI for OU 1082, refer to Table 4-7. Most samples taken at OU 1082 will be surface soil samples taken with hand augers. Other samples will include borings though soil and bedrock with a diamond drill. All sampling activities at OU 1082 will be conducted only after procedures are approved by the Explosives Safety Committee.

Field sample handling procedures will include collection of material for volatile organic analysis, metals, radionuclides, and semivolatiles.

Samples will be collected from defined sampling points, a sampling grid, or by stratified random sampling. To implement stratified random sampling the field survey team will be given x and y offsets from a sampling grid. Stratified random sampling is used where there is a concern about the presence of heterogeneously distributed contaminants where there is no spatial pattern to contamination.

4.6 Field Surveys

Field investigations during RFI Phase I have many common elements. While not all Phase I field surveys include all components, most surveys include: health and safety surveys, location surveys, and geophysics surveys.

4.6.1 Health and Safety Surveys

Before any site work can be started, the health and safety team must screen the site for potential worker hazards. In addition, when subsurface samples are taken, the borehole and cores are also sampled for health and safety purposes. These health and safety data may be helpful in selecting samples for laboratory analysis, or in determining the handling procedures for the samples.

4.6.2 Land Surveys

Each PRS aggregate will be field surveyed before sample collection. This will consist of site engineering mapping (geodetic) and geomorphologic mapping. Site mapping is required to accurately record the location of PRSs and sampling points. In the field, the engineering survey will locate, stake, and document all PRS locations (that can be ascertained before sampling) and all surface engineering features and structures. These data will be recorded on a base map. If the repositioning of a sample location becomes necessary during sample collection, this new position will be resurveyed and the revised location will be indicated on the base map. The engineering survey will be performed by a licensed professional working to "Minimum Standards for Land Surveying In New Mexico: (New Mexico Board of

Registration for Professional Engineers and Surveyors, (1/1/89) with oversight by the field team leader.

The geomorphologic survey will consist of the mapping of the first-order stream channels downslope of any identified drain outfall. This mapping will facilitate the selection of outfall sediment sample collection points. The surface drainage mapping will include the sediment catchment sites adjacent to any identified outfall.

4.6.3 Geophysics Surveys

The purpose of geophysics surveys is to locate subsurface objects. Engineering as-built diagrams locate objects, but not always with the precision needed for sampling. For example, samples taken adjacent to an active septic system drain line, must miss the line and collect the material of interest. In other cases, subsurface utility lines may be in the vicinity of the proposed soil cores.

The general location of the subsurface components will be determined from examination of dated aerial photographs and engineering drawings, land surveys, and from on-site visual inspection. Geophysical surveys will be conducted if necessary to precisely determine the boundaries of subsurface structures. The Geosciences Technical Team will provide guidance as to the appropriate geophysical methods. Once located, the sites will be surveyed in and permanently marked in the field and the data recorded on a base map.

4.6.4 Field Quality Assessment Samples

The purpose of field quality assessment samples to quantify the performance of a sampling technique (surface samples taken by a hand auger, boreholes taken by a diamond drill, etc.). A rule-of-thumb for a usual investment in QA is 10 to 20 % more samples (1 to 2 QA field samples for 20 field samples). There are several kinds of QA samples that can be collected. For example, for composite samples of a soil column, one may subsample the core twice or one may collect a second aliquot of the homogenized sample. Another kind of field QA sample is a collocated (or neighboring) sample. The investment in these various field QA types depends on the sources of variation in the sampling process. The largest source of variation is usually from field sample preparation (homogenizing), which indicates that the best investment in field QA is to collect additional subsamples of the homogenate.

4.7 Analytical Options

Use of field screening procedures and the field mobile laboratory are two analytical approaches that will ensure that the initial fixed laboratory findings capture the likely presence or indicate the absence of anticipated site PCOCs during reconnaissance sampling. These two analytical approaches allow the field team to better select samples that may reflect a site problem and to ensure that adequate samples are collected to characterize the PRS. Field screening will be particularly useful at OU 1082, where a limited number of compounds (HE, barium) present the majority of likely human risk, and field screening methods for these compounds are fast, effective, and have low detection limits. Field laboratory methods will not be needed for most OU 1082 aggregates, except for radiological constituents.

These two screening approaches are not intended to replace the need for fixed analytical laboratories during reconnaissance, baseline risk assessment, or VCA sampling, but to make decision-making more efficient through data timeliness, dollar and people resource use, and adequacy of decision data quality. During the reconnaissance phase, the objective of the screening assessment process is primarily to confirm the site COCs and to estimate the upper bound on the COC concentration. The screening approaches will help select biased samples representative of the maximum concentration in a PRS, and this material will be sent to the analytical laboratory. The selected approach and the supporting quality assessment and quality control data must always be specific to the site decision that is being made. This decision-based strategy to specify data quality helps ensure the adequacy of the analytical data generation process.

4.7.1 Field Screening Methods

Field screening methods include volatile organic methods (PID, FID), metals method (XRF, LIBS), the HE spot test for explosives, and radiation methods (beta/gamma or alpha counters, low energy spectra instruments - FIDLER, Phoswich). For instruments based on a counting technology (e.g., XRF, FIDLER) increasing counting time reduces the detection limit (a factor of $\frac{1}{\sqrt{n}}$, where n is the multiple by which counting is increased, e.g., 10 min. count has a detection limit of 71% of a 5 min. count). Typical detection limits for field screening and field laboratory methods of importance in this RFI work plan are summarized in Table 4-1.

Photoionization detector (PID): A Model PI 101 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 is usually not specific for a particular compound, unless the sample contains a limited number of volatile organics. The applicable SOP is Health and Safety Monitoring of Organic Vapors with a Photoionization Detector.

Flame ionization (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 flammability of the calibration gas. The applicable SOP is Health and Safety Monitoring of Organic Vapors with a Photoionization Detector.

Laser-Induced Breakdown Spectroscopy (LIBS): The laser spark from a Spectra-Physics DCR-11 has been used as an excitation source for the analysis of inorganics via atomic emission spectroscopy. In this method, a powerful laser pulse is focused on or in the material to be analyzed. As a result the material is vaporized and a plasma of high temperature and high electron density is formed, consisting of electron and excited atoms. One identifies emitting species by spectrally and temporally resolving the plasma light. Detection limits of 2 ppm for chromium and lead and 0.1 ppm for beryllium were determined (Han and Cremers 1990, 15-16-470). For measurements using 100 sparks (10 seconds), accuracies were within 80% and precision was 20% risk-specific dose (RSD) or better for chromium detection. Preliminary experiments suggest that LIBS also has good detection limits (estimated at <100 ppm) for barium in soils (Brown et al. 1992, 15-16-389).

XRF: X-ray fluorescence (XRF) is a technique for analyzing metals in solids. The instrument consists of a source for sample excitation, a detector or proportional counter, a sample chamber, and an energy analyzer. The XRF instrument will be used for detection of metals, particularly barium, that are heavier than sulfur, on solid surfaces. Dried soil or crushed debris samples are placed in a sample chamber, excited, and counted for finite time periods (such as 200 seconds). XRF only scans the upper layer of any material, which means that sample preparation can have a large impact on repeated measurements of a sample. There is no ER SOP for field-based XRF; calibration and field procedures recommended by the instrument manufacturer will be followed. Lower detection limits are related to the sample counting time. Thus, counting time must be selected with a knowledge of the list of PCOCs and appropriate SALs. Examples of manufacturer-reported lower detection limits are 10 ppm for uranium, 55 ppm for silver, and 15 ppm for lead. EM-9 estimates the barium detection limit to be 10 ppm.

HE Spot-Test Kit: The HE spot-test kit was developed to identify the presence of explosives as contaminants on equipment and in environmental media. Three reagents in a carrying case with a portable ultraviolet (UV) lamp can be used to detect any of the common explosives used at Los Alamos. These explosives are HMX, RDX, TNT, PETN, and TATB. After a suspect area or material is wiped with a clean filter paper, a drop of each of the three reagents placed on different parts of the sample will change color when explosives and/or other nitrogen compounds are present. A UV light (short wavelength, 254 nm) enhances color for RDX/HMX explosives. For checking soil contaminated with TNT, it was possible to detect a content as low as 0.01% (100 ppm) as determined by laboratory experiments (Baytos 1991, 0741).

Low-Energy Gamma Instruments: 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 americium-241 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 rate meter or scaler. Measurements may also be made at the ground surface to characterize material without collecting a sample.

4.7.2 Field Laboratory

Refer to the field laboratory methods summary table (Table 4-10) for a list of all field laboratory methods that are currently available and may be used at OU 1082.

TABLE 4-10

MOBILE LABORATORY METHODS USED IN OU 1082

METHOD	ANALYTE OR ANALYTE CLASS	LABORATORY REPORTING LIMIT
XRF with quick extraction via microwave	RCRA metals	e.g., Barium (Ba) - 10 ppm
GC/MS	VOC, SVOC, pesticides	e.g., Acetone - 0.05 ppm
HE colorimetic	TNT, DNT, RDX	TBD
Beryllium (Be) spot test	Be	TBD
Mercury (Hg) spot test	Hg	TBD
Gross α/β	α/β radiation	α - 55 pCi/g[1,a] β - 24 pCi/g [1,a]
Gross γ	γ radiation	4 pCi/g [1,b]
γ spectroscopy	γ radiation	<5 pCi/g[1,2,b]

a 1 gm sample
b 100 gm sample
c 15 gm sample
1 5 minute counts
2 Isotope dependent
TBD to be determined by EM-9

4.7.3 Analytical Laboratory Methods

See the PCOC summary table for a listing of the principal analytical methods (Table 4-1). We have defined a subset of the SW-846 6010 metals as the OU 1082 metals suite. In many cases only this subset of metals will be reported. These metals include: barium, beryllium, cadmium, chromium, copper, lead, nickel, silver, thallium, and zinc.

4.8 Quality Assessment

4.8.1 Laboratory Quality Assessment Samples

Refer to Annex II for a description of the type and number of laboratory quality assessment samples. The purposes of these samples are to assess analytical precision and bias, and to help discover fraud.

4.8.2 Field Quality Assessment Samples

The purpose of field quality assessment samples is to quantify the performance of a sampling technique (surface samples taken by a hand auger, boreholes taken by a diamond drill, etc.). Thus, adequate data should collected within OU 1082 to evaluate each sampling method. Many kinds of quality assessment samples can be collected (e.g., collocated samples, homogenate subsamples, field duplicates), and the type and number of these samples depends on the major source of variation in the sample collection process. The implementation plan for OU 1082 will use guidance in the IWP and survey-specific requirements in determining the number and type of field quality assessment samples. A brief discussion of the types of field quality assessment samples proposed in reconnaissance and baseline risk assessment surveys is presented below.

Reconnaissance sampling surveys usually involve collecting discrete samples from the surface or a segment of a soil core. These samples are selected by field screening or judgment to represent the maximum concentration in the PRS. Quality assessment samples will be taken to quantify the effectiveness of the biasing by collecting additional samples at random (within the PRS or in the soil core). Another quality assessment investment is to collect collocated samples. Collocated samples help determine the local variation in PCOCs, which is an important assumption in the statistical survey design. A roughly equal number of quality assessment samples for evaluating the biasing procedure and for collocated samples is expected to be allocated.

Baseline risk assessment surveys will collect material that is representative of the risk scenario. In some cases, samples will be homogenized in the field before being submitted to the analytical laboratory. The largest source of variation is usually from field sample preparation (homogenizing), which indicates that the best investment in field quality assessment for baseline risk assessment surveys is to collect additional subsamples of the homogenate. Collocated samples will also be collected, but the expected investment is three additional subsamples for every one additional collocated sample. The rationale for this investment is that field quality assessment information for collocated samples will be collected in the reconnaissance surveys, and that sample homogenization is expected to contribute an order of magnitude more variation to the sampling process than does local spatial variation of PCOCs.

4.9 Recordkeeping and Field Logs

All records generated by OU 1082 field investigations will be processed and archived in accordance with the Records Management Plan presented in Annex IV of the IWP (LANL 1992, 0768). Records generated during field activities will be documented in the field log. Records documenting activities occurring after samples are shipped from the field to the analytical laboratory, including laboratory analyses, laboratory analytical results, data validation, data analysis, and preparation of the RFI Report will be archived in accordance with the Records Management Plan.

A field log will be maintained during the sampling program. The log will document all field activities, including the sampling activity; record the information obtained from the field screening instrumentation; identify the procedures used in sampling and sample site selection; identify the personnel involved; and, record any other information pertinent to the sampling process and to the quality of the results. Field logs maintained by individual field team members will be consolidated into a master log at the end of each major sampling activity.

The completed field log will document the implementation of this work plan. Most importantly, it will document the site-specific decisions of the field team leader required under the phased approach presented in this plan, as well as any modifications to the plan required to address unanticipated site conditions. Because sampling and site characterization are essentially processes of discovery, minor modifications to the sampling plan and to its implementing procedures may occur. As a vehicle for documentation, the field log will be written to provide sufficiently comprehensive descriptions of the sampling activities and their rationale so that modifications to the work plan are not expected to be needed.

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Executive Summary

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- TA-11, Firing Site
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- TA-11, Potential Surface Contamination
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5.0 EVALUATION OF POTENTIAL RELEASE SITE AGGREGATES

Chapter 5 describes the history, data quality objectives, and sampling plans for the Operable Unit (OU) 1082 potential release sites (PRSs) for which sampling is deemed appropriate at this time. The solid waste management units (SWMUs) that are covered here are from Tables A and B of the Hazardous and Solid Waste Amendments (HSWA) Module and other PRSs that fit systematically into this work plan activity. The remaining OU 1082 PRSs will be addressed in subsequent Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) work plan addenda.

The framework for sample collection strategies and use of data as applied in Chapter 5 is found in Chapter 4, Subsections 4.5.1.1 and 4.5.1.2. Annex II, Quality Assurance Project Plan, describes the quality control issues pertinent to this work plan. Occupational Safety and Health Administration (OSHA) requirements for current site workers are the responsibility of the operating groups and are not addressed in this work plan.

5.1 Blowdown Tanks and Dry Wells, SWMUs 16-001(a-d)

5.1.1 Background

Four SWMUs compose the blowdown tank and dry well SWMU aggregate (Table 5-1). These SWMUs, 16-001(a-d), are grouped as a SWMU aggregate for two reasons: 1) the SWMUs are all located on the western edge of Technical Area (TA) 16 in or near the administration area of the site (Fig. 5-1); and 2) the structures associated with these SWMUs received liquid wastes that may have infiltrated the subsurface.

5.1.1.1 Description and History

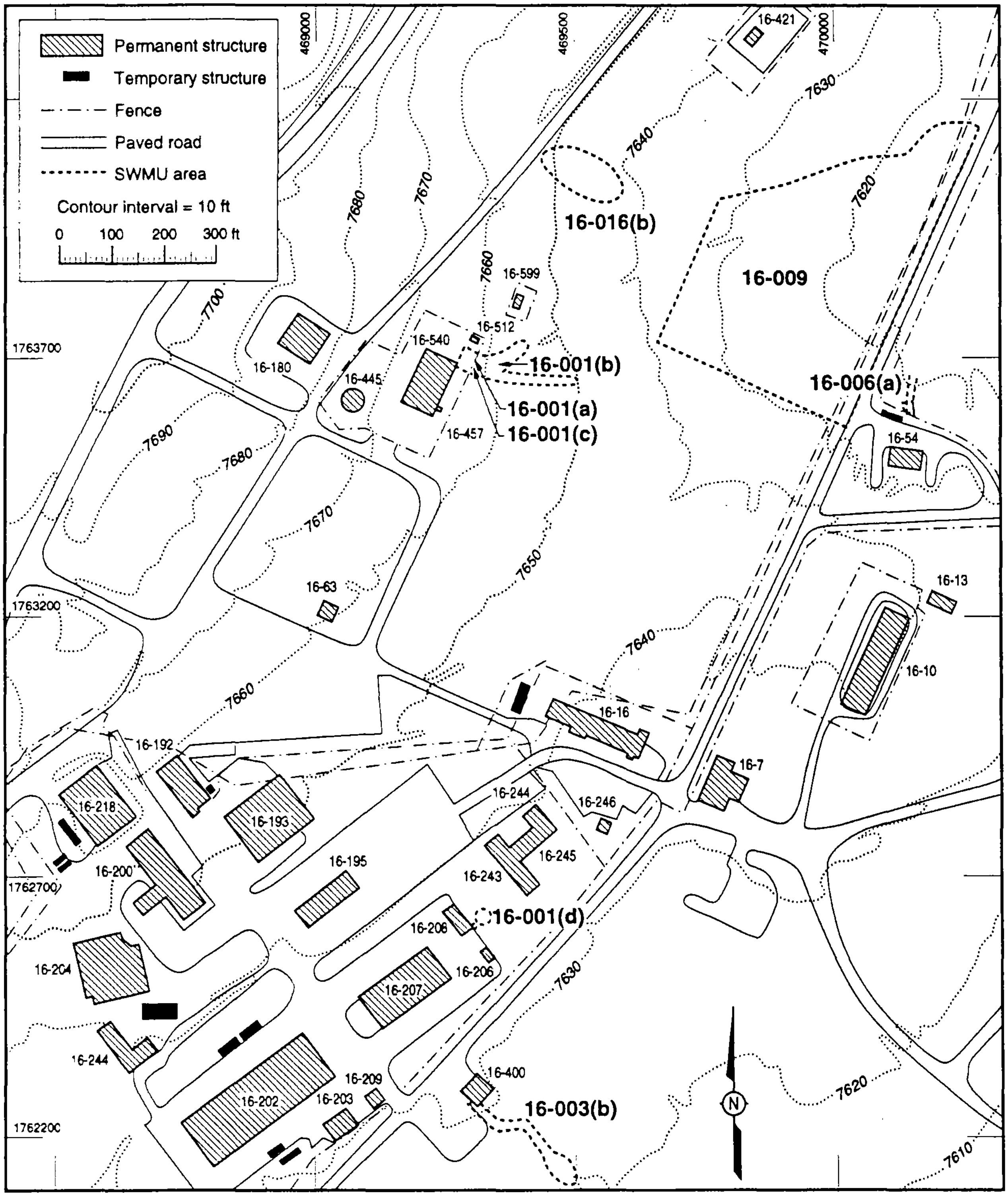
SWMUs 16-001(a-c) are associated with TA-16-540, the steam plant (Fig. 5-1). SWMU 16-001(d) is associated with TA-16-208, a drum storage building (Fig. 5-1). Both of these structures are located in the administration area at the western end of S-Site.

The steam plant, TA-16-540, was built in 1952 to serve the S-Site explosives development mission. The building has provided steam for heating the buildings at TA-16 since its construction. Effluent from the plant, which includes cooling water for the boilers, plus flow from floor and roof drains is

TABLE 5-1

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, BLOWDOWN TANKS AND DRY WELLS AGGREGATE

				METALS		ORGANIC	
PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	CHROMATES	METALS SUITE	VOLATILES	SEMIVOLATILES
16-001(a)	Blowdown tank TA-16-456	Cool boiler water, may contain scale inhibitors	Y	x	x	x	x
16-001(b)	Dry wells	Effluent from floor drains in TA-16-540	N	x	x	x	x
16-001(c)	Blowdown tank TA-16-541	Cool boiler water, may contain scale inhibitors	N	x	x	x	x
16-001(d)	Dry well at TA-16-208	Effluent from solvent storage building	N			x	x



cARTography by A. Kron 6/13/93

Fig. 5-1. TA-16 administration area.

routed through a discharge system. Three SWMUs are associated with the system. Blowdown tank TA-16-456, SWMU 16-001(a), was installed in 1968; it replaced the original tank TA-16-541, SWMU 16-001(c) (LANL 1990, 0145). SWMU 16-001(b) consists of two dry wells. The dry well system discharges to Environmental Protection Agency (EPA) Outfall 02A007; it has been refurbished since 1988 with new blowdown and settling tanks.

SWMU 16-001(a). SWMU 16-001(a) was blowdown tank TA-16-456, which served the TA-16 steam plant boilers. The tank received hot water blowdown from the steam boilers and was designed to cool the water before discharge to an outfall. The tank has a release stack to permit superheated water to vent to the atmosphere. The tank was located about 40 ft from the northeast corner of the steam plant, TA-16-540, and was half-buried in the ground. The tank was 7 ft-long steel tube with an inside diameter of 6 ft, and a 2 000-gal. capacity. This tank was replaced in 1988. The area around the tank is level with bare soil. East of the tank, beyond the fence enclosing the steam plant complex, the ground drops sharply about 6 ft then slopes gently toward the east.

SWMU 16-001(b). SWMU 16-001(b) consists of two dry wells connected in series. The wells are 4 ft in diameter; one is 6 ft deep, the other 7.5 ft deep. Each is constructed of concrete and covered with a manhole cover. Neither has a floor; the wells are designed to allow effluent to seep into the ground. A pipe equipped with a splash deflector enters each well near its bottom. The primary well has an outflow pipe leading to the secondary well. The dry wells are located outside the fence about 50 ft downslope and northeast of tank TA-16-456. The dry wells previously received overflow from the blowdown tank, but were bypassed after 1988 because their capacity was inadequate.

SWMU 16-001(c). SWMU 16-001(c) is tank TA-16-541, which received blowdown from the steam plant, TA-16-540. It was installed in 1962; blowdown was diverted to tank TA-16-456, SWMU 16-001(a) in 1968. The tank is still in place on level ground just south of TA-16-456. It is covered with a concrete pad and is equipped with a wire-mesh vent. A standpipe vent is located about 8 ft east of the tank. About 100 ft further downslope is a ditch that may have received outfall from this tank.

SWMU 16-001(d). SWMU 16-001(d) is an abandoned dry well that has not been located. Engineering drawing ENG-R 867, dated June 1959, shows a dry well northeast of TA-16-208; notation indicates the well was 3 ft in diameter and 9 ft deep, connected to the building with a 4-in. pipe. The location shown on the drawing is in a slight depression running parallel to the north side of TA-16-208 in a broad, level field covered with grass. The area around the building is paved on the other three sides. The building is a 10 ft long x 30 ft wide metal structure on a concrete foundation. It was built in 1952 and designed to house 55-gal. drums on racks along the long walls.

The building is still used to store drums of chemicals, including dimethylsulfoxide, acetone, chloroethene, electrolyte liquid, ethyl acetate, ethylene glycol, toluol, trichloroethelyene, and lubricating fluid. The drums are set on their sides with the spigots over a groove cut in the concrete floor. The floor of the building is contoured, with a slight ridge down the center, so that the sides slope to the grooves on each side. The floor is hosed down once a week. At the front of the room is a channel with grated wells on each side. Liquid accumulating in these wells once drained to the outside grassy area, perhaps to the dry well, but the outlets have been plugged. Liquid is now collected in buckets for permitted disposal.

5.1.1.2 Conceptual Exposure Model - Dry Wells

The conceptual exposure model is presented in Fig. 4-5. Site-specific information on potential release sources, chemicals of concern, migration pathways, and potential receptors is presented below.

5.1.1.2.1 Nature and Extent of Contamination

The principal potential contaminants of concern (PCOCs) at the steam plant, SWMUs 16-001(a-c), are chromates (Table 5-1). Chromates were typically used as algaecides to prevent fouling of boilers. However, according to a Laboratory engineer, chromates were not used as descalers at this plant (Radzinski 1992, 15-11-067). Despite these assurances, chromates are a PCOC because documentary evidence concerning operations in the steam plant during the 1950s and 1960s are lacking. During reviews prior to granting an NPDES permit at TA-16-540, effluent was analyzed for iron (0.28 to 16 ppm) and copper (0.032 to 0.6 ppm), suggesting compounds containing these elements may have been used as descalers (LASL 1977, 15-16-430). Solvents and oils may have been discharged through floor drains. The volume of potentially contaminated soil is presumed to be small.

Contaminants of concern (COCs) in TA-16-208, SWMU 16-001(d), include a range of organic solvents (see above) (Table 5-1). Additional organic solutions, corrosives, and toxic liquids may have been stored in this building in the past. No record of a solvent spill in this building has been found.

5.1.1.2.2 Potential Pathways and Exposure Routes

The dry wells and tanks, SWMUs 16-001(a-d), are potential sources of subsurface and surface contamination as a result of liquid disposal, leaks, overflow, and spills. The dry wells were designed to dispose of liquid waste by infiltration into the subsurface soil. The primary migration pathway for surface contamination is by surface water runoff resulting in the potential accumulation in sedimentation areas in drainages. Subsurface contamination can be brought to the surface via excavation or erosion.

Current human receptors are limited to on-site workers. Chapter 4 contains a detailed discussion of the migration pathways, conversion mechanisms, human receptors, and exposure routes to be considered should the need for a baseline risk assessment arise.

5.1.2 Remediation Decisions and Investigation Objectives

Problem Statement [Data Quality Objective (DQO) Step 1]

Historical activities in TA-16-540 and TA-16-208 may have resulted in release of PCOCs into the dry wells and tanks that compose this aggregate. Thus, for this SWMU aggregate, the principal goal of Phase I of the RFI is to determine if PCOCs are present in and around blowdown tanks and dry wells, SWMUs 16-001(a-d). No information exists about present sources of contamination related to SWMUs 16-001(a-d). Anecdotal evidence suggests that chromium and other metals used as descalers are PCOCs for SWMUs 16-001(a-c). Organics are a potential subsurface COC at dry wells 16-001(b) and 16-001(d). The reconnaissance data collected during Phase I investigations of these SWMUs will be used to determine whether these potential contaminants are present.

Decision Process (DQO Step 2)

Phase I data will lead to one of three actions: 1) propose no further action (NFA) for the tank or dry well, 2) perform voluntary corrective action (VCA), or 3) collect enough Phase II data to perform a baseline risk assessment or to understand the cost consequences of a VCA. This phase of the RFI will also confirm or disallow specific PCOCs at these SWMUs.

If the Phase I investigation shows that the PCOCs within the SWMU boundaries are not different from background or are not above screening action levels (SALs), then NFA is proposed for these SWMUs. If contamination different from background and above SALs is found during the Phase I investigations outlined here, this finding may result in more extensive Phase II investigations. Phase II data collection will be designed to characterize the extent of contamination to a level sufficient to complete a baseline risk assessment for these SWMUs and/or to evaluate remedial alternatives.

Possible remediation alternatives for these SWMUs if the screening assessment process suggests that NFA is not a viable option include: 1) removal of contaminated material to a permitted landfill; 2) *in-situ* stripping of organics; and, 3) stabilization in-place with continued monitoring.

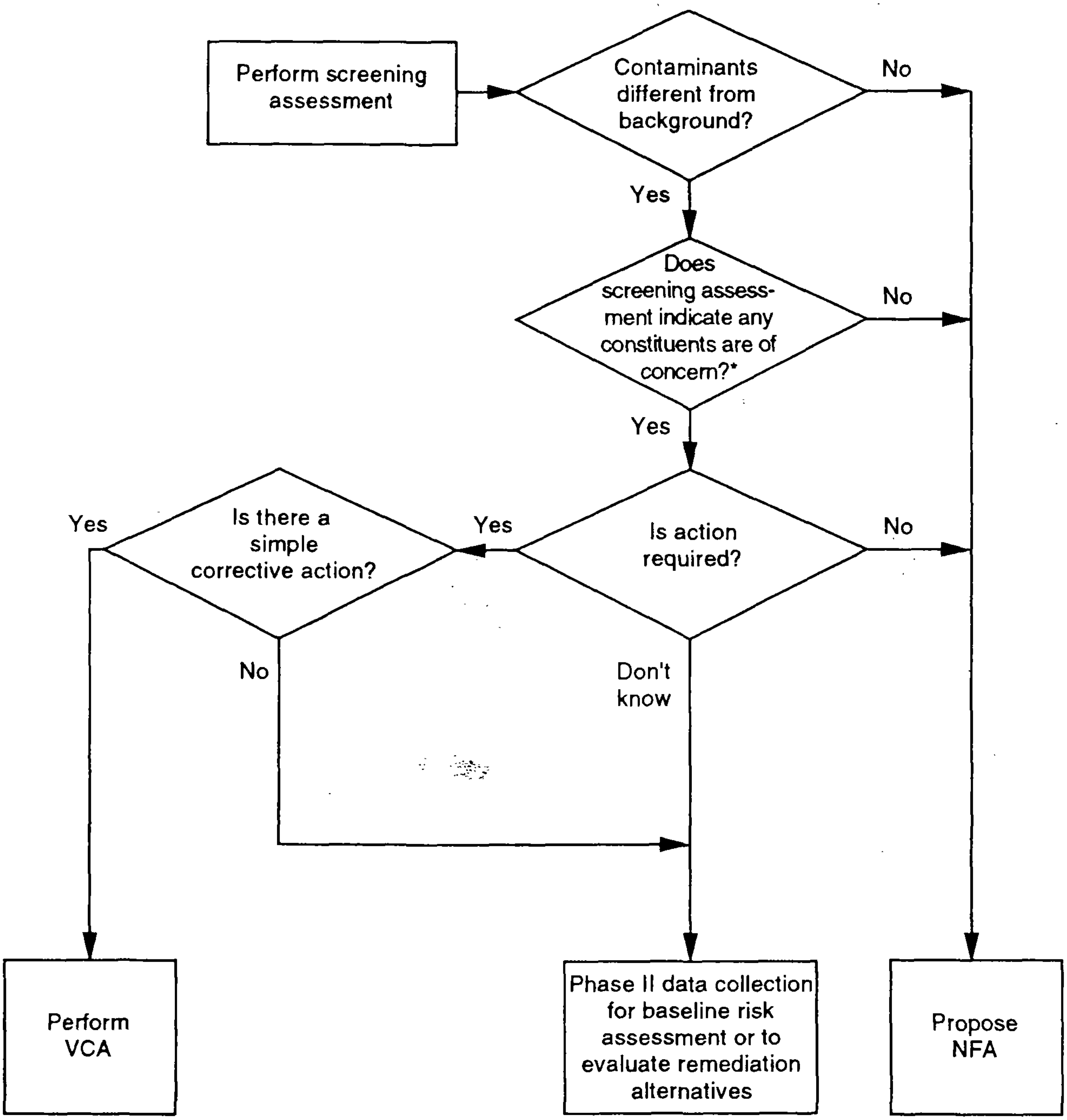
The decision process is summarized in Fig. 5-2.

5.1.3 Data Needs and Data Quality Objectives

Decision Inputs (DQO Step 3)

As discussed above, the PCOCs for these SWMUs are metals, particularly chromium, and organics. In Phase I, the following questions will be addressed:

1. Is there surface contamination associated with the blowdown tanks, SWMUs 16-001(a,c), or dry wells, SWMUs 16-001(b), of the steam plant?



* PCOCs > SALs or possible multiple contaminant problem

Fig. 5-2. Decision flow for dry wells.

2. Have metals or organics infiltrated the surface soils and tuffs resulting in subsurface contamination beneath dry wells 16-001(b) and 16-001(d) or adjacent to 16-001(a) and 16-001(c)?

The data needed to determine whether surface metal contamination is present is the concentration of metals in the vicinity of the dry well and blowdown tanks near the steam plant. To determine whether subsurface metal or organic contamination is present, the concentrations of metals and organics in the subsurface soils and upper tuff beneath dry well SWMU 16-001(b) and adjacent to 16-001(a) and 16-001(c) will be needed. For SWMU 16-001(d) analyses near the subsurface dry well will be needed to determine whether organic contamination is present. If this dry well cannot be located, then samples will be taken near the outfall point for the drainage lines exiting TA-16-208, which is assumed to be the next most likely point for potential contamination.

In Phase I, we propose sampling only within the SWMU boundaries because we assume that high concentrations of all PCOCs will remain in the vicinity of their sources.

Investigation Boundary (DQO Step 4)

Deposition of blowdown contaminants from the steam plant would be expected to concentrate PCOCs on the surface soils immediately surrounding the blowdown tanks. The sampling region for potential surface contamination will be the surface soils within 2 ft of either blowdown tank, 16-001(c), or its replacement, 16-001(a). The blowdown tanks may have leaked PCOC-bearing effluent into adjacent soil or tuff. Discharge released to the dry wells could have resulted in possible subsurface contamination. The subsurface soils and tuff beneath dry wells 16-001(b) and 16-001(d) and adjacent to blowdown tanks 16-001(a) and 16-001(c) will be considered from the surface 2.5 ft into bedrock. Based on previous studies in which metal contamination has been found within bedrock, it is expected that the highest concentrations of PCOCs in tuff will occur within 2.5 ft of the soil/bedrock interface (Nyhan et al. 1984, 0166; McLin 1989, 15-16-405).

Decision Logic (DQO Step 5)

To examine potential surface contamination at SWMUs 16-001(a) and 16-001(c), ten samples will be field screened for total chromium and the highest sample sent to the analytical laboratory for analysis. The chromium concentration from this sample will be used in the screening assessment. For all samples, the sample maxima of the concentrations of metals and/or organics will be compared to SALs.

If contamination is shown to be present which is different from background and above screening action limits in Phase I, then a more detailed Phase II source characterization study of extent of contamination applicable to risk studies, transport modeling, and evaluation of remediation alternatives will be undertaken. This would include the area surrounding the dry wells and blowdown tanks. If contaminants are not different from background or are detected below SALs, then the SWMUs will be proposed for NFA.

Design Criteria (DQO Step 6)

The sampling philosophy for this aggregate is to use field screening to bias laboratory sampling, in order to detect PCOCs above SALs within the SWMUs.

Since blowdown deposition of potential surface metal contamination is assumed to be uniformly distributed, and the probability of metal contamination is low, a single judgmentally-located laboratory surface sample will be selected at the blowdown tanks at the steam plant. The location of the sample to be submitted for laboratory analysis will be determined by chromium field screening of 10 sample locations located 1 ft from the blowdown stacks at evenly-spaced points around the dry wells. The location with the highest chromium reading from the field screening will be selected as the location of the laboratory sample.

For subsurface constituents that may have leaked from blowdown tanks 16-001(a) and 16-001(c), three augered coreholes will be drilled within 1 ft of the two tanks. Two of these will be located on the southeast, down the topographic gradient in the area, and one will be located to the northwest of the dry well, 16-001(c). These areas represent the likeliest zones of potential subsurface contamination around the dry wells.

For subsurface contamination of the 16-001(b) dry wells, two augered cores will be selected from each dry well to represent worst-case exposure to subsurface contamination. The material within the small area of the dry well, SWMU 16-001(b), will be assumed to be laterally uniform so that these cores are representative of the subsurface soils. It is assumed that blowdown mixing in the dry well would yield a homogeneous distribution of contaminants (if present) in the material within the dry wells. The small area of dry well 16-001(d), the likelihood of uniform lateral contaminant distributions, and the unlikely prospect of contamination justify two samples for laboratory analysis. These samples will be taken from the excavated and exposed soils of the dry well, if located, or at the end of the subsurface outfall to represent worst-case exposure.

5.1.4 Sampling and Analysis Plans

Phase I sampling is intended to determine if releases have occurred from these units. SOPs used in this sampling plan are listed in Table 5-2. Sample numbers and necessary analyses are shown in Table 5-3. Field screening methods are described in Subsection 4.7; SOPs for these procedures are in preparation.

TABLE 5-2

STANDARD OPERATING PROCEDURES FOR FIELD ACTIVITIES

LANL-ER-SOP	TITLE	NOTES
01.02, R0	Sample Containers and Preservation	Applied to all laboratory samples
01.04, R1	Sample Control and Field Documentation	Applied to all laboratory samples
06.10, R0	Hand Auger and Thin-Wall Tube Sampler	VOC-bearing soil samples
06.11, R0	Stainless Steel Surface Soil Sampler	All 0 to 6 in. surface samples
12.01, R0	Field Logging, Handling, and Documentation of Borehole Materials	All cored samples

TABLE 5-3

SUMMARY OF SITE SURVEYS, SAMPLING, AND ANALYSIS FOR BLOWDOWN TANKS/ DRY WELLS

			Laboratory Samples						Field Screening							Field Lab.						Laboratory Analyses											
PRS	PRS TYPE	Sampled Media	Structure	Field dup	Surface	Field dup	Subsurface	Field dup	Gross Alpha	Gross Gamma/Beta	Organic Vapor	HE Spot Test	Geophysics Surface	Chromium - LIBS	Geological Characterization [A]	Gross Alpha	Gross Gamma/Beta	Tritium	Volatile Organics	XRF [B]	Soil Moisture	Alpha spectroscopy	Gamma spectroscopy	Beta spectroscopy [C]	Total Uranium	Isotopic Plutonium	Isotopic Uranium	VOA (SW 8240) [D]	Semivolatiles (SW 8270) [E]	Metals (SW 6010) [F]	PCBs (SW 8080) [G]	High Explosives (SW 8330) [H]	Cyanide
16-001(a)	Tank	Soil			1		3				#			10#														4	4	4			
16-001(b)	Dry wells	Soil					2				#			#														2	2	2			
16-001(c) *	Tank	Soil																															
16-001(d)	Dry well	Soil					2	1			#		x															2	2				

* 16-001(a) and 16-001(c) sampling plans are considered together.
A, B, C, G, H = not applicable; D, E = full suite; D = subsurface samples only; F = 1082 suite.
The number of field-screening samples for subsurface will depend on the depth to bedrock and the geometry of the excavation for 16-001(d).

5.1.4.1 Engineering Survey

An engineering survey is needed to accurately locate SWMUs in the field as well as define locations for field screening, the geophysical survey, and sampling. The engineering survey will locate, stake, and document all SWMU boundaries and all surface and geomorphic engineering features. All sample locations will be registered on a base map, scale 1:7 200. If, during the course of sampling, any sample points must be relocated, the new position will be resurveyed and the revised locations will be indicated on the map. The engineering survey will be performed by a licensed professional under the supervision of the field team leader.

5.1.4.2 Geophysical Surveys

The location of the dry well associated with drum-storage building TA-16-208, SWMU 16-001(d), is unknown. A small-scale electromagnetic and magnetics survey will be undertaken northeast of TA-16-208 in order to locate this missing dry well. SOPs for geophysical investigations are currently in preparation. This survey will extend southeast-northwest for roughly 50 ft and southwest-northeast for roughly 50 ft (Fig. 5-3).

5.1.4.3 Sampling

At the blowdown tanks, ten surface sampling points will be field screened for chromium using LIBS. These screening samples will consist of 0 to 6 in. of soil and will be taken at roughly evenly spaced locations within 2 ft of the two tanks, 16-001(a) and 16-001(c) (Fig. 5-3). The sample containing the highest chromium concentration will be selected for laboratory analysis.

One drilled core will be taken of the bottom soils from within each dry well 16-001(b) for a total of two cores (Fig. 5-3). In addition, three coreholes will be drilled adjacent to the blowdown tanks [16-001(a) and (c)] (Fig. 5-3). All of these cores will extend at least 2.5 ft into the underlying tuff. The cores will be field screened on 6-in. intervals for chromium and organics. A 6 in. sample will be taken of each core, and analyzed for metals and organics. The location of these core samples will be biased for positive field screening results for chromium or organics; in the absence of such positive results, the interval containing the soil-tuff interface will be selected.

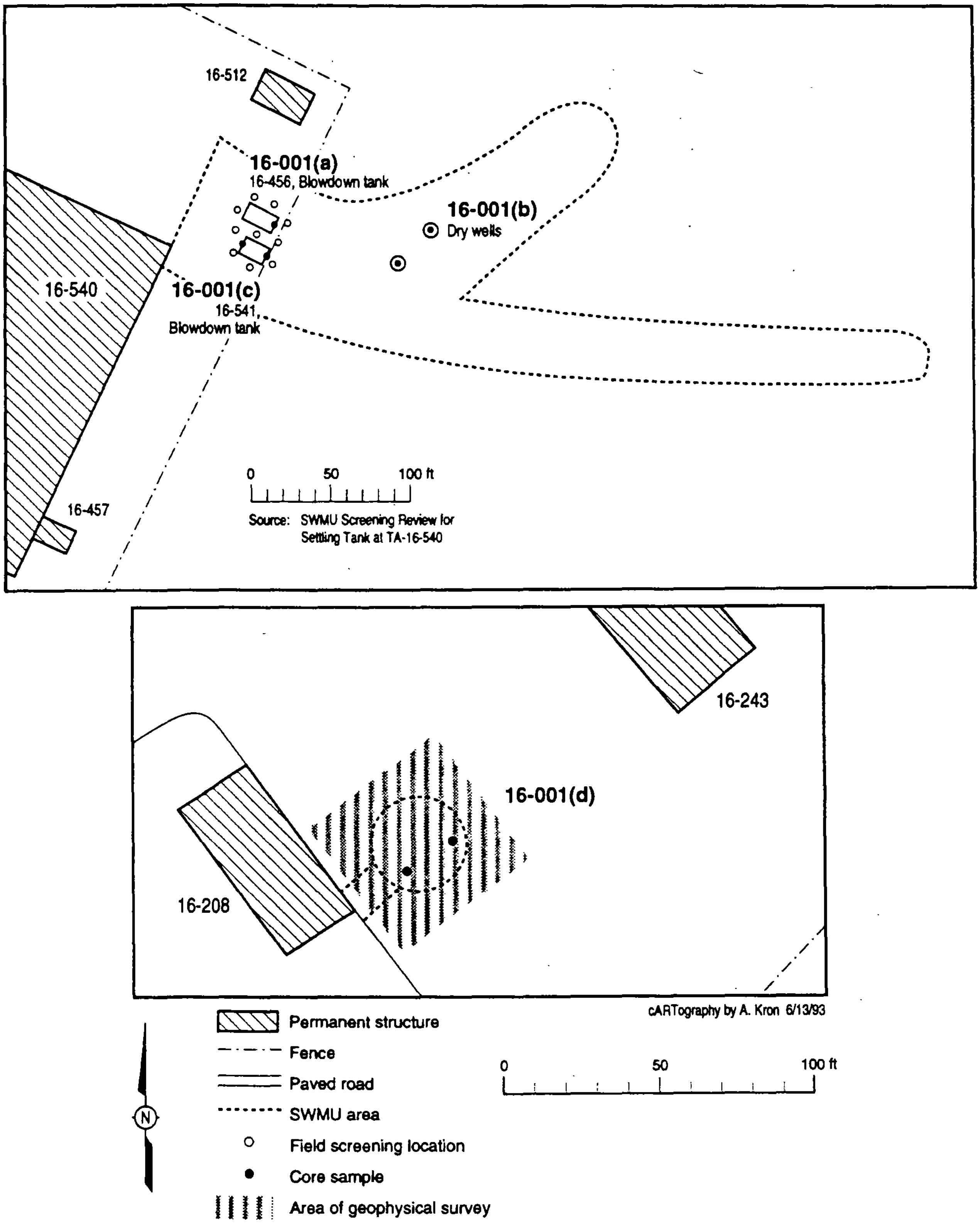


Fig. 5-3. Schematic administration area sampling maps.

Dry well 16-001(d) will be excavated to reveal its top and exposed soils and/or tuff will be field screened for organics. If the dry well cannot be located, the outfall pipe will be traced to its end, excavated, and a single analysis will be taken. If the dry well is located, then two samples of soil or backfill from within and around the exposed dry well will be analyzed for organics, as biased by the field screening. The samples will be taken at a depth of 0 to 6 in. from the excavated subsurface.

5.1.4.4 Laboratory Analysis

Full laboratory analyses of samples will be at Level III using the following methods: volatile organic compounds (VOCs) (SW-846 Method 8240), SVOCs (SW-846 Method 8270), and metals (SW-846 Method 6010). No specific PCOCs have been identified in 16-001(a-c) based on archival data. PCOCs possible in 16-001(d) include dimethylsulfoxide, acetone, chlolorthene, ethyl acetate, ethylene glycol, toluol, and trichloroethelyene, as well as other materials that may have been stored in the building in the past.

5.1.4.5 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the latest revision of the Installation Work Plan (IWP) (LANL 1992, 0768). All sampling parameters are summarized in Table 5-1-3, including a listing of appropriate quality assurance (QA)/quality control (QC) field duplicate samples planned to be collected during the course of the field investigation.

5.2 HE Sumps and Outfalls, SWMUs 16-003(a-j, l-o), 16-026(b-e,v,h2,j2), 16-029(a-g), 16-001(e)

This aggregate consists of 36 high explosive (HE) sumps and associated drain lines and outfalls as well as one dry well associated with HE processing (Table 5-4). Twenty-six of the drain lines and outfalls are currently considered inactive because the outlets from the sumps recently have been plugged, or are expected to be plugged, to prevent discharge. The other ten sumps and associated outfalls are currently active, they continue to discharge to the environment. However, the sumps are included in a single aggregate, because it is not known specifically which of these sumps will be active during Phase I of the RFI. The SWMU Report (LANL 1990, 0145) also refers to active and inactive sumps, SWMUs 16-003(a-q) being active and SWMUs 16-029(a-g2) being inactive. The active and inactive sumps in this section do not necessarily correspond to similar designations in the SWMU Report, either because the sumps were plugged since the SWMU Report was issued, or because there are errors in the designations outlined in the SWMU Report.

We propose a generic sump sampling plan that will be applied to any sumps that are plugged prior to initiation of Phase I of the RFI. Those sumps that continue to discharge chemicals to the environment will not be sampled until they are plugged. Any characterization or remediation efforts would be rendered inadequate by subsequent chemical release. If any of these active sumps is plugged between completion of this RFI work plan and the beginning of fieldwork, it will be sampled using the generic sump sampling plan.

5.2.1 Background

Because the sumps operated for more than 40 years before they were plugged, the following discussion applies to both plugged and unplugged sumps (inactive and active outfalls). It also applies to the thirteen sumps at TA-16-260 discussed in Subsection 5.3.

The SWMUs include the HE sump, its drain lines and outfall, and the drainage channel from the outfall. A list of National Pollutant Discharge Elimination System- (NPDES) permitted discharges and associated HE

TABLE 5-4

HIGH EXPLOSIVES SUMPS AND OUTFALLS

SUMP SWMU	OUTFALL SWMU	BUILDING	EPA ID NUMBER	NUMBER OF SUMPS	MANUFACTURING PROCESS
16-003(a)	*	16-410	05A 053	1***	Assembly
16-003(b)	*	16-400	05A 063	1**	Truck wash
16-003(c)	16-026(v)	16-460	05A 072	1	Analytical chemistry
16-003(d)	*	16-300	05A 058	2***	Mock HE
16-003(e)	*	16-302	05A 058	2***	Casting
16-003(f)	*	16-304	05A 058	2***	Plastics
16-003(g)	*	16-306	05A 058	2**	Plastics
16-003(h)	16-030(d)	16-280	05A 061	1***	Inspection
16-003(i)	*	16-265	05A 057	1**	In-line assembly
16-003(j)	*	16-267	05A 149	1**	In-line assembly
16-003(k)	16-021(c)	16-260	05A 056	13	Machining
16-003(l)	16-030(h)	16-430	05A 071	3***	Pressing
16-003(m)	16-030(g)	16-380	05A 052	1**	Powder inspection
16-003(n)	*	16-342	05A 062	1	HE preparation
16-003(o)	*	16-340	05A 054	6	HE preparation
16-029(a)	16-026(b)	16-307	none	2**	Rest house
16-029(b)	16-026(c)	16-305	none	2**	Rest house
16-029(c)	16-026(d)	16-303	none	2**	Rest house
16-029(d)	16-026(e)	16-301	none	2**	Rest house
16-029(e)	16-026(h2)	16-360	05A 159	1**	Shipping
16-029(f)	16-026(j2)	16-345	none	1	Rest house
16-029(g)	*	16-450	04A 091	1	Testing

SWMUs include the HE sump, its drain line and outfall, and drainage channel from the outfall.
SWMUs 16-003(k) and 16-021(c) are covered in Subsection 5.3.
* Outfall is incorporated into sump SWMU.
** Sump outlet(s) plugged; no discharge to outfall.
*** Sump outlet(s) planned to be plugged.

sumps is given in Table 5-4. Building numbers and manufacturing processes are also listed.

The sumps were constructed in the early 1950s when TA-16 (S-Site) was modernized to replace the World War II complex. The sumps are an integral part of the process buildings which they serve. The sumps were modified in 1966 to improve their effectiveness and to reduce HE handling (Engineering drawing ENG-C 34240).

Each building in the modern S-Site complex was designed with a specific role in the HE-component fabricating process. In general, unless specified otherwise, operations within a specific building or building complex have not changed materially since the early 1950s. What has changed is the nature and quantity of explosives used in each building. The principal change in HE formulation is a decreased emphases on cast explosives, such as Composition B, and since the 1950s an increased reliance on plastic-bonded explosives. Volumes of HE processed have also decreased significantly since the 1950s.

Operating Principles - HE sumps

HE sumps remove suspended solids from process waste water prior to discharge to an outfall. HE manufacturing processes, such as machining, produce scrap of various sizes (< 0.5 microns to 1 inch). Process water is used as a coolant-lubricant in the machining of HE, to clean contaminated parts and equipment, and to wash down processing bays. HE-contaminated water is routed to the sumps through drain troughs in the floor of the process bay. Scrap is collected from the sumps and treated at the S-Site burning ground; the water is filtered and tested before it is discharged to an outfall.

HE sumps are rectangular, concrete tanks with removable, 0.25 in. aluminum lids. The outside dimensions of a typical sump are approximately 12 ft long, 4 ft wide, and 5 ft high. The walls and bottom are 8-in.-thick steel-reinforced concrete. As initially constructed, HE fines (scrap) were collected in a cloth filter bag secured inside a metal filter basket. The baskets and filter bags were periodically collected and cleaned at the basket washing facility, TA-16-390, which is located at the burning ground. HE fines too small to be collected by the filter bags settled to the bottom of the sump. To assist separation of the suspended solids, the water flowed under an aluminum baffle and over a concrete weir before it discharged to an outfall. HE in the bottom of the sump was periodically removed and burned.

In the mid-1960s, water-tight, aluminum tanks were installed in the sumps, eliminating the filter baskets and cloth bags. Each tank has two baffle and weir separation stages on the long axis of the sump. Waste products in the sumps are periodically removed and burned in the sand beds at the TA-16 burning ground, SWMU 16-010. This unit operates under RCRA interim status provisions of 40 CFR 265. A RCRA Part B permit application was submitted to NMED in 1988.

5.2.1.1 SWMU Descriptions and Histories

The sumps and their associated process buildings are discussed individually below. Characteristics of each sump are listed in Tables 5-5 and 5-6. First, the 26 current inactive HE sumps and their process buildings are described, then the 10 current active sumps are described.

SWMU 16-003(a): TA-16-410. SWMU 16-003(a) is a single inactive HE sump and an outfall associated with TA-16-410 (Fig. 5-4). Waste consists primarily of wash-down water. In 1970, Wilder classed use of HE as high, but the probability of HE in the sump as low (Wilder 1970, 15-16-282). Panowski determined that small to moderate amounts of potentially hazardous effluent may have been discharged to the environment (Panowski and Salgado 1971, 15-16-038).

The outfall receives effluent from the HE sump; and floor, roof, and equipment drains, as shown on Laboratory drawing 13Y-192114 (Palmer and Abercrombie 1991, 15-16-366). The effluents flow into a common drain line that discharges over a steep canyon wall into the main course of Water Canyon to the southeast of TA-16-410. Water Canyon will be investigated as part of OU 1049, Canyons.

TA-16-410 is a test device assembly building. Explosive charges and other components are assembled into finished test devices. Some components may contain, or have been fabricated from, natural or depleted uranium. No machining or scrap-producing processing of radioactive materials is performed (LANL 1989, 15-16-363). TA-16-410 is also used for disassembly of devices that have undergone environmental and other types of nondestructive tests.

TABLE 5-5

HIGH EXPLOSIVES SUMPS AND DRAIN LINES WITH INACTIVE OUTFALLS

SUMP SWMU	LENGTH*, QUANTITY	SUMP DRAIN LINE**	ENGINEERING DRAWING NUMBERS
16-003(a)	111", 1	8" VC and CM pipe	13Y-192114 ENG-R888
16-003(b)	172", 1	6" VC pipe	13Y-192102 ENG-R875
16-003(d)	123", 1 203", 1	6" VC pipe 8" VC pipe	13Y-192092 ENG-R871
16-003(e)	123", 1 203", 1	6" VC pipe 8" VC pipe	13Y-192094 ENG-R871
16-003(f)	123", 1 203", 1	6" VC pipe 10" VC pipe	13Y-192096 ENG-R879
16-003(g)	123", 1 203", 1	10" VC pipe	13Y-192098 ENG-R879
16-003(h)	117", 1	15" VC pipe	13Y-192113 ENG-R870
16-003(i)	76", 1	16" x 6" concrete trench	13Y-192117 ENG-R862
16-003(j)	76", 1	16" x 6" concrete trench	13Y-192075 ENG-R862
16-003(l)	88", 2 114", 1	6" WS pipe	13Y-192071 ENG-R883
16-003(m)	192", 1	15" CM pipe	13Y-192091 ENG-R891
16-029(a)	84", 1 160", 1	6" CI pipe 6" VC pipe	13Y-192099 ENG-R885
16-029(b)	84", 1 160", 1	6" CI pipe	13Y-192079 ENG-R879
16-029(c)	84", 1 160", 1	6" CI pipe	13Y-192095 ENG-R878
16-029(d)	84", 1 160", 1	6" CI pipe	13Y-192093 ENG-R871
16-029(e)	160", 1	6" soil pipe	13Y-192111 ENG-R885

* All sumps are 41" wide by 31" high

** VC: Vitrified clay
CI: Cast iron
CM: Corrugated metal
WS: Welded steel

Materials that have been used during assembly and disassembly operations include: explosives, natural and depleted uranium, ethylene glycol (Panowski and Salgado 1971, 15-16-038), metals, and other solvents.

SWMU 16-003(b): TA-16-400. SWMU 16-003(b) is a single inactive HE sump and an outfall associated with TA-16-400 (Fig. 5-1). Waste consists

TABLE 5-6

HIGH EXPLOSIVES SUMPS AND DRAIN LINES WITH ACTIVE OUTFALLS

SUMP SWMU	LENGTH*, QUANTITY	SUMP DRAIN LINE**	ENGINEERING DRAWING NUMBERS
16-003(c)	90", 1 ea	8" VC pipe	13Y-192067 ENG-R875
16-003(n)	88", 1 ea	6" VC pipe	13Y-192101 ENG-R872
16-003(o)	124", 6 ea	10" VC pipe	13Y-192074 ENG-R873
16-029(f)	88", 1 ea	1-1/2" steel pipe	13Y-192180 ENG-R873
16-029(g)	159", 1 ea	6" soil pipe	13Y-192110 ENG-R881

* All sumps are 41" wide by 31" in height.
** VC: vitrified clay.

of equipment wash-down water. Wilder found that use of HE was low and the probability of HE in the sump was low (Wilder 1970, 15-16-282).

The outfall receives effluent from the HE sump and a steam-pit drain as shown on LASL drawing 13Y-192102 (Palmer and Abercrombie 1991, 15-16-366). The effluents flow into a common drain line that discharges into a level meadow on the southeast.

TA-16-400 is a truck washing facility, although it has also been used for cleaning other HE-contaminated materials such as drain pipe excavated from the World War II HE sumps (Courtright 1969, 15-16-318; LASL Photograph No. 665241).

Most of the trucks were used for transporting boxed HE and process equipment. Periodic wash down is required for maintenance and administrative control purposes.

The sump receives HE-bearing water from washing the trucks. The SWMU Report (LANL 1990, 0145) states that solvents are discharged to the sump, but no evidence has been found to support the claim.

The 300-Line Sumps with a Common Outfall and Dry Well

The 300-Line consists of process buildings TA-16-300, 302, 304, and 306, and their rest houses TA-16-301, 303, 305, and 307 as shown in Fig. 5-5.

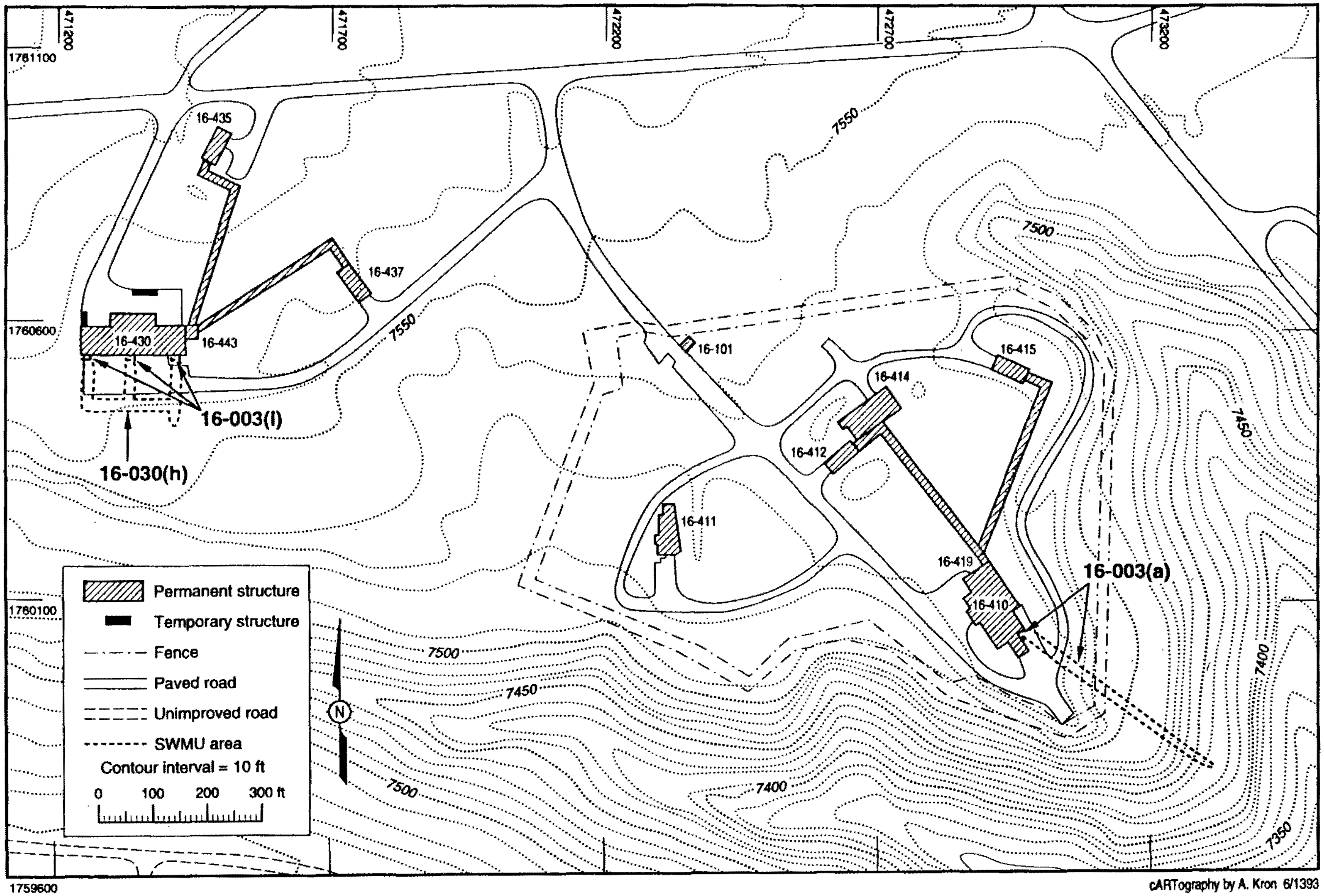


Fig. 5-4. TA-16-410 and TA-16-430 area.

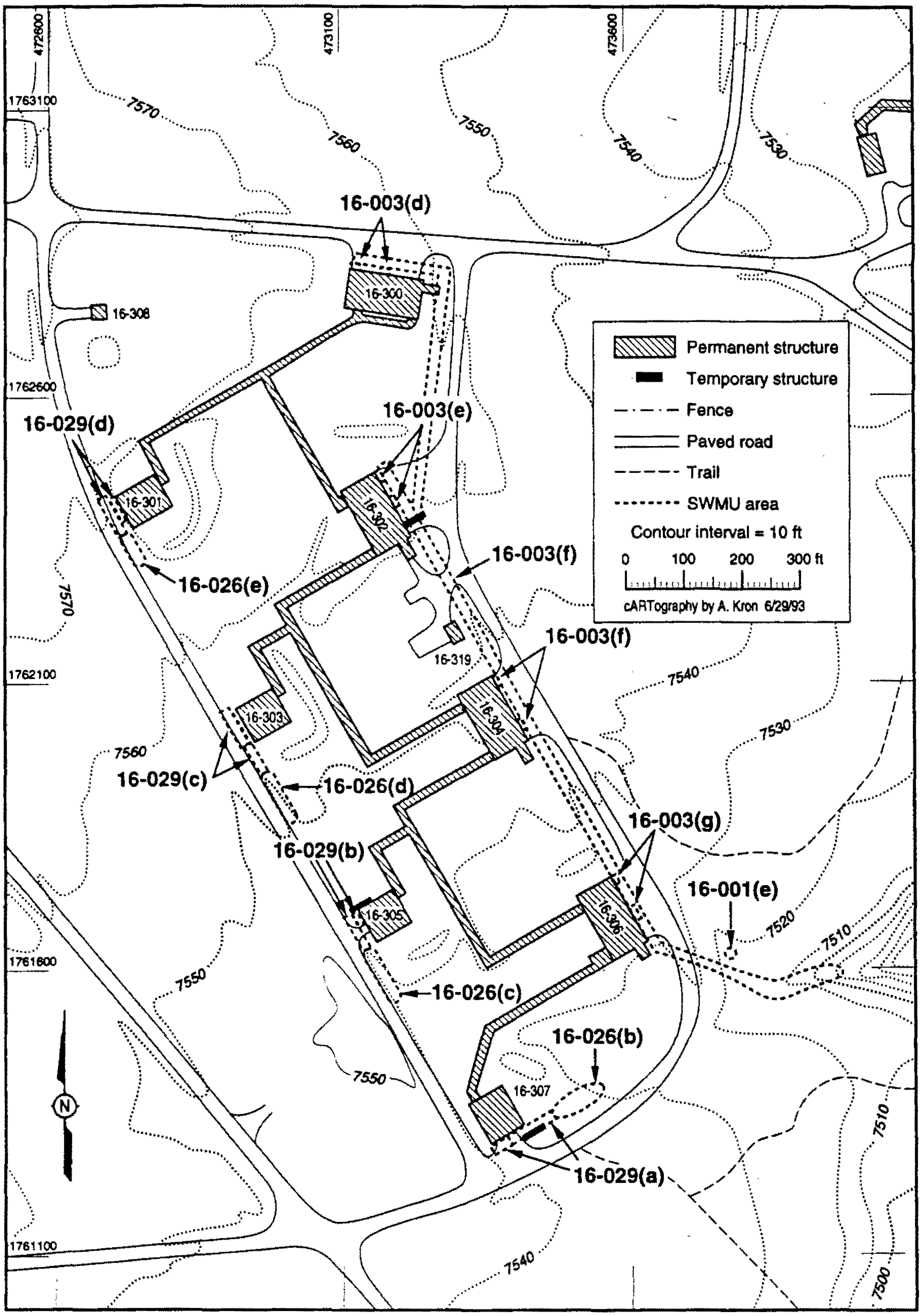


Fig. 5-5. TA-16 300 line.

The line was built in late 1951 and early 1952 for casting HE, such as TNT, Composition B, and baratol (Engineering drawing ENG-C 15725). The buildings were converted to other uses when cast explosives were replaced by plastic-bonded explosives, except TA-16-302, which remains a casting facility (Griffin 1992, 15-16-341). The TA-16-304 and 306 complex was converted to plastics development in 1958. TA-16-300 was converted to inert processing in 1962 or 1963 (Barr 1992, 15-16-329). Concern over explosives seeping into cracks in the floors of the processing bays and in the drainage troughs feeding the sumps in TA-16-300 and 302 has been reported (Dion 1963, 15-16-120; LANL 1989, 15-16-362).

TAs 16-300, 302, 304, and 306 have a common liquid waste trunk line on the northeast of the buildings as shown in Fig. 5-5. The outfall, EPA 05A058, discharges into a well-defined drainage across the road and southeast of TA-16-306.

Toluene 2,4-diisocyanate, anthracene, acetone, 1,1,1-trichloroethane, and methylene chloride are used in the various facilities in the 300-Line (LANL 1989, 15-16-362). Cyanuric acid is used extensively in TA-16-300 (Hickmott and Martin 1993, 15-16-448). TA-16-304 and 306 discharge plastics, oil, and solvents such as chlorothene, acetone, and methylene chloride (LANL 1989, 15-16-362; Panowski and Salgado 1971, 15-16-038). The SWMU Report states that methyl ethyl ketone solubles have been released from the process building sumps (LANL 1990, 0145).

Solvents are no longer discharged to the sumps or other drains in the 300-Line. The current practice is to drum the solvents before they reach the sumps. The solvents are then properly disposed of elsewhere.

SWMU 16-003(d): TA-16-300. SWMU 16-003(d) is two inactive HE sumps associated with TA-16-300 (Fig. 5-5). No HE is presently used and the probability of HE in the sumps is low (Wilder 1970, 15-16-282). Panowski stated that in 1970 pollution effluents from the building were effectively negligible (Panowski and Salgado 1971, 15-16-038).

TA-16-300 is a mock (inert) explosives preparation facility. Raw materials such as pentaerythritol (Pentek), barium nitrate, cyanuric acid, and nitrocellulose are blended into plastic-bonded molding powders. Currently there are no HE operations. Process and wash-down water is drained to the sumps.

An H-Division report mentions the use of octyl at the facility (H-Division 1955, 0762). During an interview, Lynn Parkinson, former group leader of WX-3, stated that solvents were used (LANL 1989, 15-16-363).

SWMU 16-003(e): TA-16-302. SWMU 16-003(e) is two inactive HE sumps associated with TA-16-302 (Fig. 5-5). Wilder classified use of HE in TA-16-302 as very high, but probability of HE in the sumps as low (Wilder 1970, 15-16-282).

TA-16-302 is a HE casting facility. Explosives such as Composition B, baratol, and TNT are melted in steam-heated kettles and poured into molds. The castings are later machined to final shape. Molds, kettles, and other equipment are cleaned using steam and high-temperature wash water that drains into the sumps.

Panowski reported that TA-16-302 discharged small to moderate amounts of castable explosives and solvents to the environment (Panowski and Salgado 1971, 15-16-038; LANL 1989, 15-16-362). Panowski did not specify the solvents used in the facility. No plastic-bonded explosives are processed. In 1954, H-Division found low air concentrations of anthracene in the building and in TNT samples (H-Division 1954, 15-16-220).

SWMU 16-003(f): TA-16-304. SWMU 16-003(f) is two inactive HE sumps associated with TA-16-304 (Fig. 5-5). No HE is currently used and the probability of HE in the sumps is low (Wilder 1970, 15-16-282; LANL 1989, 15-16-362).

TA-16-304 functions as a plastics and plastic components development and production facility for the weapons program. Polycarbonate components are fabricated using injection molding machines. Other components are fabricated using hydraulic presses. Large, high-temperature ovens are used for drying molding powders and curing thermoset plastics. Solvents have been used in the facility. Panowski and Salgado (1971, 15-16-038) report that pollution effluents from the facility were effectively negligible, and did not report the nature of solvents in use at that time. Solvents are now drummed before they reach the sumps.

SWMU 16-003(g): TA-16-306. SWMU 16-003(g) is two inactive HE sumps associated with TA-16-306 (Fig. 5-5). No HE is currently used and the probability of HE in the sumps is low (Wilder 1970, 15-16-282; LANL 1989, 15-16-362).

TA-16-306 functions as a plastic components development and production facility for the weapons program. Operations include molding of polysiloxane foam and polyurethane components, intrusion molding, and epoxy and laminate work. Ovens are used for curing thermoset plastics.

Panowski and Salgado reported that TA-16-306 was one of the larger users of solvents at S-Site (Panowski and Salgado 1971, 15-16-038; Salgado 1971, 15-16-012; LANL 1989, 15-16-362). These solvents included acetone, chlorothene, freon-PCA solvent, and methylene chloride. Methylene chloride was used as a spray-can propellant but its use has been discontinued. Use of all chlorinated solvents has been discontinued. In 1959, H Division found above-permissible levels of toluene diisocyanate within TA-16-306 (H-Division 1959, 0480).

Solvents are no longer discharged to the sumps. Solvents are now drummed before they reach the sumps.

SWMU 16-001(e): Dry Well. SWMU 16-001(e) is an inactive dry well adjacent to the outfall of the TA-16-300 process line. It was constructed in the early 1980s, but did not function properly because it drained to impermeable tuff. The well is corrugated metal pipe 4 ft in diameter and of unknown depth. A T-pipe exits the dry well.

The dry well is located about 100 ft east of TA-16-306 at the head of a small tributary to Water Canyon. A level area about 50 ft in diameter has been graded east of the dry well, which lies beneath a 10 ft bank cut. Outfall EPA 05A058 emerges from the bank about 15 ft south of the dry well. Effluent from the outfall has formed a stream that descends the gently sloping canyon. The dry well is currently filled with soil in which grasses and weeds grow.

Potentially hazardous materials are HE and the various types of solvents used in the process line (TA-16-300, 302, 304, and 306), as discussed above.

The 300-Line Sumps with Individual Outfalls

The 300-Line is described above and illustrated in Fig. 5-5. The rest houses (TA-16-301, 303, 305, and 307) are located to the southwest of the process buildings. Each rest house has a pair of HE sumps. The effluent from each sump drained into the gutter adjacent to the roadway in front of the rest houses.

Except for TA-16-303, the buildings are no longer used for the storage of explosives. None of the sump outfalls require EPA permits and all have been plugged.

SWMU 16-029(a) and SWMU 16-026(b): TA-16-307. SWMU 16-029(a) is two inactive HE sumps associated with TA-16-307. SWMU 16-026(b) is the outfall from SWMU 16-029(a) and is located northeast of TA-16-307 (Fig. 5-5).

TA-16-307 is a rest house that serves TA-16-306. The rest house is used for storage of molds and other materials used in the plastics development facilities. At one time the building housed a solvent disassembly tank used for removing HE from test devices (LANL 1989, 15-16-362). This operation was the principal cause of HE contamination in the outfall drainage channel. Panowski and Salgado (1971, 15-16-038) report that TA-16-307 emitted small or moderate amounts of explosives or solvents of concern to the environment, but they did not specify the solvents of principal concern.

An H-Division report mentions the use of anthracene (H-Division 1955, 15-16-225). Panowski listed TA-16-307 as discharging low to moderate amounts of hazardous constituents to the environment (Panowski and Salgado 1971, 15-16-038; LANL 1989, 15-16-362).

SWMU 16-029(b) and SWMU 16-026(c): TA-16-305. SWMU 16-029(b) is two inactive HE sumps associated with TA-16-305, a rest house. SWMU 16-026(c) is the outfall from SWMU 16-029(b) and is located southwest of TA-16-305 (Fig. 5-5).

TA-16-305 is a rest house that serves TA-16-304 and 306, the plastics development and production facility. It is used for storage of chemicals used in plastics processing. Filament winding of developmental weapons components is also conducted in TA-16-305.

SWMU 16-029(c) and SWMU 16-026(d): TA-16-303. SWMU 16-029(c) is two inactive HE sumps associated with TA-16-303. SWMU 16-026(d) is the outfall from SWMU 16-029(c) and is located on the southwest of TA-16-303 (Fig. 5-5).

TA-16-303 is a rest house that serves TA-16-302, an HE casting facility. The rest house is used for storage of raw materials used in the casting process, and HE castings produced in the casting building (LANL 1989, 15-16-362).

SWMU 16-029(d) and SWMU 16-026(e): TA-16-301. SWMU 16-029(d) is two inactive HE sumps associated with TA-16-301. SWMU 16-026(e) is the outfall from SWMU 16-029(d) and is located southwest of TA-16-301 (Fig. 5-5). In 1970, use of HE in the building was high and the probability of HE in the outfall was moderate (Wilder 1970, 15-16-282).

At one time TA-16-301 was a rest house that served the mock HE processing operations in TA-16-300. The rest house was used for storage of raw materials used in the preparation of mock HE.

Currently, TA-16-301 is used as an environmental testing laboratory in which weapons and other components are subjected to extremes in temperature, pressure, and humidity. The nature of this work is such that no discharge of HE or radioactive materials occurs.

Solvents may have been stored at the facility in the past. Panowski classed TA-16-301 as discharging moderate to low amounts of hazardous constituents, but he did not specify the solvents (Panowski and Salgado 1971, 15-16-038; LANL 1989, 15-16-362).

SWMU 16-003(h) and SWMU 16-030(d): TA-16-280. SWMU 16-003(h) is an inactive HE sump associated with TA-16-280. SWMU 16-030(d) is the outfall from SWMU 16-003(h) and is located northeast of TA-16-280. They are shown in Fig. 5-6. Wilder listed the use of HE in the building as high, but the probability of HE in the sumps as nil (Wilder 1970, 15-16-282).

The sump receives effluent from a room in which HE testing (density measurements) is conducted and from two roof drains as shown on

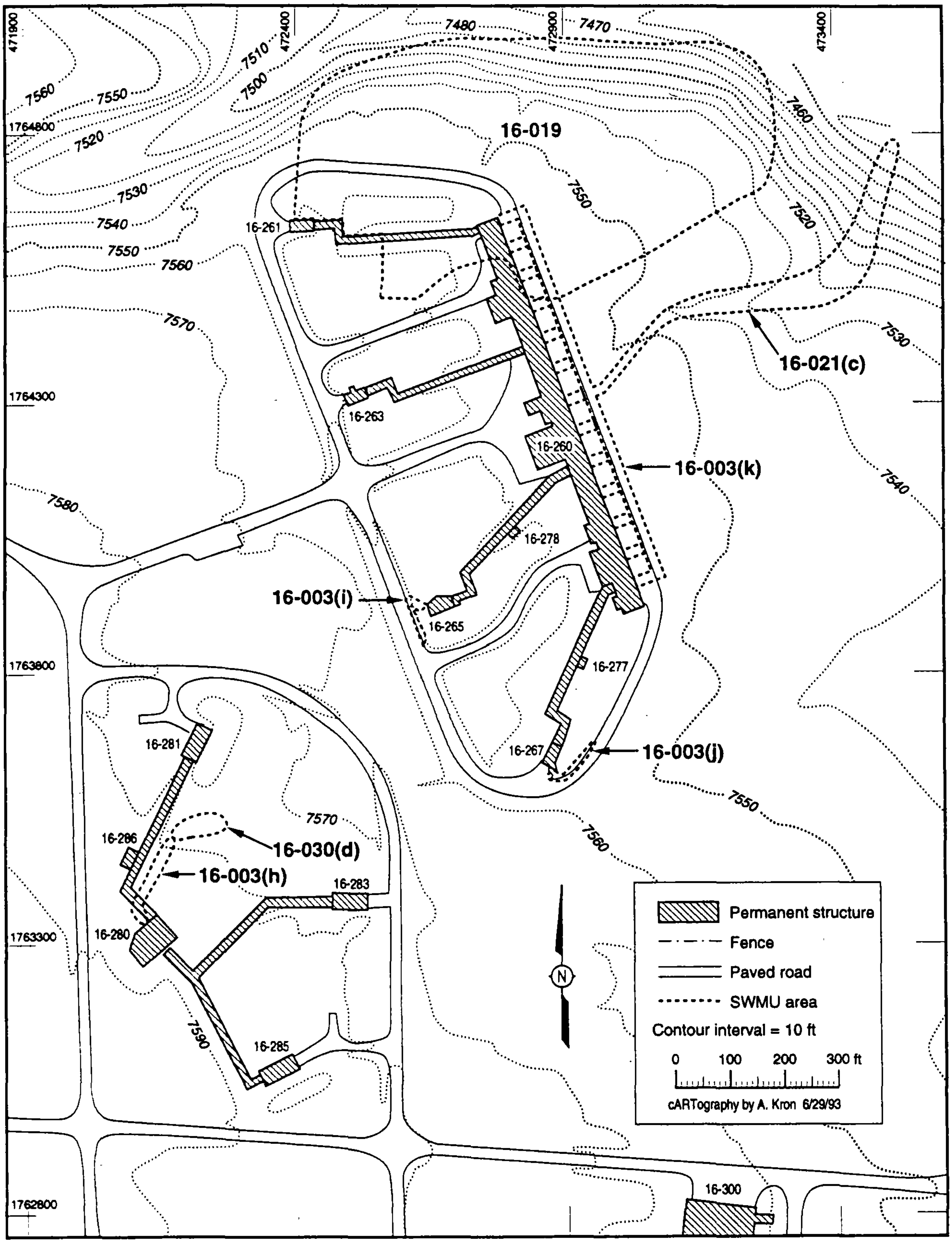


Fig. 5-6. TA-16-260 and TA-16-280 groups.

Laboratory drawing 13Y-192113 (Palmer and Abercrombie 1991, 15-16-366). No other effluent sources are discharged to the outfall.

TA-16-280 is a physical inspection and metrology laboratory for HE and other weapon and non-weapon components, including depleted uranium products. Dimensional and other physical characteristics are measured. It also serves as a staging facility for test device components to be assembled in TA-16-410. No mechanical processing (e.g., machining) is performed; no explosive or radioactive scrap is produced.

HE, solvents, and uranium are the PCOCs in TA-16-280, but likelihood of their presence is small (LANL 1989, 15-16-362). Panowski and Salgado (1971, 15-16-038) classed TA-16-280 as discharging small to moderate amounts of material to the environment, but they did not specify what solvents were in use. Solvents may previously have been discharged to the sump, but are now drummed to prevent their reaching the waste system (LANL 1989, 15-16-363).

In-Line Assembly Sumps and Outfalls

TA-16-265 and 267 function as an in-line assembly facility. They are located on the southwest of TA-16-260 as illustrated in Fig. 5-6.

The buildings are used for in-process assembly of HE products machined in TA-16-260, such as gluing components together and building small subassemblies. In 1970, the use of HE was high, but the probability of HE in the sumps was nil (Wilder 1970, 15-16-282).

The buildings were rest houses, but were converted for in-line assembly work. Each has a HE sump, SWMU 16-003(i) and 16-003(j). In 1966, according to Engineering drawing ENG-C 34241, concrete drain lines were added to the sumps. The outfalls drained to the gutter adjacent to the road in front of the buildings, but the sumps are now plugged.

Potential wastes are HE and solvents. Panowski and Salgado (1971, 15-16-038) found that small to moderate amounts of hazardous materials may have been released to the environment but they did not specify solvents in use (Panowski and Salgado 1971, 15-16-038; LANL 1989, 15-16-362). TA-16-267 may have discharged uranium particulate matter.

SWMU 16-003(i): TA-16-265. SWMU 16-003(i) is an inactive HE sump associated with TA-16-265 (Fig. 5-6). The sump receives effluent from a sink and a drinking fountain as shown on Laboratory drawing 13Y-192117 (Palmer and Abercrombie 1991, 15-16-366).

The outfall, EPA 05A057, originates from the northwest corner of TA-16-265.

An H-Division report mentions the use of 'vythene' (1,1,1 trichloroethane) and chloromaleic anhydride in the building (H-Division 1955, 15-16-232).

SWMU 16-003(j): TA-16-267. SWMU 16-003(j) is an inactive HE sump associated with TA-16-267 (Fig. 5-6). According to Engineering drawing 13Y-192075, the sump receives effluent from a janitor sink (Palmer and Abercrombie 1991, 15-16-366).

The outfall, EPA 05A149, originates from the southeast corner of TA-16-267.

SWMU 16-003(l) and SWMU 16-030(h): TA-16-430. TA-16-430 functions as an HE pressing facility (Fig. 5-4). Plastic-bonded explosive and mock HE powders are pressed to shape. Waste consists primarily of small quantities of HE powder. Wilder classed the use of HE as high, but the probability of HE in the sumps as low (Wilder 1970, 15-16-282). Panowski and Salgado determined that small to moderate amounts of hazardous effluent may have been discharged to the environment, but did not specify the solvents used in the facility. The small quantities of solvents and HE collected in the sumps were burned (Panowski and Salgado 1971, 15-16-038).

An H-Division report mentions monitoring for trimethyl phenol at TA-16-430 (H-Division 1955, 0762). The SWMU Report states that known releases of acetone and methyl ethyl ketone have occurred (LANL 1990, 0145). No documentation of the releases has been found.

SWMU 16-003(l). SWMU 16-003(l) is three inactive HE sumps associated with TA-16-430. The sumps receive effluent from the five pressing bays, as shown on Laboratory drawing 13Y-192071 (Palmer and Abercrombie 1991, 15-16-366).

SWMU 16-030(h). SWMU 16-030(h) is three outfalls associated with the three HE sumps at TA-16-430 (Fig. 5-4). The outfalls receive effluent from the sumps.

SWMU 16-003(m) and SWMU 16-030(g): TA-16-380. TA-16-380 (Fig. 5-7) functions as an inspection site for raw HE powder brought to TA-16. Wilder classed the use of HE as very high and the probability of HE in the sumps as moderate (Wilder 1970, 15-16-282).

SWMU 16-003(m). SWMU 16-003(m) is the inactive HE sump associated with TA-16-380. The sump receives wash-down water generated during cleaning activities (LANL 1989, 15-16-361). The waste consists primarily of HE.

SWMU 16-030(g). SWMU 16-030(g) is an outfall, EPA 05A052, associated with the HE sump at TA-16-380. It receives effluent from the sump, two roof drains, and a drop inlet as shown in Laboratory drawing 13Y-192091 (Palmer and Abercrombie 1991, 15-16-366). The drop inlet drains the parking area on the east of TA-16-380.

The SWMU Report (LANL 1990, 0145) lists two HE sumps, one of an unknown size, discharging to outfall EPA 05A057. The sump of unknown size is actually a parking lot drain that discharges to outfall EPA 05A052. It is shown on Laboratory drawing 13Y-192091 as a drop inlet (Palmer and Abercrombie 1991, 15-16-366).

SWMU 16-029(e) and SWMU 16-026(h2): TA-16-360. TA-16-360 (Fig. 5-7) is packing and shipping facility for finished HE products. Explosive components are packaged for storage or for shipment to other users. In 1970, use of HE was low and probability of HE in the sumps was very low (Wilder 1970, 15-16-282). Hazardous wastes discharged from the building were effectively negligible (Panowski and Salgado 1971, 15-16-038).

SWMU 16-029(e). SWMU 16-029(e) is an inactive HE sump associated with TA-16-360, as shown on Laboratory drawing 13Y-192111 (Palmer and Abercrombie 1991, 15-16-366).

SWMU 16-026(h2). SWMU 16-026(h2) is an outfall associated with the HE sump at TA-16-360. The sump and outfall most likely received wash water from past cleaning practices (LANL 1989, 15-16-361).

SWMU 16-003(c) and SWMU 16-026(v): TA-16-460. SWMU 16-003(c) is an active HE sump associated with TA-16-460 (Fig. 5-8). SWMU 16-026(v)

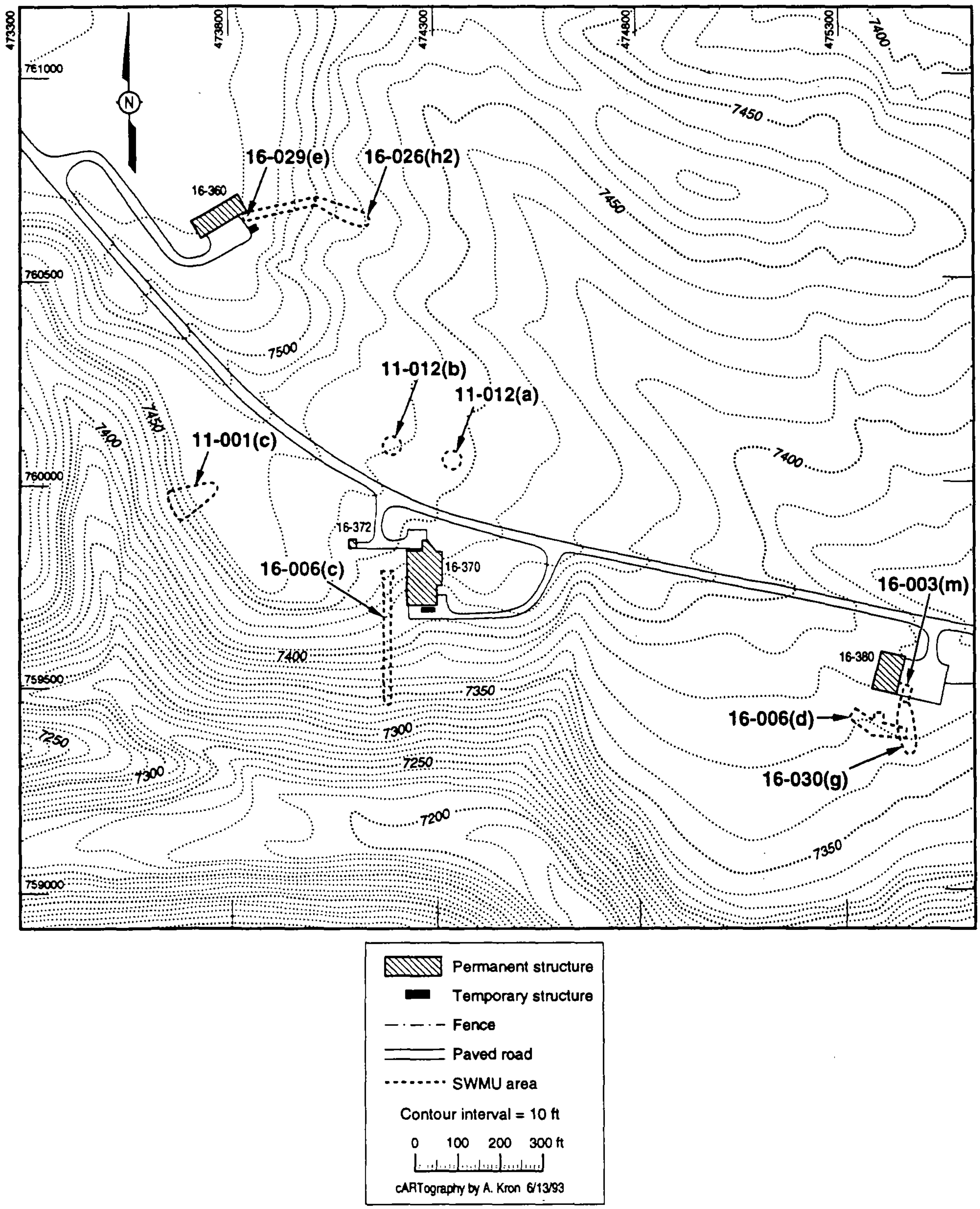


Fig. 5-7. TA-16-360, TA-16-370, and TA-16-380 area.

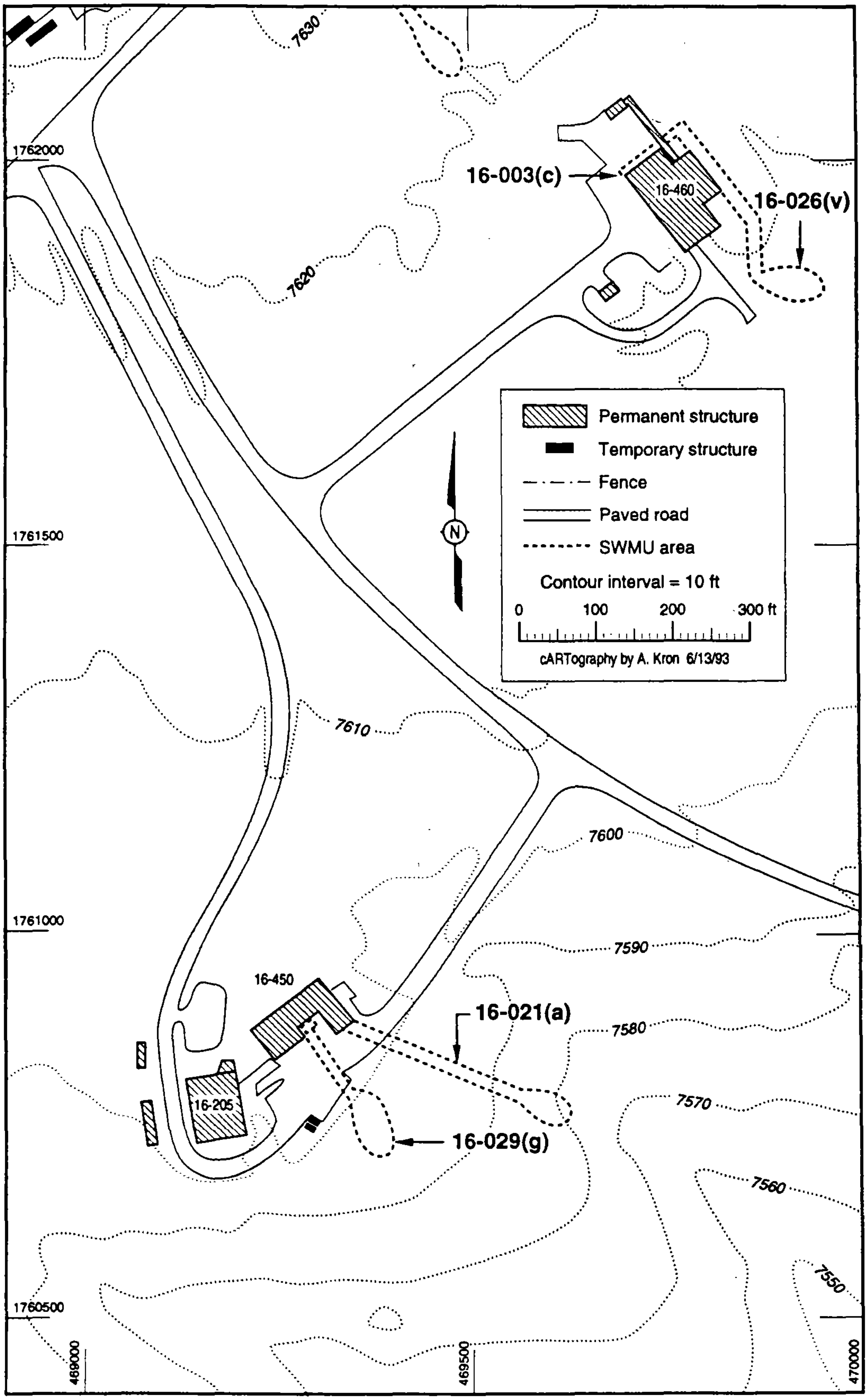


Fig. 5-8. TA-16-460 and TA-16-450 area.

is its associated outfall. The waste consists primarily of fine grains of HE from analytical chemistry experiments. In 1970, Wilder classed use of HE in the building as low and probability of HE in the sump as very low (Wilder 1970, 15-16-282). Solvents and other chemicals were previously discharged to this sump. A wide range of solvents has been used in this facility. According to Panowski and Salgado's report, significant quantities (> 10 lb.) of acetic acid, acetone, chloroform, and hydrochloric acid were used during late 1970 and early 1971. Other chemicals used included diethlylene triamine, cupric oxalate, cupric oxide, sodium bichromate, magnesium perchlorate, potassium bromide, potassium hydroxide, 1,2-dichloroethane, dimethylformamide, isopropyl alcohol, and hydrobromic acid (Panowski and Salgado 1971, 15-16-038). Currently, solvents are drummed to prevent their reaching the sump. The outfall, EPA 05A072, receives effluent from the HE sump and the floor drains, bench-sink cup drains, steam cup drains, sink drains, and a drinking fountain drain on the first floor of TA-16-460, as shown in Laboratory drawing 13Y-192067 (Palmer and Abercrombie 1991, 15-16-366). The effluent flows into a common drain line that discharges into the meadow on the southeast.

TA-16-460 functions as an analytical chemistry laboratory. In 1971, Panowski and Salgado determined that small to moderate amounts of hazardous effluent may have been discharged to the environment (Panowski and Salgado 1971, 15-16-038). In 1968, a small mercury spill occurred in one of the laboratories. Group H-5 found no mercury vapor in the room. There is no record that the mercury reached the drain system (Fletcher 1968, 15-16-132; LANL 1989, 15-16-363).

The 340-Line Sumps and Outfalls

The 340-Line consists of process buildings TA-16-340 and 342, and their rest houses TA-16-341, 343, and 345, as shown in Fig. 5-9. The line was built in 1951 and 1952. It is used for preparing plastic-bonded explosive powders. Currently, solvents are drummed to prevent their reaching the sumps.

SWMU 16-003(n): TA-16-342. SWMU 16-003(n) is an active HE sump associated with TA-16-342 (Fig. 5-9). Waste consists primarily of HE and solvents. Wilder classed use of HE as high but intermittent and the probability

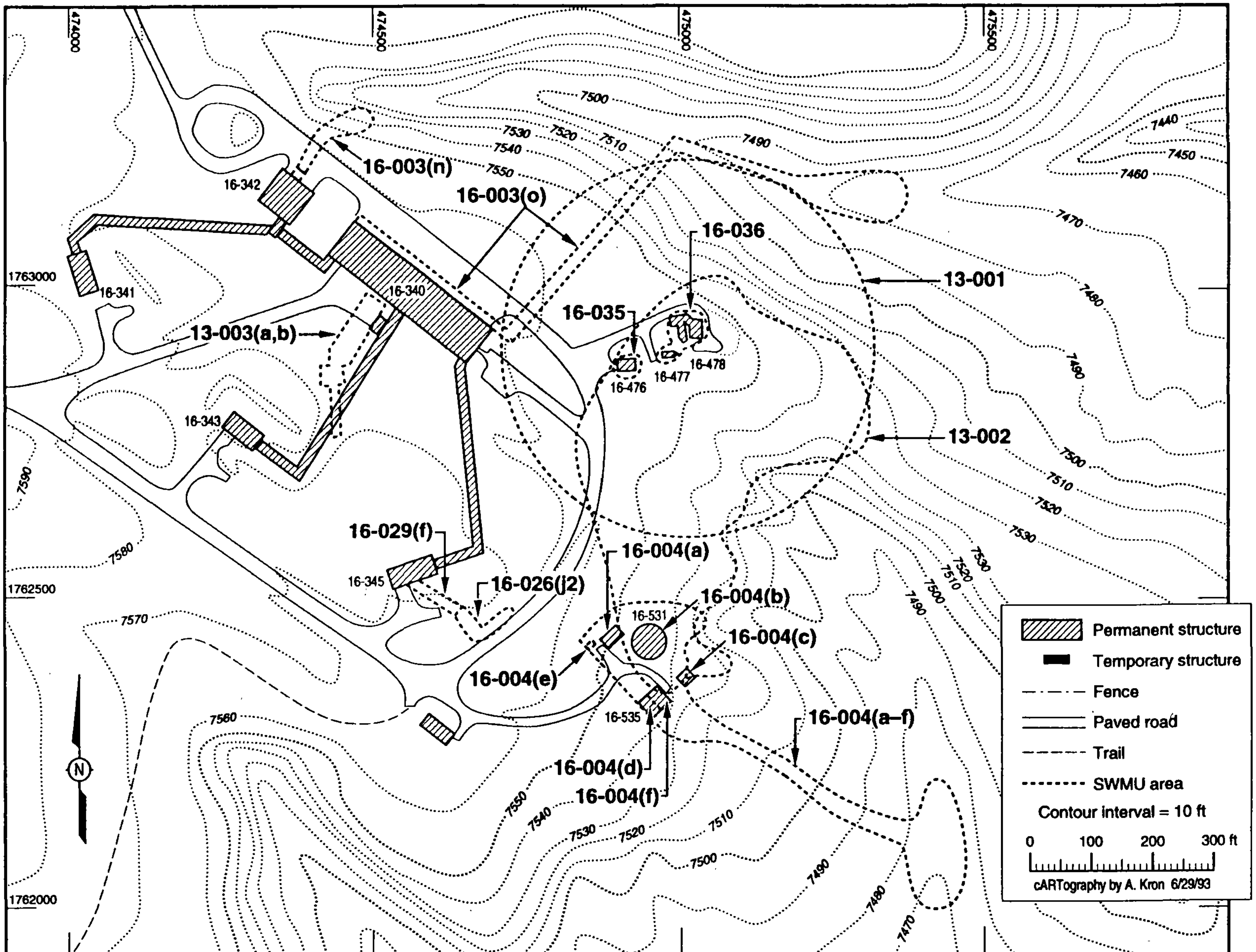


Fig. 5-9. TA-16-340 line, waste water treatment plant, and TA-13 (P-Site).

of HE in the sump as low (Wilder 1970, 15-16-282). Panowski and Salgado determined that pollution effluents discharged from the building were effectively negligible, and did not identify any solvents used in the building (Panowski and Salgado 1971, 15-16-038).

The outfall, EPA 05A062, receives effluent from a HE sump on the northeast corner of TA-16-342, as shown in Laboratory drawing 13Y-192101 (Palmer and Abercrombie 1991, 15-16-366). The sump receives process and wash-down water following cleaning activities. The outfall discharges into a tributary of Cañon de Valle.

TA-16-342 is a facility for mixing and blending the constituents of plastic-bonded explosive formulations. Voelz, Laboratory H-DO, recorded that natural uranium had been used in the building; he did not specify quantities or frequency of use (Voelz 1979, 15-37-003; LANL 1989, 15-16-361).

SWMU 16-003(o): TA-16-340. SWMU 16-003(o) is six active HE sumps associated with TA-16-340 (Fig. 5-9). Waste consists primarily of HE and solvents. In 1970, Wilder classed the use of HE as moderate and the probability of HE in the sump as low (Wilder 1970, 15-16-282).

The outfall, EPA 05A054, discharges effluent from the six HE sumps on the northeast side of TA-16-340, sink drains, floor drains, equipment drains, and roof drains, as shown in Laboratory drawing 13Y-192074 (Palmer and Abercrombie 1991, 15-16-366). The effluent flows into a common drain line that discharges into a short tributary of Cañon de Valle. An attempt was made to eliminate volatile organic compounds from the outfall by installing a 250-ft-long weir-type discharge aerator that functioned as an air stripper. This structure caused outfall liquid to be disseminated over a larger area because of splashing.

TA-16-340 is a facility for producing plastic-bonded explosives; Most of the volatiles are distilled during the processing. In the past, any remaining solvents were discarded to the sump with the waste water. However, a solvent distillation treatment unit has been recently installed to trap residual solvents before discharge (LANL 1989, 15-16-361). Voelz, LANL H-DO, recorded that natural uranium had been used in the building; he did not specify quantities or frequency of use (Voelz 1979, 15-37-003; LANL 1989, 15-16-361).

Panowski reported TA-16-340 as the largest user of solvents at TA-16. He classed the building as having emitted large quantities of explosives, solvents, gases, and other materials (Panowski and Salgado 1971, 15-16-038). The most volumetrically significant solvents used in TA-16-340 were acetone and n-butyl acetate.

The SWMU Report incorrectly identifies the outfall, EPA 05A054, as EPA 05A062 (LANL 1990, 0145).

SWMU 16-029(f) and SWMU 16-026(j2): TA-16-345. SWMU 16-029(f) is an active HE sump associated with TA-16-345 (Fig. 5-9). SWMU 16-026(j2) is the outfall from SWMU 16-029(f) and is located southeast of TA-16-345. Wilder stated that HE was stored in containers and the probability of HE in the sump was nil (Wilder 1970, 15-16-282). Panowski and Salgado classed the quantity of pollution effluent discharged from the building as effectively negligible (Panowski and Salgado 1971, 15-16-038).

The outfall receives effluent from the sump, as shown in Laboratory drawing 13Y-192180 (Palmer and Abercrombie 1991, 15-16-366). The exact discharge point is unknown. The EPA designation is unassigned (LANL 1989, 15-16-361).

TA-16-345 is a rest house that serves as a HE storage facility for TA-16-340. It has a single sump and associated drain lines. The sump has received wash-down water generated during cleaning activities. HE is the only known material stored in the building (LANL 1989, 15-16-361).

SWMU 16-029(g): TA-16-450. SWMU 16-029(g) is an active HE sump associated with TA-16-450 (Fig. 5-8). The sump receives wash-down water from floor trenches in Room 101.

The outfall, EPA 04A091 located to the southeast of TA-16-450, receives effluent from the sump as shown in Laboratory drawing 13Y-192110 (Palmer and Abercrombie 1991, 15-16-366).

TA-16-450 is a materials testing facility. Activities such as tensile and compression tests are performed on non-explosive objects (LANL 1989, 15-16-363). TA-16-450 was constructed in the early 1950s as a chemical engineering laboratory in which explosives could be processed. It was not used as such and HE was never introduced into the building (Griffin 1992, 15-16-341).

The CEARP Report states that at one time TA-16-450 housed an electroplating operation (DOE 1987, 0264; 15-16-370). No evidence has been found to support this claim. Richard Daly, a long-term employee at S-Site and past group leader of WX-3, states that no plating operations were ever conducted in the building (Griffin 1992, 15-16-341). TA-16-93 was the S-Site plating facility discussed in Environmental Problem number 24 (DOE 1989, Request LA824, 15-16-345).

Panowski and Salgado classed TA-16-450 as emitting small or moderate amounts of hazardous constituents to the environment. They identified diethylene triamine as the only potentially hazardous material used at the building (Panowski and Salgado 1971, 15-16-038).

5.2.1.2 Conceptual Exposure Model for HE Sumps and Inactive Outfalls

The conceptual exposure model is presented in Fig. 4-9. Site-specific information on potential release sources, chemicals of concern, migration pathways, and potential receptors is presented below.

5.2.1.2.1 Nature and Extent of Contamination

The principal COCs in HE sumps, outfalls, and drainage channels include: HE (principally TNT, HMX, RDX, TATB), HE by-products (e.g., DNT, TNB, DNB), cyanide (derived from cyanuric acid), organics, uranium, and metals, particularly barium (Table 5-7). Many potential contaminants will be building and process specific.

Several studies of the effluent from TA-16 sumps and process buildings have been performed over the last thirty years. The methodologies of the major studies performed are described below, followed by a summary of results organized by contaminant type. These data are provided in Tables 5-8 through 5-18.

Baytos. Baytos conducted both soil and water studies of HE in the S-Site drainage system (Baytos 1970, 15-16-278; through Baytos 1988, 15-16-266;

TABLE 5-7

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, SUMPS AGGREGATE

PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	HE: UNDETONATED HE	HE: HE DEGRADATION PRODUCTS	RAD: URANIUM	METALS: METALS SUITE	METALS: BARIUM	ORGANICS: VOLATILES	ORGANICS: SEMIVOLATILES	CYANIDE
16-001(e)	Dry well	All 300-line effluent	N	x	x			x	x	x	x
16-003(a)	Sump	Test device assembly TA-16-410	N	x	x	x		x	x	x	
16-003(b)	Sump	Truck washing TA-16-400	N	x	x	x		x		x	
16-003(c) 16-026(v)	Sump and outfall	Analytical laboratory TA-16-460	Y	x	x	x	x	x	x	x	x
16-003(d)	Sump	Mock explosives preparation 300 line	N					x	x	x	x
16-003(e)	Sump	HE casting 300 line	N	x	x			x	x	x	
16-003(f)	Sump	Plastics development 300 line	N						x	x	
16-003(g)	Sump	Plastics development 300 line	N						x	x	
16-003(h) 16-030(d)	Sump and outfall	Physical inspection TA-16-280	N	x	x	x		x	x	x	
16-003(i)	Sump	Rest house TA-16-265 sink	N	x	x	x		x	x	x	
16-003(j)	Sump	Rest house TA-16-267 sink	N	x	x	x		x	x	x	
16-003(l) 16-030(h)	Sump and outfall	HE pressing TA-16-430	N	x	x			x	x	x	
16-003(m) 16-030(g)	Sump and outfall	Cleaning TA-16-380	N	x	x			x		x	
16-003(n)	Sump	Blending HE mixtures TA-16-342	Y	x	x	x		x	x	x	
16-003(o)	Sump	Plasticizing HE TA-16-340	Y	x	x	x		x	x	x	
16-026(b) 16-029(a)	Sump and outfall	Rest house TA-16-307 storage	N	x	x	x		x	x	x	

TABLE 5-7 (continued)

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, SUMPS AGGREGATE

PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	HE		RAD	METALS		ORGANICS		
				UNDETONATED HE	HE DEGRADATION PRODUCTS	URANIUM	METALS SUITE	BARIUM	VOLATILES	SEMIVOLATILES	CYANIDE
16-026(b) 16-029(a)	Sump and outfall	Rest house TA-16-307 storage	N	x	x	x		x	x	x	
16-026(c) 16-029(b)	Sump and outfall	Rest house TA-16-305 storage	N	x	x				x	x	
16-026(d) 16-029(c)	Sump and outfall	Rest house TA-16-303 storage	N	x	x			x	x	x	
16-026(e) 16-029(d)	Sump and outfall	Rest house TA-16-301 storage	N	x	x			x	x	x	x
16-026(h2) 16-029(e)	Sump and outfall	Packing and shipping HE products	N	x	x			x		x	
16-026(j2) 16-029(f)	Sump and outfall	Rest house TA-16-345 storage	Y	x	x			x		x	
16-029(g)	Sump	Non-HE materials testing	Y				x		x	x	

TABLE 5-8

HIGH EXPLOSIVES IN INACTIVE DRAINAGE CHANNELS, BAYTOS' STUDIES OF 1970-1985

SAMPLE DATE	SAMPLE LOCATION	HMX/RDX	TNT	TOTAL HE
07/18/84	TA-16-265, 6 ft from outfall	0.0	0.0	0.0
07/18/84	TA-16-267, 6 ft from outfall	0.0	0.0	0.0
09/12/85	TA-16-267, 6 ft from outfall	0.0	0.0	0.0
04/29/70	TA-16-300-line outfall	0.2	0.86	1.1
11/18/70	TA-16-300-line outfall	0.6	1.1	1.7
08/22/73	TA-16-300-line outfall	0.0	0.0	0.0
09/12/85	TA-16-300-line outfall	0.0	0.3	0.3
04/29/70	TA-16-303 outfall	0.02	0.0	0.0
04/29/70	TA-16-305 outfall	0.0	0.0	0.0
04/29/70	TA-16-307 outfall	0.7	0.13	0.8
11/18/70	TA-16-307 outfall	1.8	0.3	2.1
11/05/71	TA-16-307 outfall	0.4	0.0	0.4
08/22/73	TA-16-307 outfall	2.4	0.0	2.4
11/14/74	TA-16-307 outfall	1.1	0.2	1.3
12/05/75	(3 ft from outfall)	0.4	0.0	0.4
11/19/76	TA-16-307 outfall	11.2	1.8	13.0
12/27/76	TA-16-307 outfall	7.1	1.1	8.2
07/18/84	TA-16-307 outfall	0.3	0.1	0.4
04/29/70	TA-16-380 outfall	0.04	0.01	0.05
11/18/70	TA-16-380 outfall	0.0	0.0	0.0
08/22/73	TA-16-380 outfall	0.0	0.0	0.0
11/14/74	TA-16-380 outfall	0.0	0.0	0.0
11/19/76	TA-16-380 outfall	0.0	0.0	0.0
07/18/84	TA-16-380 outfall	0.1	0.3	0.4
04/29/70	TA-16-400 outfall	0.01	0.08	0.1
11/18/70	TA-16-400 outfall	0.0	0.0	0.0
11/19/76	(10 ft. from outfall)	0.0	0.0	0.0
07/18/84	(18 in. from outfall)	0.0	0.0	0.0
09/12/85	(18 in. from outfall)	0.0	0.0	0.0
04/29/70	TA-16-430 Bay 1 outfall	1.5	0.12	1.6
11/18/70	TA-16-430 Bay 1 outfall	1.1	0.1	1.2
07/18/84	(Bays 2, 3, 4 outfall)	0.0	0.5	0.5

Quantities of explosives are given in weight percent (wt %). Surface samples were taken from the soil along the center line of the drainage channel. The drainage channels were dry when the samples were taken. The sampling technique and analytical method are described in Baytos 1972, 15-16-275. SALs in soil: TNT=40 ppm (0.004 wt %); HMX=4 000 ppm (0.4 wt %); and, RDX=64 ppm (0.0064 wt %).

TABLE 5-9

HIGH EXPLOSIVES IN ACTIVE DRAINAGE CHANNELS, BAYTOS' STUDIES OF 1970-1985

SAMPLE DATE	SAMPLE LOCATION	HMX/RDX	TNT	TOTAL HE
04/29/70	TA-16-340 outfall	0.1	0.5	0.6
11/18/70	TA-16-340 outfall	0.3	0.3	0.6
07/18/84	(18 in. from outfall)	0.0	0.2	0.2
09/12/85	(18 in. from outfall)	0.0	0.2	0.2
11/05/71	TA-16-342 outfall	0.1	0.0	0.1
08/22/73	TA-16-342 outfall	0.1	0.0	0.1
11/19/76	TA-16-342 outfall	0.0	0.1	0.1
07/18/84	(3 ft from outfall)	0.2	0.0	0.2
09/12/85	(3 ft from outfall)	0.0	0.0	0.0
11/18/70	TA-16-345 outfall	0.0	0.0	0.0

Quantities of explosives are given in weight percent (wt %). Surface samples were taken from the soil along the center line of the drainage channel. The drainage channels were dry when the samples were taken. The sampling technique and analytical method are described in Baytos 1972, 15-16-275. SALs same as Table 5-8.

TABLE 5-10

SUMP AND DRAINAGE SAMPLES, TURNER AND SCHWARTZ (1971)

SAMPLE	LOCATION	HMX/RDX	TNT	BARIUM
1	TA-16-302	1	72	22
3	TA-16-260	0.3	33	4
4	TA-16-340	None	None	None
5	TA-16-430	None	None	None
7	TA-16-380	<1	11	<10
8	TA-16-370	None	None	19
9	TA-16-460	None	None	None

All concentrations in ppm. Samples 1-5 are water samples, and samples 6-9 are Soxhelt-extracted soils. Samples 2 and 6 are not included because they are not sump samples. Soil SALs same as Table 5-8. SALs in water: HMX=1.8 ppm; RDX=0.00032 ppm; TNT=0.0175 ppm; and barium=1 ppm.

TABLE 5-11

DAILY WATER TESTING FOR CONTAMINANTS IN HIGH EXPLOSIVES SUMPS, TA-16-302 SUMP 1 (WASH-DOWN BAY)*

DAY:	1	2	3	4	5	6	7	8	9	10	MEAN	STANDARD DEVIATION	WATER SAL
pH	7.5	7.2	7.8	7.9	7.1	7.1	7.0	8.2	7.2	7.0	7.4	0.43	
Suspended solids	14.0	10.0	6.0	4.0	2.0	3.0	1.0	5.0	5.0	2.0	5.2	4.02	
$Ba(NO_3)_2$	6.0	6.0	20.0	23.0	23.0	14.0	24.0	28.0	28.0	23.0	19.5	8.14	1
TNT	1.7	0.6	0.8	0.3	2.8	0.6	2.2	3.0	14.8	29.1	5.6	9.31	0.0175
RDX	0.8	0.2	2.6	4.9	0.0	0.0	0.1	0.0	9.9	19.1	3.8	6.26	0.00032
HMX	1.1	0.8	1.3	1.7	2.0	0.6	1.3	1.1	3.1	3.7	1.7	1.01	1.8
Acetone	8.7	3.0	nd	nd	1.2	nd	nd	0.9	nd	0.9	-	-	3.5
MEK	nd	1.2	1.9	nd	nd	nd	nd	nd	nd	nd	-	-	1.7
Bu-Ac	nd	nd	nd	nd	nd	nd	nd	5.7	nd	nd	-	-	
Toluene	nd	nd	nd	nd	nd	nd	nd	0.5	nd	nd	-	-	0.75

* Baytos 1988, 15-16-266

Quantities are given in parts per million (ppm). Samples were taken on ten consecutive working days. Mean and standard deviation computed by others.

nd: Not detected
MEK: Methyl ethyl ketone
Bu-Ac: n-Butyl acetate

TABLE 5-12

DAILY WATER TESTING FOR CONTAMINANTS IN HIGH EXPLOSIVES SUMPS, TA-16-302 SUMP 2 (CASTING KETTLE BAYS)*

DAY:	1	2	3	4	5	6	7	8	9	10	MEAN	STANDARD DEVIATION
pH	7.4	7.4	7.9	7.9	7.8	7.8	7.7	8.3	7.8	7.7	7.8	0.26
Suspended solids	13.0	6.0	14.0	12.0	12.0	8.0	3.0	1.0	1.0	4.0	7.4	5.08
$Ba(NO_3)_2$	7.0	7.0	19.0	14.0	11.0	17.0	14.0	23.0	13.0	12.0	13.7	5.01
TNT	0.0	0.5	0.3	0.2	0.7	0.7	0.8	1.8	12.3	6.4	2.4	3.96
RDX	1.0	1.6	0.6	1.1	0.3	0.0	0.0	0.0	5.2	5.1	1.5	2.00
HMX	1.8	1.4	1.6	1.6	1.3	0.4	1.5	2.1	1.6	2.0	1.5	0.47
Acetone	13.4	1.3	nd	1.0	nd	nd	1.0	nd	0.8	1.0	-	-
MEK	15.2	nd	nd	nd	nd	nd	4.1	nd	nd	nd	-	-
Bu-Ac	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-
Toluene	nd	nd	nd	nd	nd	nd	nd	nd	2.1	nd	-	-

Footnotes and SALs same as Table 5-11.

TABLE 5-13

DAILY WATER TESTING FOR CONTAMINANTS IN HIGH EXPLOSIVES SUMPS, TA-16-340 OUTFALL*

DAY:	1	2	3	4	5	6	7	8	9	10	MEAN	STANDARD DEVIATION
pH	7.90	8.00	8.30	7.95	8.30	8.20	8.25	8.30	8.29	8.30	8.18	0.163
Suspended solids	10.8	0.7	0.0	0.2	0.0	0.0	0.0	0.0	0.4	0.0	1.2	3.38
TNT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
RDX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
HMX	0.41	0.31	0.02	0.57	0.01	0.30	0.35	0.26	0.25	0.0	0.25	0.188
Acetone	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-
MEK	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-
Bu-Ac	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-
Toluene	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-

Footnotes and SALs same as Table 5-11.

TABLE 5-14

DAILY WATER TESTING FOR CONTAMINANTS IN HIGH EXPLOSIVES SUMPS, TA-16-460 OUTFALL*

DAY:	1	2	3	4	5	6	7	8	9	10	MEAN	STANDARD DEVIATION
pH	7.98	7.68	7.97	7.97	8.08	7.91	7.90	7.85	8.50	8.50	8.03	0.267
Suspended solids	0.0	1.4	0.6	0.0	0.0	0.5	0.0	2.1	2.5	1.8	0.9	0.97
TNT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
RDX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
HMX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-
Acetone	nd	nd	nd	nd	nd	nd	nd	8.0	nd	nd	-	-
MEK	nd	2.2	nd	nd	nd	nd	nd	nd	nd	nd	-	-
Bu-Ac	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-
Toluene	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-

Footnotes and SALs same as Table 5-11.

TABLE 5-15

ANALYSES OF EFFLUENT FROM TA-16-340 SUMPS ENVIRONMENTAL PROBLEM #10 (LANL 1989, 15-16-344)

SAMPLE	309-1	309-2	309-3	310-1	310-2	310-3	311-1	311-2	311-3	SALs	SALs
Medium	Water	Water	Water	Water	Water	Water	Sediment	Sediment	Sediment	Soil	Water
Units	mg/L (ppm)	mg/L (ppm)	mg/L (ppm)	mg/L (ppm)	mg/L (ppm)	mg/L (ppm)	µg/g (ppm)	µg/g (ppm)	µg/g (ppm)	µg/g (ppm)	mg/L (ppm)
VOCs											
Acetone	.06[b]	.12[b]	.022	.06[b]	.13[b]					8 000	3.5
2-Butanone	120[a,b]	350[a,b]	5.6[a,b]	120[a,b]	390[a,b]	1.3[a,b]				2 100	1.7
Metals											
Barium*							229	121	275	5 600	1
Beryllium				8.2						0.16	0.0000081
Cadmium*								3[a]		80	0.005
Chromium*				25			116	7	48	400	0.050
HE											
RDX			0.6			0.5	4			64	0.00032
Radionuclides											
Total Uranium		1.5								240	0.100
Uranium-235 (pCi/g)		.03					.28			18	
Cesium-137** (pCi/g)							.253		.35	4	

A blank cell indicates that the analyte was not detected.
a Analyte detected in blank; result may be biased high.
b Analyte concentration exceeded calibration range; result may be biased low.
* Result may be biased high by 140-160%.
** Cesium-137 is not a PCOC at Building 340; however, it is included in this table for completeness of the existing data set.

TABLE 5-16

ANALYSES OF TA-16-300 LINE EFFLUENT, ENVIRONMENTAL PROBLEM #10 (LANL 1989, 15-16-344)

SAMPLE	314-1	314-2	314-3	315-1	315-2	315-3	SALs	SALs
Medium	Water	Water	Water	Sediment	Sediment	Sediment	Soil	Water
Units	mg/L (ppm)	mg/L (ppm)	mg/L (ppm)	µg/g (ppm)	µg/g (ppm)	µg/g (ppm)	µg/g (ppm)	mg/L (ppm)
VOCs								
2-Butanone			.019[a]				2 100	1.7
1,1,1-Trichloroethane						.012	1 000	0.060
Metals								
Barium*				542	327	125	5 600	1
Cadmium*				8			80	0.005
Chromium*				42	12	9	400	0.050
Lead				607	213		400	0.050
HE								
HMX				3	4	32	4 000	1.8
RDX						31	64	0.00032
TNB						2	4	0.0057
Tetryl				1	27	7	800	0.35
TNT				13	11	145[b]	40	0.0175
Radionuclides								
Uranium-235 (pCi/g)						.103	18	
Cesium-137** (pCi/g)					.166		4	

a Analyte found in blank; result may be biased high.
b Analyte concentration exceeded calibration range; result may be biased low.
A blank cell indicates that analyte was not detected.
* Result may be biased high by 140-160%.
** Cesium-137 is not a PCOC at Building 300; however, it is included in this table for completeness of the existing data set.

TABLE 5-17

ANALYSES OF EFFLUENT FROM TA-16-342 SUMP, ENVIRONMENTAL PROBLEM #10 (LANL 1989, 15-16-344)

SAMPLE	318-1	318-2	318-3	SALs
Medium	Sediment	Sediment	Sediment	Soil
Units	µg/g (ppm)	µg/g (ppm)	µg/g (ppm)	µg/g (ppm)
VOCs				
1,1,1-Trichloroethane	.008	na	na	3.2
Metals				
Barium	344	5 720	13 800	5 600
Chromium	6	22	10	400
HE				
HMX		4 330[a]	107[a]	4 000
2,4-DNT			2	1
Radionuclides				
Cesium-137** (pCi/g)	.6	1.3	2.5	4

A blank cell indicates the analyte was not detected.
a Analyte concentration exceeded calibration range, result may be biased low.
na Not analyzed
** Cesium-137 is not a PCOC at Building 342; however, it is included in this table for completeness of the existing data set.

TABLE 5-18

GMX-3 CHEMICAL INVENTORY*

STRUCTURE MATERIAL	16-260	16-306	16-340	16-410	16-450	16-460
Acetic acid						10
Acetone		220	700			139
Ammonium sulfate			500			
n-Butyl acetate			330			
Carbon tetrachloride						4
Chlorobenzene						<1
Chloroform			3			12
Chlorothene		55				
Cupric oxalate						1
Cupric oxide						3
1,2-Dichloroethane			55			<1
Diethylene triamine					1	1
Dimethylformamide				110		3
Dimethyl sulfoxide	94					
Ethyl acetate			11			
Ethylene glycol				10		
Freon-PCA solvent		2				
n-Hexane						<1
Hydrobromic acid						<0.1
Hydrochloric acid						24
Isopropyl alcohol			72			<1
Magnesium perchlorate						<1
Methanol			110			
Methylcyclohexane						1
Methylene chloride		55	72			
Methyl ethyl ketone			750			
Potassium bromide						1
Potassium hydroxide						6
Sodium bichromate						2
Toluene			110			

* Panowski and Salgado 1971, 15-16-038. Six-month period November 1970 through April 1971. *Quantities in pounds.*

15 internal reports). Soil and sediment in the drainage channels were evaluated over the 15-year period 1970 though 1985. Sediment taken from the drainage channel at TA-16-260 had HE concentrations as high as 31 wt %. In 1988, Baytos (1988, 15-16-266) studied explosive and solvent contamination in water taken from sumps and outfalls.

Turner and Schwartz. In 1970, Turner and Schwartz evaluated soil contamination throughout the S-Site drainage system. Samples were either direct analyses of process or environmental water or four-hour Soxhelt extractions of soils in water. The study included soil and water samples taken from several process building sumps, Cañon de Valle, Water Canyon, and their tributaries (Turner and Schwartz 1971, 15-16-284).

Wilder and Panowski. In 1970 and 1971, Wilder and Panowski conducted independent surveys of the effluents discharged at TA-16. Wilder surveyed the operational condition of the HE sumps and drain lines. He reported his estimate of the relative quantities of HE used in the buildings, the probability of HE in the drain lines, and the physical condition of the outfalls (Wilder 1970, 15-16-282). Panowski classified the buildings on the basis of the quantities of explosives and chemicals emitted. He itemized the quantities of chemicals issued to individual buildings during the six-month period November 1970 through April 1971 (Panowski and Salgado 1971, 15-16-038).

Environmental Problem #10. As part of Environmental Problem #10 (DOE 1989, 15-16-344) samples were collected at NPDES outfalls associated with three buildings at TA-16. Samples were analyzed for HE, VOCs on the EPA target compound list, metals on the EPA target analyte list, and radionuclides. Analyses for asbestos were performed for one set. SALs for soil are listed in each table to provide comparison values.

At SWMU 16-003(o), TA-16-340, nine samples were collected: three water samples above NPDES 05A054 discharge point, three at the discharge point, and three sediment samples from the area around the ladder (Fig. 5-10). Water samples were collected with automated composite samplers over three consecutive days. Grab water samples were collected for VOC analyses.

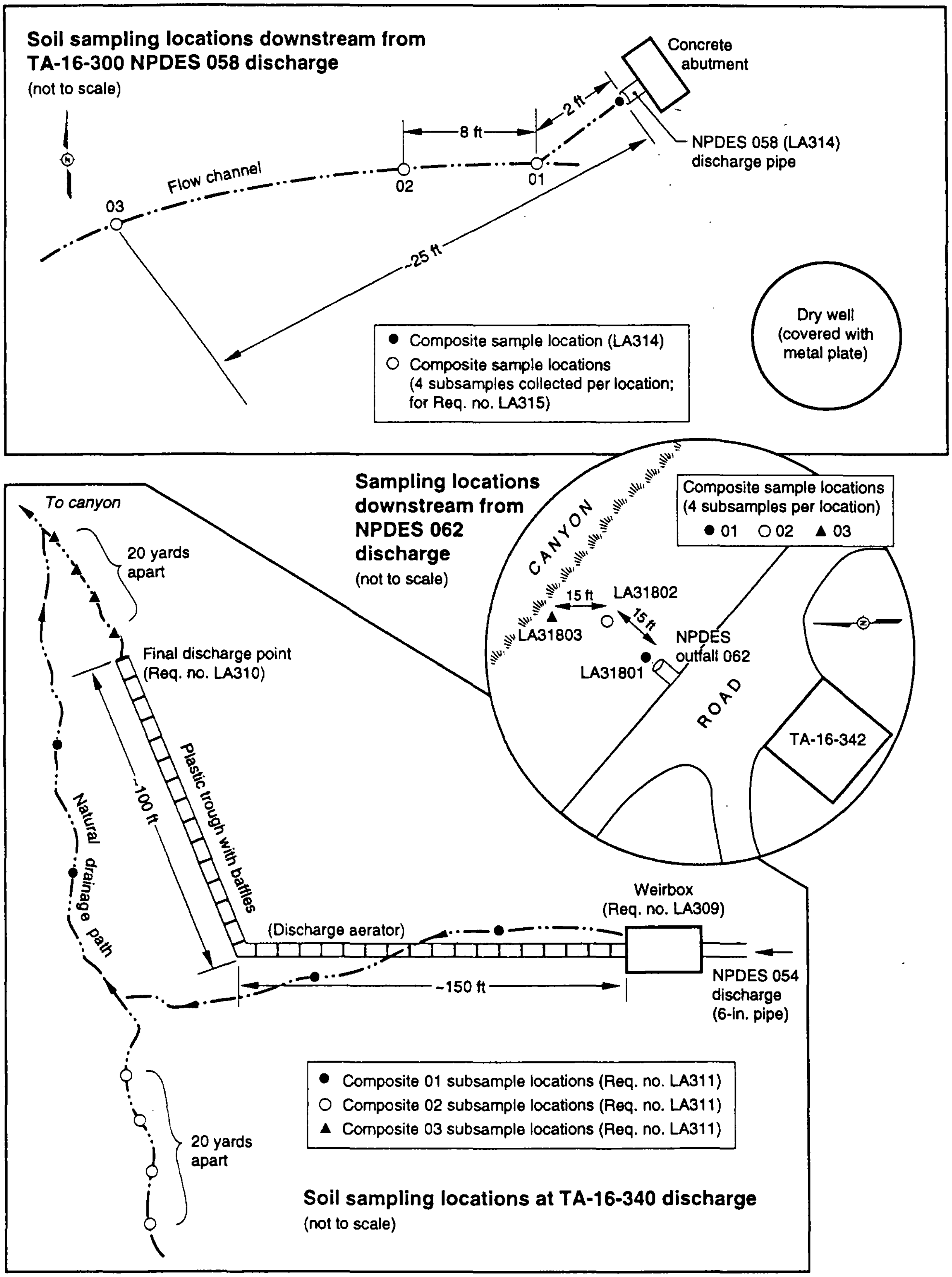


Fig. 5-10. Sampling maps from Environmental Problem #10.

Each sediment sample consisted of four composited subsamples from depths of 0 to 6 in. Below the SWMU 16-003(d,e,f,g) discharge point NPDES 05A058 at the end of the TA-16 300-Line, three composited water samples and three composited surface (0 to 6 in.) sediment samples, consisting of four subsamples each, were collected. At SWMU 16-003(n), NPDES outfall from TA-16-342, no effluent discharged during the sampling period so no water samples were taken. Three composited soil samples, consisting of four subsamples, were collected at depths of 0 to 4 in. Samples 318-2 and 318-3 were very dry, so they were not analyzed for VOCs. See Fig. 5-10 for sampling locations.

HE in Soil and Sediment

HE is the most significant contaminant of concern at TA-16, thus a number of studies have considered the extent and nature of contamination in sumps, drain lines, and outfalls.

Panowski and Salgado estimated the amount of HE explosive waste processed at S-Site between November 1970 and April 1971. They stated that approximately 50 000 lb of waste explosives were burned during the six-month period and that an additional 125 lb were discharged in drainages a short distance downstream from sump outlets (Panowski and Salgado 1971, 15-16-038).

Baytos studied the HE contamination in soils and sediments during the 15-year period 1970 through 1985; and in the water from HE sumps and outfalls in 1988 (Baytos 1970, 15-16-278, though Baytos 1988, 15-16-266).

Baytos sampled the soil and sediment from HE sump outfalls and drainage channels throughout the S-Site complex. He analyzed the samples for TNT and combined RDX-HMX. He also published data taken in 1960. Baytos' results are summarized in Tables 5-8 and 5-9.

Baytos found the highest concentration of residual explosives in the drainage channel from TA-16-260 (Subsection 5.3). Data for other areas at S-Site showed lower (< 2 wt %) concentrations of residual explosives with the exception of TA-16-307, the chemical disassembly building, SWMUs 16-029(a) and 16-026(b). Residual explosives were 13 wt % in 1975, and had dissipated to 0.4 wt % by 1984. The wide range of concentrations represents the activity level of device disassembly operations in TA-16-307. The drainage channels from the 300-Line and TA-16-430, the pressing building, had greater than 1.5 wt % total HE in 1970, but fell to 0.5 wt % or less by 1985. Other drainage channels, such as those serving TA-16-301, TA-16-380, and TA-16-400, showed minimal HE (< 1.5 wt %) or no HE (TA-16-265, TA-16-267).

In 1971, during Turner and Schwartz's study, the highest concentration of HE in sumps in the S-Site operating area was from the HE sumps at TA-16-302 (Turner and Schwartz 1971, 15-16-284) (Table 5-10). The samples were a worst case because they were taken following kettle washing operations. The kettles had been used to prepare cyclotol and baratol melts.

Environmental Problem #10 found relatively low levels of HE in the soils within the drainages of TA-16-340, the 300-Line, and TA-16-342. Maximum HE in these drainages was 4 330 ppm in the drainage from NPDES 05A062, which is associated with TA-16-342. See Tables 5-15, 5-16, and 5-17.

HE Sump Water. During the 1970s, waters in all of the active sumps at TA-16 were analyzed as part of the NPDES permit application process. Sumps associated with TA-16-302 (HMX 1-4 ppm, RDX 16-63 ppm, TNT 54-199 ppm) and TA-16-380 (TNT 4-20 ppm) contained measurable high explosives (Rickenbaugh 1979, 15-16-440; LASL 1977, 15-16-380). TNT in the other NPDES-permitted sumps at TA-16 was <0.4 ppm. In 1988, Baytos analyzed water samples taken from HE sumps and outfalls at the major HE process buildings for explosives and solvents. Samples were taken each day over a period of ten consecutive work days. The purpose of the study was to develop a basis for designing a charcoal filtration system. The data were taken before the sumps were plugged. The data are tabulated in Tables 5-11 through 5-14 (Baytos 1988, 15-16-266).

The data illustrate that the concentration of explosives and organics in the sumps depends on the work load and the nature of the process. For example, the high level of barium nitrate in the sumps at the casting building, TA-16-302 (Table 5-12), indicates that baratol castings were being poured during the survey period. The low level of RDX would indicate that no Composition B was being poured.

Environmental Problem #10 also examined HE contents in water associated with process buildings TA-16-340, TA-16-342, and TA-16-300 (DOE 1989, 15-16-344). They found low levels of HE (< 1 ppm) in all the liquid effluent from these process buildings.

Metals and Asbestos. Turner and Schwartz analyzed barium in several sumps associated with process buildings. The highest values were found in water in sumps at the 300-Line, where kettle-washing operations had recently taken place (Table 5-10).

Analyses for Environmental Problem #10 yielded metal concentrations above background in both water and soils associated with the sump drainages for TA-16-340, TA-16-342, and the 300-Line. Very high beryllium (8.2 mg/L) was found in a single water sample at TA-16-340. Barium in sediments ranged up to 13 800 ppm; the highest value was in a soil sample from the drainage at TA-16-342. Lead reached a maximum concentration of 607 ppm in the TA-16-300 drainage. Other metals were detected above background (see Tables 5-15 through 5-17) but below SALs. Copper (96 to 1 040 ppm) and zinc (33 to 465 ppm) were detected in several soil samples well below SALs of 3 000 and 24 000 ppm respectively. Asbestos was detected in both water and soil samples; this may be contamination from sample packaging.

Organics and gross radioactivity. Panowski and Salgado's 1970 survey of solvents delivered to TA-16 provides a snapshot of typical wastes and waste quantities in process buildings at S-Site during the past (Panowski and Salgado 1971, 15-16-038). Quantities of chemicals used in individual buildings undoubtedly changed as the amount of work being done at S-Site varied. In addition, acetone, chlorinated solvents, and methyl ethyl ketone (MEK) formerly used for cleanup have recently been replaced with non-Resource Conservation and Recovery Act (RCRA) listed solvents (Barr 1992, 15-16-329).

Panowski and Salgado stated that about 3 600 gal. of various chemicals were delivered to S-Site between November 1970 and April 1971. Materials used in large quantities include acetone, MEK, and ammonium sulfate (Table 5-18). The chemicals left the process buildings by various routes, but it is likely that virtually all the materials either evaporated into the atmosphere within a short distance or were burned as part of the standard disposal activities.

The outfalls of TA-16-340, TA-16-342, and the 300-Line were investigated in 1989 as part of Environmental Problem #10 in the DOE Environmental Survey (DOE 1989, 15-16-344, Requests LA314, LA315, and LA316). Results of analyses are summarized in Tables 5-15 through 5-17.

In addition to the VOCs listed, the following compounds were detected below the quantitation limit of 0.005 mg/L: chloroform, bromodichloromethane, dibromochloromethane, toluene, and 1,1,1-trichloroethane.

The outfalls of TA-16-340, TA-16-342, and the 300-Line showed low levels of radioactive materials. A maximum cesium-137 or 2.5 pCi/g was found in sediments at the outfall of TA-16-342. Uranium-235 exhibited a maximum value of 0.28 pCi/g at the TA-16-340 outfall. Small amounts of natural uranium were detected. Other radionuclides were not detected.

Summary

The existing data demonstrates that HE has been detected at levels greater than SALs for TNT, HMX, and RDX in soil and sump water associated with several of these SWMUs. The HE by-product DNT has been detected above SALs in sediment, and another HE by-product, TNB, has been detected below SALs. In addition, barium, chromium, lead, and beryllium have been detected above SALs in soil or water in TA-16 drainages. Uranium in a water sample at TA-16-340 was above the SAL. Organics were present in several drainages below SALs and above SALs in sump water. These data do not suggest that any sumps, drains, or outfalls in the aggregate contain HE at explosive concentrations.

5.2.1.2.2 Potential Pathways and Exposure Routes

Potential release of contaminants from the sumps, drain lines, and outfalls could occur as the result of leaks from the sump bottom or pipe joints into subsurface soil, and spillage and liquid disposal to the outfall onto surface soil and sediments in drainages. It is unlikely that any leakage from the sump bottoms has occurred since the installation of aluminum liners in the sumps in 1966. Once these contaminants have been released into the environment the major migration pathway is via surface water runoff which may carry contaminants beyond the original release site to accumulate in sedimentation areas in drainages. Potential subsurface contamination can be brought to the surface via excavation or erosion.

Current human receptors include on-site workers and recreational users. Chapter 4 contains a detailed discussion of the migration pathways, conversion mechanisms, human receptors, and exposure routes.

5.2.2 Remediation Decisions and Investigation Objectives

Problem Statement (DQO Step 1)

HE operations in the modern TA-16 complex have resulted in known releases of COCs into drainages associated with HE sumps at levels above SALs. The principal goal of Phase I of the RFI work plan for the sumps is to delineate the HE contamination in the drainages associated with the inactive sumps, in order to implement an effective VCA. We anticipate that this VCA will consist of excavation of contaminated soil, removal of HE by burning, and disposal of the residue in an appropriate landfill. A CMS is not expected to be required. A subsidiary goal is to investigate drainage distributions of PCOCs, such as organics, that have not been shown to have been released from these SWMUs above SALs.

The HE sumps, upstream process drains, and collection troughs described in this section are all operational, but only ten discharge to outfalls. In addition, the majority of the drain lines are located under paved areas. Thus, neither the sumps, nor upstream collection troughs, nor their associated downstream drain lines will be sampled during this phase of the RFI process. It is unlikely that there is any threat to the safety of current workers from HE leakage into soils surrounding the sumps and drain lines because existing data indicate that the concentration of HE in the soils is below the conservative estimate for an explosive mixture (see Subsection 5.2.1). They will be sampled in conjunction with decontamination and decommissioning of the buildings at S-Site, in keeping with current ER Program policy concerning active operations. In many cases, the sumps have been plugged, so the outfalls may be considered inactive, as

WX Division has no plans to reactivate them. Phase I sampling will be confined to the outfalls and drainages associated with these inactive outfall sumps. PCOCs include HE, barium, metals, organics, and, in some cases, uranium.

For the drain lines and outfalls considered active during RFI Phase I sampling, no sampling will be done. These sumps, their drain lines, and their outfalls are all active at this time, and ER Program policy dictates that sampling of active SWMUs will be limited to situations where an imminent danger to human health exists. All of these sumps with active outfalls are routinely sampled as part of WX-3's sampling program for the EPA NPDES permit; existing data indicates contamination at the sumps, but suggests no danger to workers at this time. In addition, it is unlikely that discharges from any of the three process buildings that currently have active sumps could impact off-site receptors: the outfall for TA-16-360 drains to Water Canyon, and routine sampling of this canyon indicates no off-site migration of contaminants; the drainage channel for the outfall for TA-16-340 will be sampled as part of the sampling plan for TA-13 (see Fig. 5-48); and, TA-16-450 has never had active HE operations. If, prior to initiation of field sampling for this work plan, any of these active sumps are plugged, they will be sampled in a similar fashion to the sumps currently classified as inactive.

In detail, the principal objective of Phase I of the RFI for this aggregate is to determine: 1) whether the levels of COCs are different from background, and if so, if they are above SALs, and 2) the extent of HE contamination for those sump outfalls known to be contaminated based on existing data. Sampling is necessary to determine, for these areas directly adjacent to the HE-contaminated areas, which will receive a VCA, whether contaminant concentrations warrant: 1) Phase II study and possible additional remediation, 2) a baseline risk assessment, or, 3) NFA based on Phase I sampling.

Decision Process (DQO Step 2)

A Phase I study will be conducted to determine for each of the inactive outfalls, which of the following actions should be recommended, subsequent to VCA of the HE-contaminated region:

1. Phase II study, if PCOCs are found above SALs and additional data are needed to further bound HE-contaminated areas or to perform a baseline risk assessment.

2. Baseline risk assessment, if PCOCs are found above SALs, and sufficient data exist to determine risks associated with the sump and outfall drainage

3. NFA, if no COCs are detected or they are below SALs

4. An expanded VCA, if it is deemed to be more cost-effective to merely expand the zone of VCA.

Possible remediation alternatives for the outfalls and drainages include: 1) removal of HE-contaminated soil to a permitted landfill after removal of HE at the TA-16 burning ground to eliminate any safety risk in transporting the soil off site; 2) *in-situ* degradation of HE by composting; or, 3) thermal, chemical, or biological treatment of HE-contaminated waste followed by replacement of clean soil. After remediation all sites will be resampled to confirm that cleanup was effective.

Figure 5-11 illustrates the decision process.

5.2.3 Data Needs and Data Quality Objectives

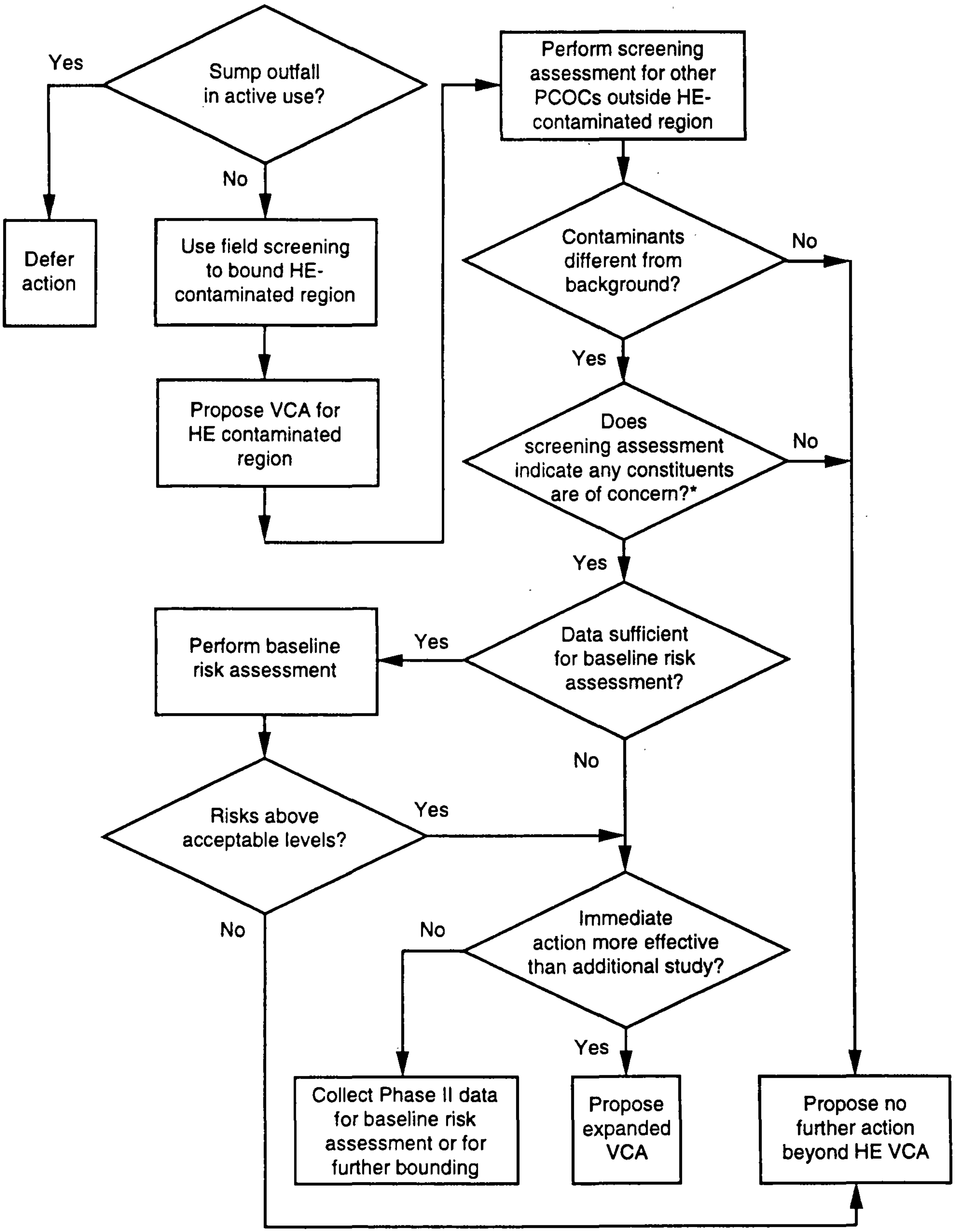
Decision Inputs and Investigation Boundary (DQO Steps 3 and 4)

In Phase I, the following questions will be addressed for each sump with an inactive outfall.

1. Over what area do HE levels exceed SALs in the surface soils of the drainages associated with the outfalls?

2. Do the levels of barium or other metals exceed SALs in the surface soils of the drainages outside the HE-contaminated zone?

3. For the sumps that were involved in processes using radioactive materials, do levels of radionuclides exceed SALs?



* PCOCs > SALs or possible multiple contaminant problem

Fig. 5-11. Decision flow for sumps.

4. Are HE, HE by-products, metal, or organic contaminants present in the subsurface soils of the drainages above SALs?

The data required to answer the first question are HE screening data and concentrations of HE in the surface soils along the drainages associated with the sump outfalls. The data needed to answer the second question are the concentrations of metals in the surface soils of drainages outside the HE-contaminated zone. The data needed to check for radioactive contamination are the levels of radionuclides present in the surface soils of the drainages. Determination of organic contamination will require field screening for organics and subsurface data beneath the outfalls.

The decision process will be applied to the surface and subsurface soils of the outfalls and their associated drainages. Sump drainages are generally well-defined; it is unlikely that contaminants have traveled upslope out of the drainage areas. Drainages will be considered for a maximum distance of 500 ft, because at TA-16-260, which is the most contaminated process-building drainage (see Subsection 5.3), existing data suggest minor HE transport beyond a distance of 500 ft from its outfall. Subsurface soils and tuffs at the outfalls will be considered down to a depth of 2.5 ft in bedrock, during Phase I. Movement of HE and barium into the tuff will be evaluated using this vertical sampling domain. Based on previous studies in which metal contamination has been found within bedrock, it is expected that the highest concentrations of PCOCs in tuff will occur within 2.5 ft of the soil/bedrock interface (Nyhan et al. 1984, 0166; McLin 1989, 15-16-405).

Surface contaminants will be assumed to be concentrated in the natural sediment traps of the drainages. If organic contamination is present, it will be assumed to be concentrated in the subsurface soils immediately below an outfall or at the first sediment trap downstream from an outfall in those situations where an outfall daylights onto bare tuff. Fractures in bedrock will be considered during Phase II, if contaminant levels above screening assessment limits are found at the bedrock/tuff interface during Phase I.

Decision Logic (DQO Step 5)

Existing data suggest that the drainages directly adjacent to many of the outfall points for these sumps are contaminated. Thus, we plan on implementing a VCA on those portions of the drainage that are shown to be contaminated based on the HE spot test results. The other decision options will be applied to those portions of the drainage that are not contaminated with HE based on the HE spot test.

Based on the results of the Phase I studies proceed as follows: 1) If the laboratory samples that field screened clean for HE were found to have HE or other COCs at levels different from background and higher than SALs, then develop a Phase II sampling plan. A baseline risk assessment will be conducted whenever sufficient data are available for an effective study. At any time, if decision analysis indicates that expansion of the VCA zone is a more cost-effective method of proceeding with the RFI for a sump than immediate additional sampling, then expand the VCA zone. 2) If none of the laboratory samples contain HE and other COCs at levels judged to be different from background and above SALs, then VCA the HE-contaminated zone, as delineated by the HE spot test field screening and propose NFA for the remainder of the drainage.

Design Criteria (DQO Step 6)

Radiation and HE screening will be conducted at roughly evenly-spaced points to check for the presence and extent of radionuclides and HE. The field screening points will be spaced at 10 ft intervals to provide adequate coverage of each drainage, with a resolution smaller than the scoop distance of a backhoe, in order to bound the region requiring VCA. The 40 ft. sampling interval proposed for each drainage downgradient from the three samples selected for laboratory analysis will provide roughly 10 points to select for evaluation of transport of PCOCs.

The reconnaissance sampling will be biased by taking samples at the outfalls themselves and down the drainage channels in sediment traps where the contaminants are expected to concentrate. This method of locating the samples will have the effect of making the actual probabilities of detecting contamination if it is present greater than those implied by the presence-absence diagram.

Surface samples for HE and metals will be located using HE field screening techniques described above. A total of 5 laboratory samples will be planned in each drainage. The preferred sample size of 5 selected for the surface samples is associated with a probability 0.66 if 20% of each drainage downstream from the known HE-bearing area is contaminated, or 0.9 if 40% is contaminated (see Subsection 4.5.1.1).

Sampling for volatile organics will be conducted in the subsurface soils of the drainages directly beneath the outfalls, or at the first downstream sediment trap if an outfall daylights in bare tuff where the concentrations would be expected to be highest if organic contaminants were present. Note that at TA-16-340, two subsurface cores will be taken, one directly at the outfall and one at the outfall of the discharge aerator. For each outfall, sample measurements will be obtained at three different depths to provide information on possible downward transport of contaminants. If contaminant levels are determined to be different from background, then the sample maxima will be compared to the SAL. Three samples will provide a probability of .55 of detecting contamination if 25% of the depth range is contaminated, or a probability of .85 if 50% of the depth range is contaminated.

5.2.4 Sampling and Analysis Plans

All of the sumps discussed in this subsection have relatively similar operational histories and suites of contaminants, with HE being the principal PCOC; thus, a generic sampling plan applicable to all of the inactive sumps included in this section is presented below. This sampling plan is illustrated schematically in Fig. 5-12. SOPs used in this sampling plan are delineated in Table 5-19. Numbers of samples in each SWMU are delineated in Table 5-20. Approximate downstream locations of field-screening points for each outfall are shown in Figs. 5-13 through 5-24. Field screening methods are described in Subsection 4.7; SOPs for these methods are in preparation.

5.2.4.1 Engineering Surveys

Detailed engineering and geomorphologic surveys are needed to accurately locate drainages from the HE outfalls in the field, as well as to lay out sampling points for HE spot tests, radiation surveys, and surface and subsurface sampling. The spacing of surveyed points is contingent on the results of the HE spot test. The survey will proceed as follows:

1. Begin by surveying in sample points in the drainages at 10-ft intervals commencing directly at the outfall. During this portion

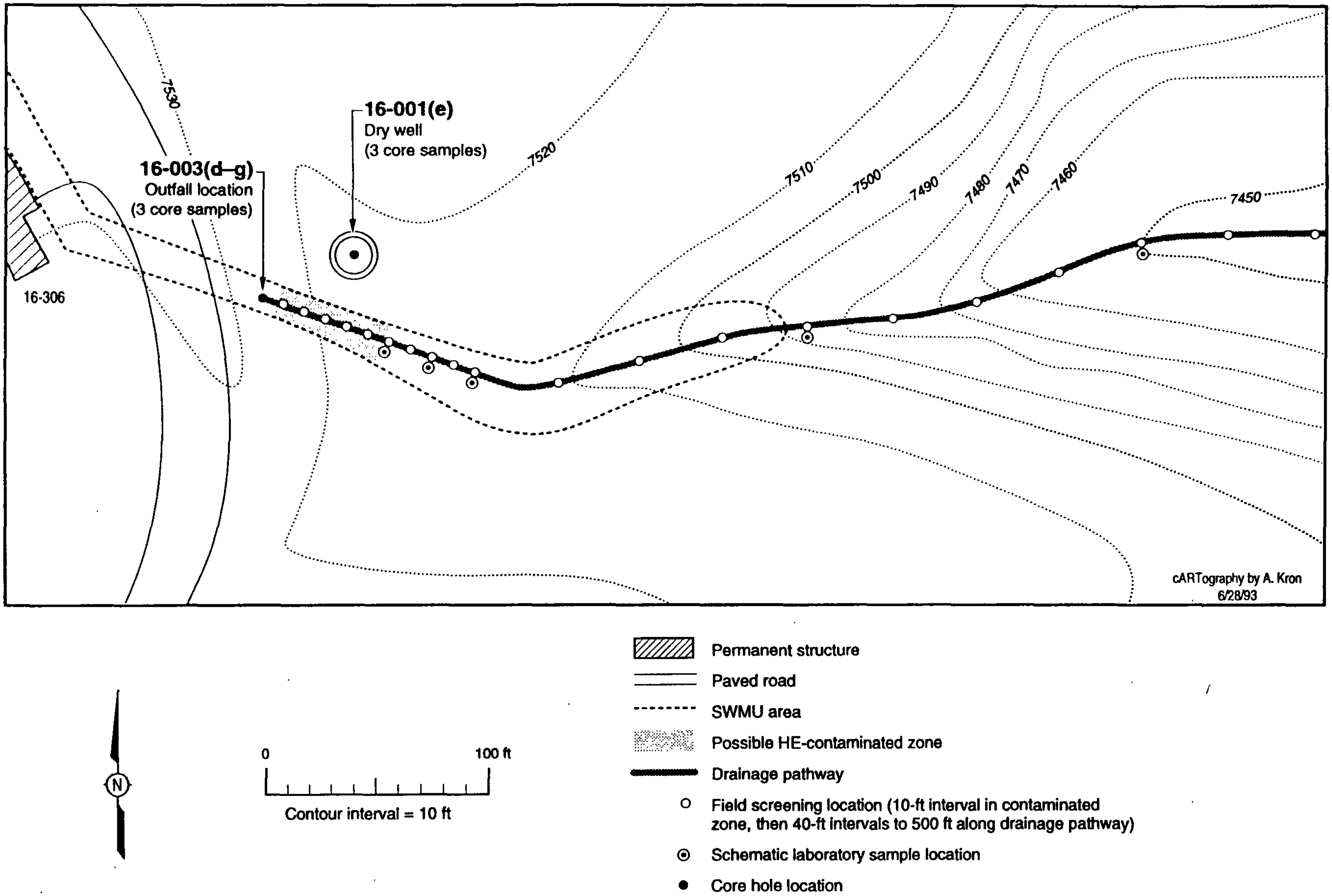


Fig. 5-12. Schematic sample locations for sump outfall (300-Line outfall shown as an example).

TABLE 5-19

STANDARD OPERATING PROCEDURES FOR FIELD ACTIVITIES

LANL-ER-SOP	TITLE	NOTES
01.02, R0	Sample Containers and Preservation	Applied to all laboratory samples
01.04, R1	Sample Control and Field Documentation	Applied to all laboratory samples
06.10, R0	Hand Auger and Thin-Wall Tube Sampler	VOC-bearing subsurface soil samples
06.11, R0	Stainless Steel Surface Soil Sampler	All 0 to 6 in. surface samples
12.01, R0	Field Logging, Handling, and Documentation of Borehole Materials	All cored samples

TABLE 5-20

SUMMARY OF SITE SURVEYS, SAMPLING, AND ANALYSIS FOR SUMPS AND OUTFALLS

		Laboratory Samples							Field Screening							Field Lab.						Laboratory Analyses											
PRS	PRS TYPE	Sampled Media	Structure	Field dup	Surface	Field dup	Subsurface	Field dup	Gross Alpha	Gross Gamma/Beta	Organic Vapor	HE Spot Test	Geophysics Surface	Barium - LIBS	A Geological Characterization	Gross Alpha	Gross Gamma/Beta	Tritium	Volatile Organics	B XRF	Soil Moisture	Alpha spectroscopy	Gamma spectroscopy	C Beta spectroscopy	Total Uranium	Isotopic Plutonium	Isotopic Uranium	D VOA (SW 8240)	E Semivolatiles (SW 8270)	F Metals (SW 6010)	G PCBs (SW 8080)	H High Explosives (SW 8330)	Cyanide
16-001(e)	Inactive dry well	Soil					3																					3	3	3		3	3
16-003(a)	Inactive HE sumps	Soil			5		3			13#		13#													8			3	8	8		8	
16-003(b)	Inactive HE sumps	Soil			5		3	1		13#		13#													8			3	8	8		8	
16-003(d)	Inactive HE sumps	Soil			5		3					13#																3	8	8		8	8
16-003(e)*	Inactive HE sumps	Soil																															
16-003(f)*	Inactive HE sumps	Soil																															
16-003(g)*	Inactive HE sumps	Soil																															
16-003(h) 16-030(d)	Inactive HE sumps Inactive outfall	Soil			5		3			13#		13#													8			3	8	8		8	
16-003(i)	Inactive HE sumps	Soil			5	1	3	1		10#		10#													8			3	8	8		8	
16-003(j)	Inactive HE sumps	Soil			5		3			13#		13#													8			3	8	8		8	
16-003(l) 16-030(h)	Inactive HE sumps Inactive outfall	Soil			5		9					13#																9	8	8		8	
16-003(m) 16-030(g)	Inactive HE sumps Inactive outfall	Soil			5		3	1				13#																3	8	8		8	
16-026(b) 16-029(a)	Inactive HE sumps Inactive outfall	Soil			5	1	3			10#		10#													8			3	8	8		8	
16-026(c) 16-029(b)	Inactive HE sumps Inactive outfall	Soil			5		3					13#																3	8	8		8	
16-026(d) 16-029(c)	Inactive HE sumps Inactive outfall	Soil			5		3	1				8#																3	8	8		8	
16-026(e) 16-029(d)	Inactive HE sumps Inactive outfall	Soil			5	1	3					8#																3	8	8		8	8
16-026(h2) 16-029(e)	Inactive HE sumps Inactive outfall	Soil			5		3					13#																3	8	8		8	
16-026(j2) 16-029(f)	Inactive HE sumps Inactive outfall	Soil			5	1	3	1				9#																3	8	8		8	

TABLE 5-20 (continued)

SUMMARY OF SITE SURVEYS, SAMPLING, AND ANALYSIS FOR SUMPS AND OUTFALLS

PRS	PRS TYPE	Laboratory Samples							Field Screening							Field Lab.						Laboratory Analyses											
		Sampled Media	Structure	Field dup	Surface	Field dup	Subsurface	Field dup	Gross Alpha	Gross Gamma/Beta	Organic Vapor	HE Spot Test	Geophysics Surface	Barium - LIBS	A Geological Characterization	Gross Alpha	Gross Gamma/Beta	Tritium	Volatile Organics	B XRF	Soil Moisture	Alpha spectroscopy	Gamma spectroscopy	C Beta spectroscopy	Total Uranium	Isotopic Plutonium	Isotopic Uranium	D VOA (SW 8240)	E Semivolatiles (SW 8270)	F Metals (SW 6010)	G PCBs (SW 8080)	H High Explosives (SW 8330)	Cyanide
16-003(c) 16-026(v)	Active HE sumps Active outfall	Soil			5		3			13#		13#													8			3	8	8		8	8
16-003(n)	Active HE sumps	Soil			5		3			13#		13#													8			3	8	8		8	
16-003(o)	Active HE sumps	Soil			5		6			25#		25#													11			6	11	11		11	
16-029(g)	Active HE sumps	Soil			5		3			19#		19#													8			3	8	8			

* These sumps have a common outfall with 16-003(d) as part of the 300-Line.
A, B, C, G = not applicable; D, E, H = full suite; D = subsurface samples only; F = 1082 suite.
The number of field screening points will be at least this many forty-ft spaced samples. The actual number will depend on the HE distribution.

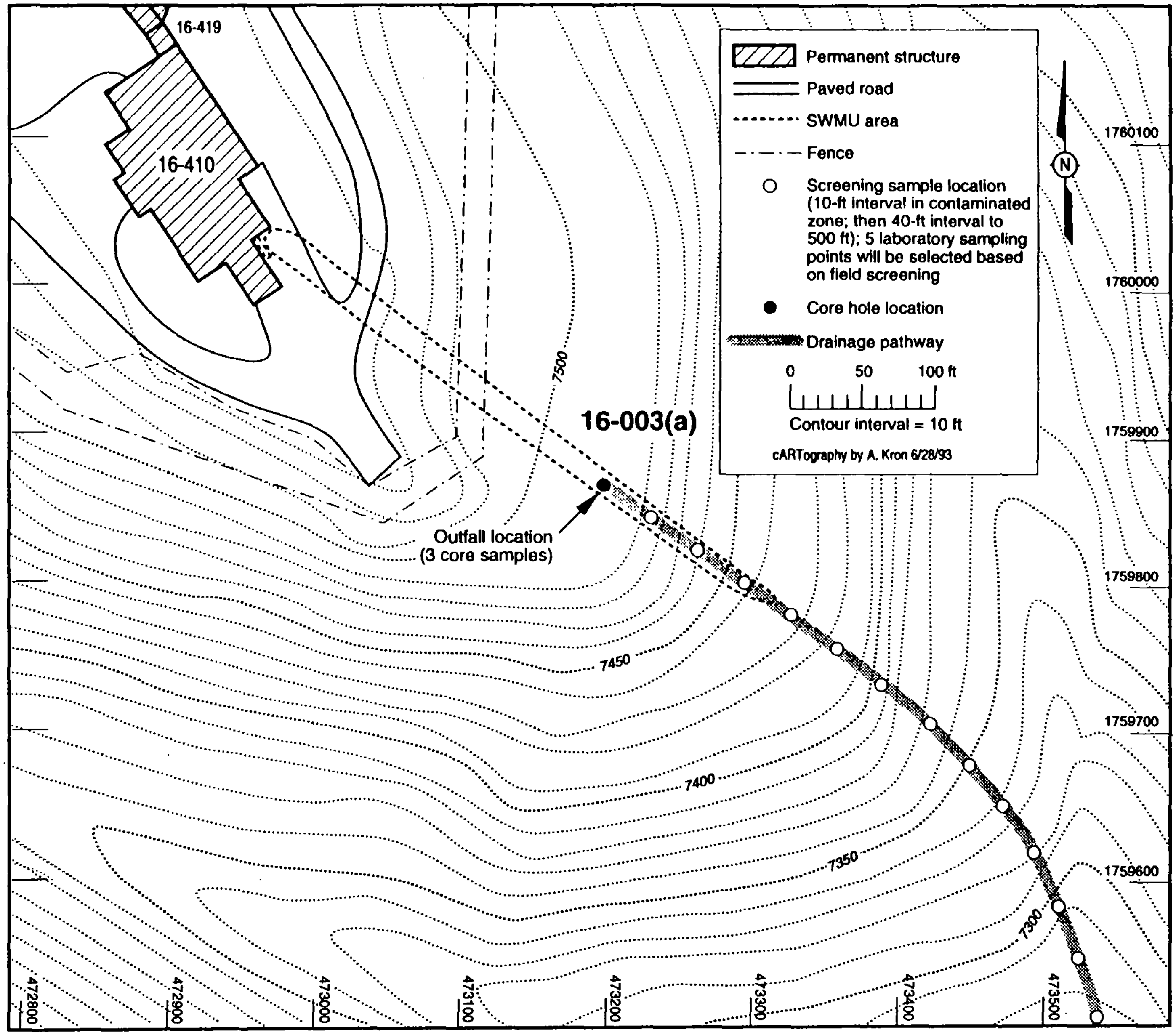


Fig. 5-13. Schematic field screening sampling locations for SWMU 16-003(a).

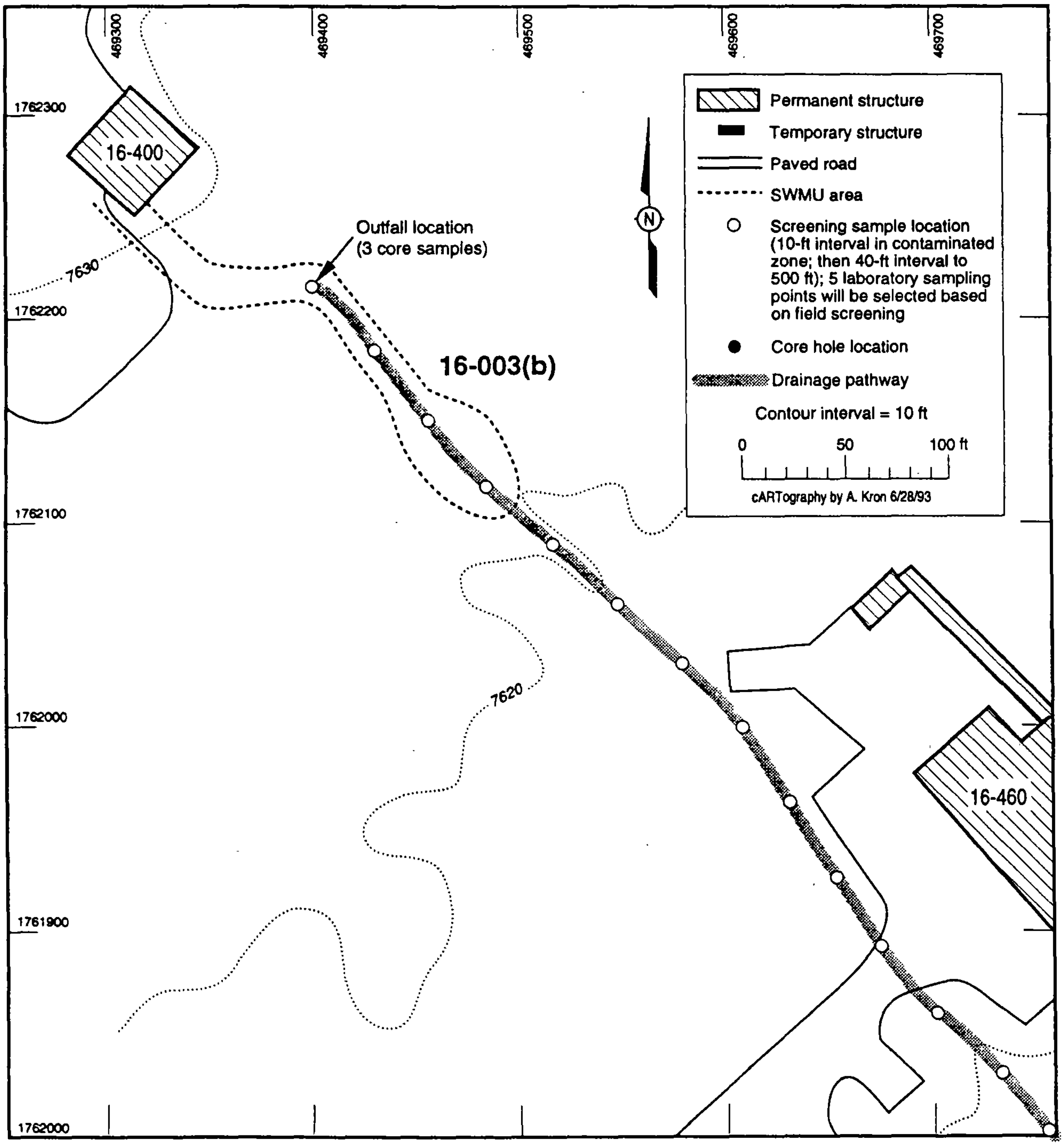


Fig. 5-14. Schematic field screening sampling locations for SWMU 16-003(b).

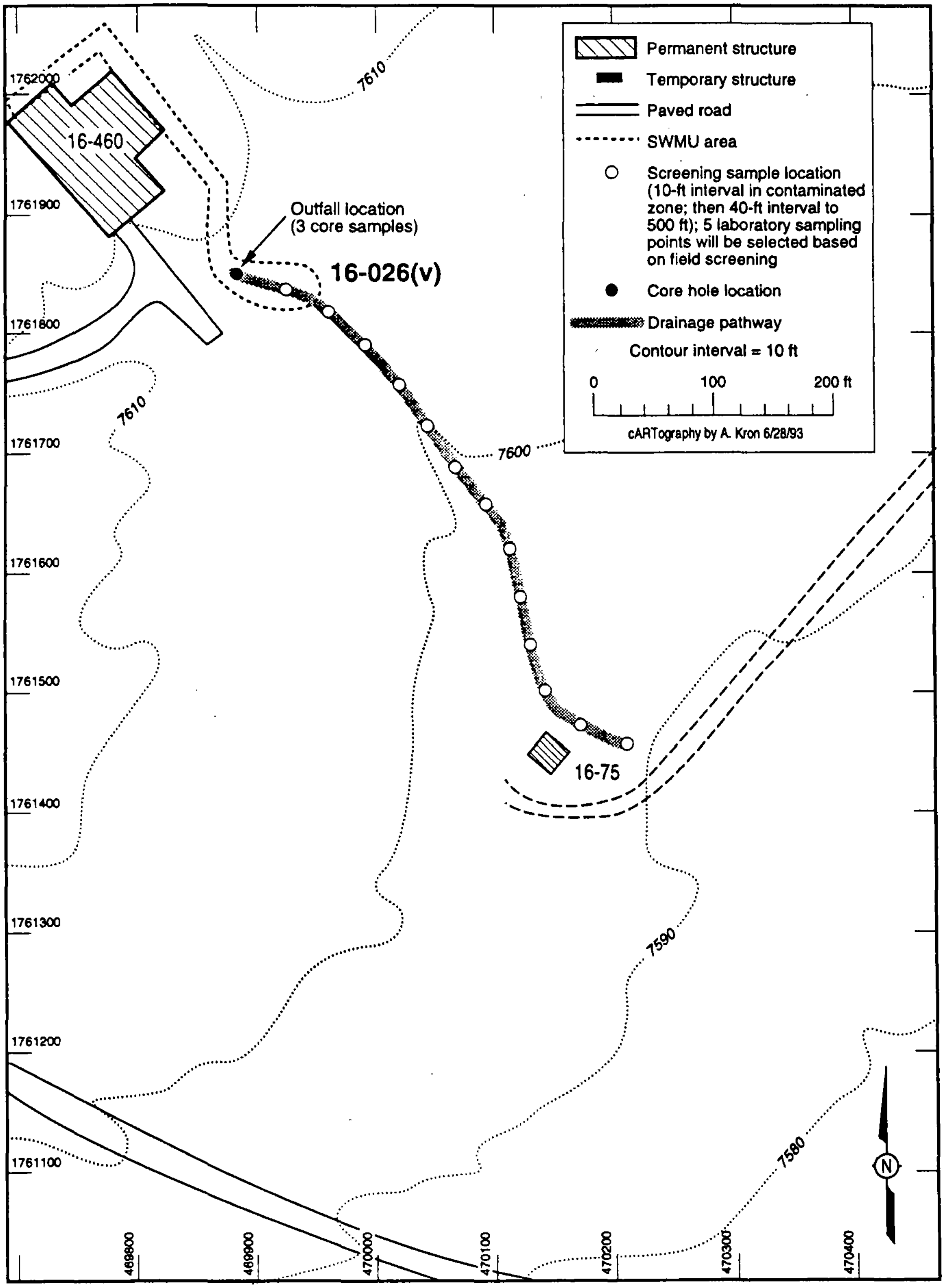


Fig. 5-15. Schematic field screening sampling locations for SWMU 16-026(v).

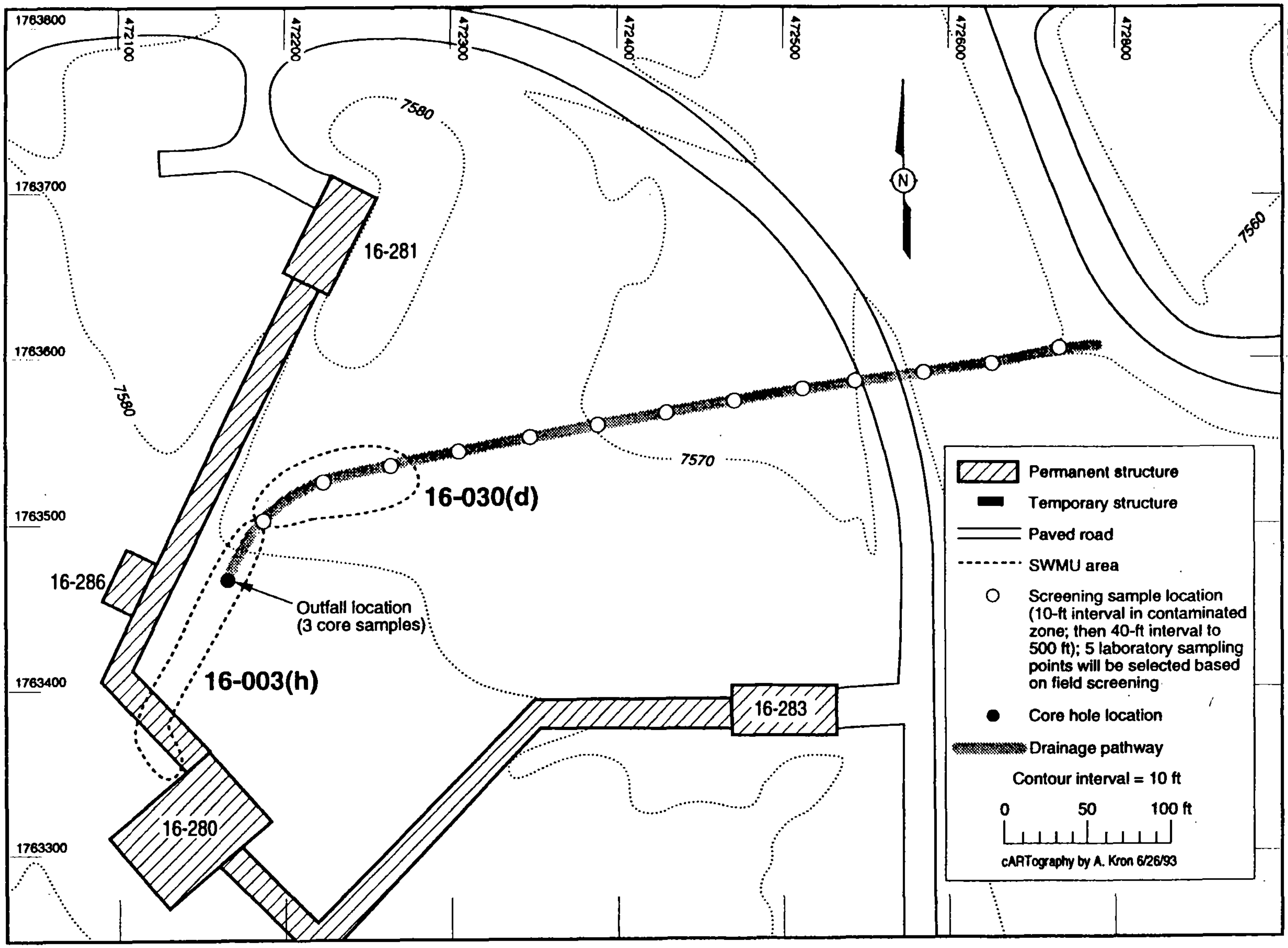


Fig. 5-16. Schematic field screening sampling locations for SWMUs 16-003(h) and 16-030(d).

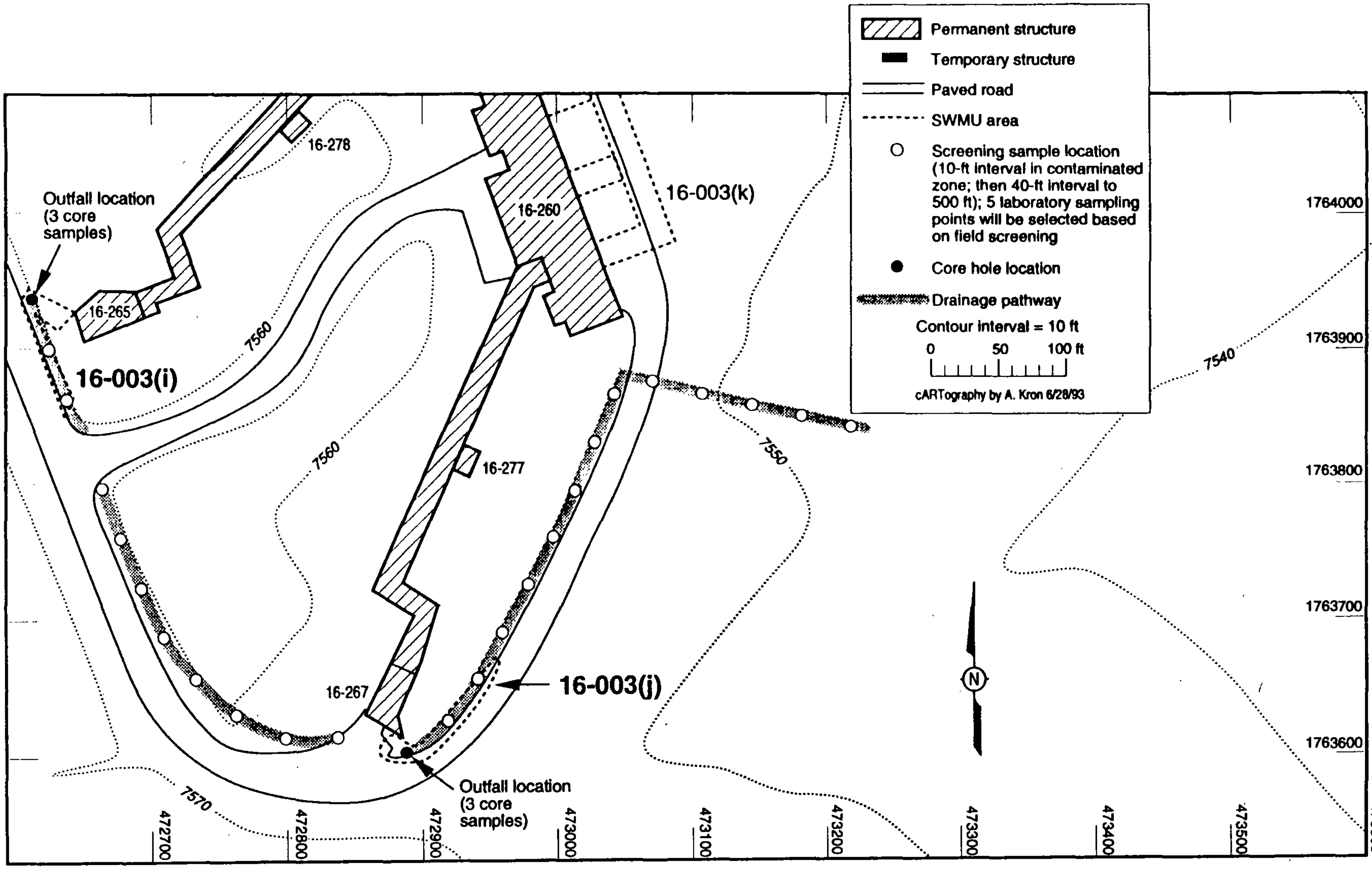


Fig. 5-17. Schematic field screening sampling locations for SWMUs 16-003(i, j).

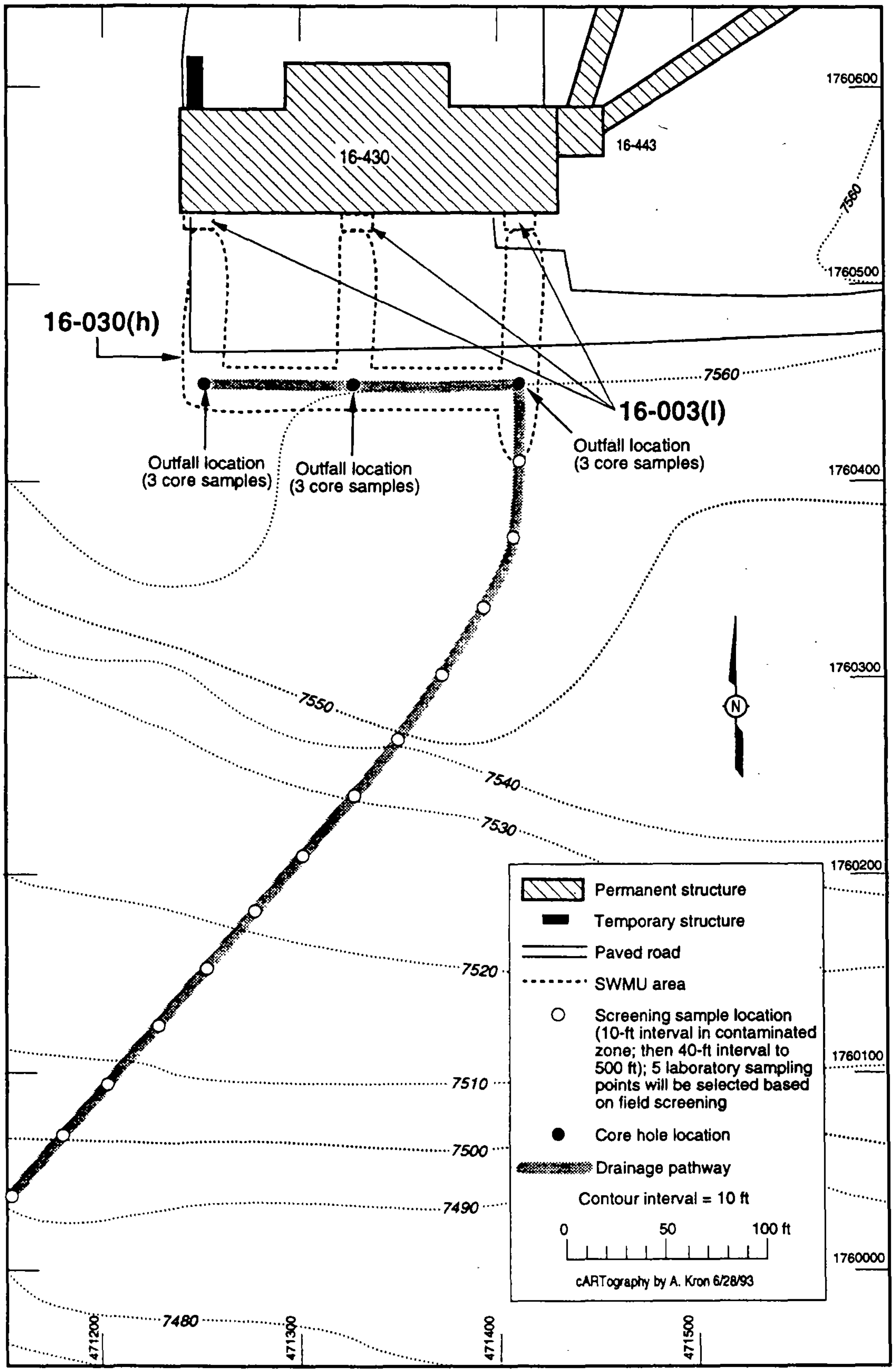


Fig. 5-18. Schematic field screening sampling locations for SWMUs 16-003(l) and 16-030(h).

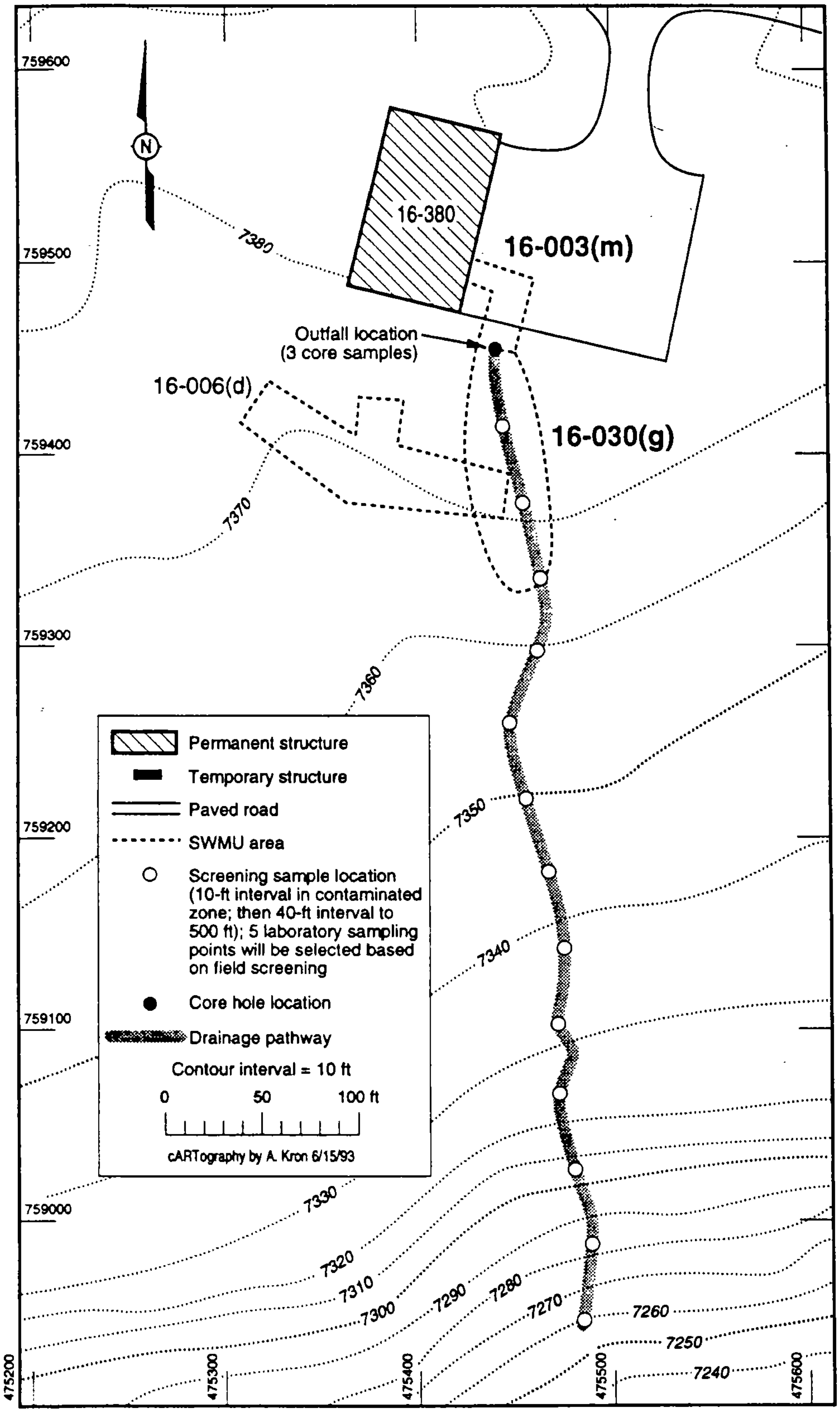


Fig. 5-19. Schematic field screening sampling locations for SWMUs 16-003(m) and 16-030(g).

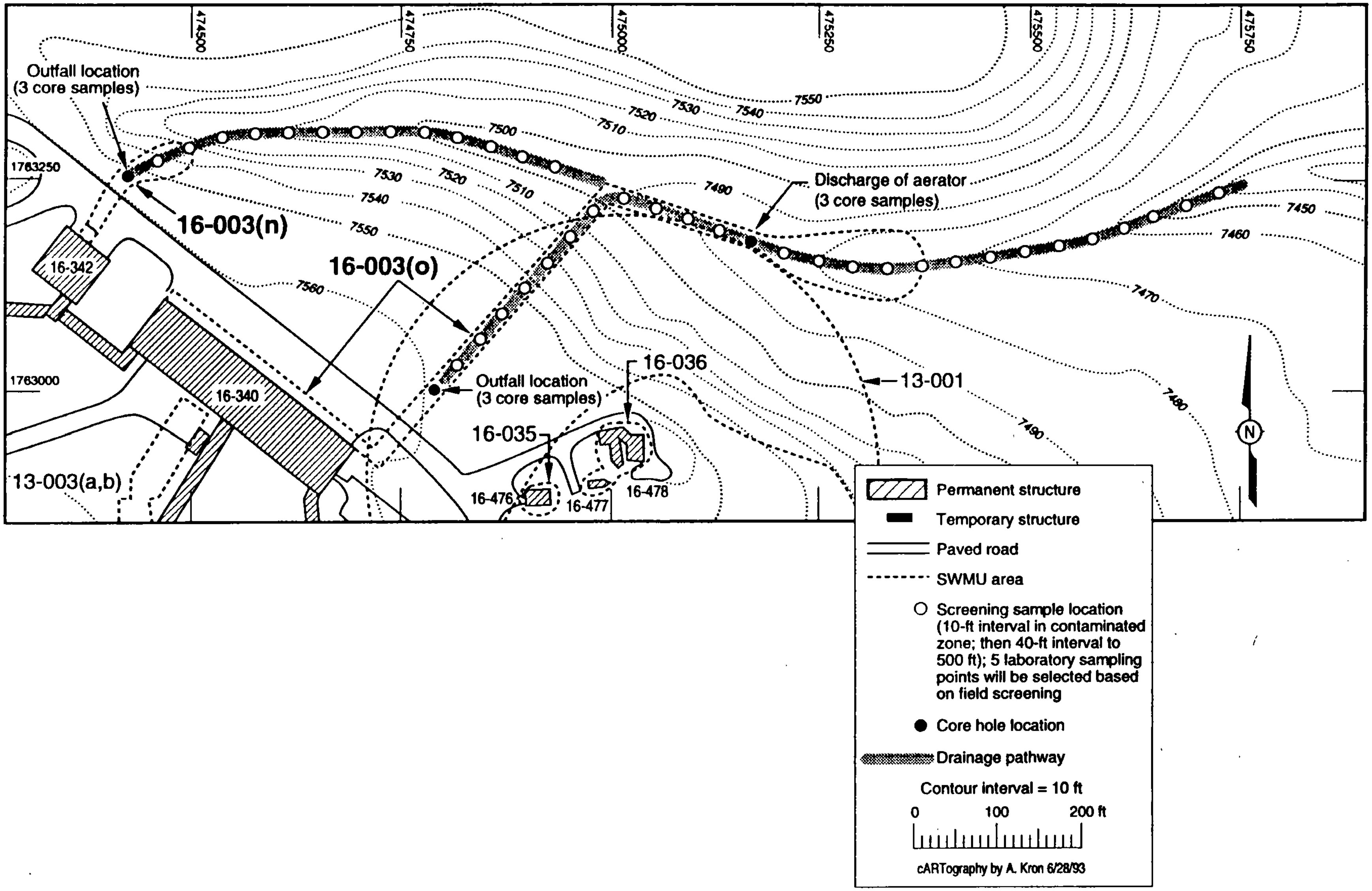


Fig. 5-20. Schematic field screening sampling locations for SWMUs 16-003(n, o).

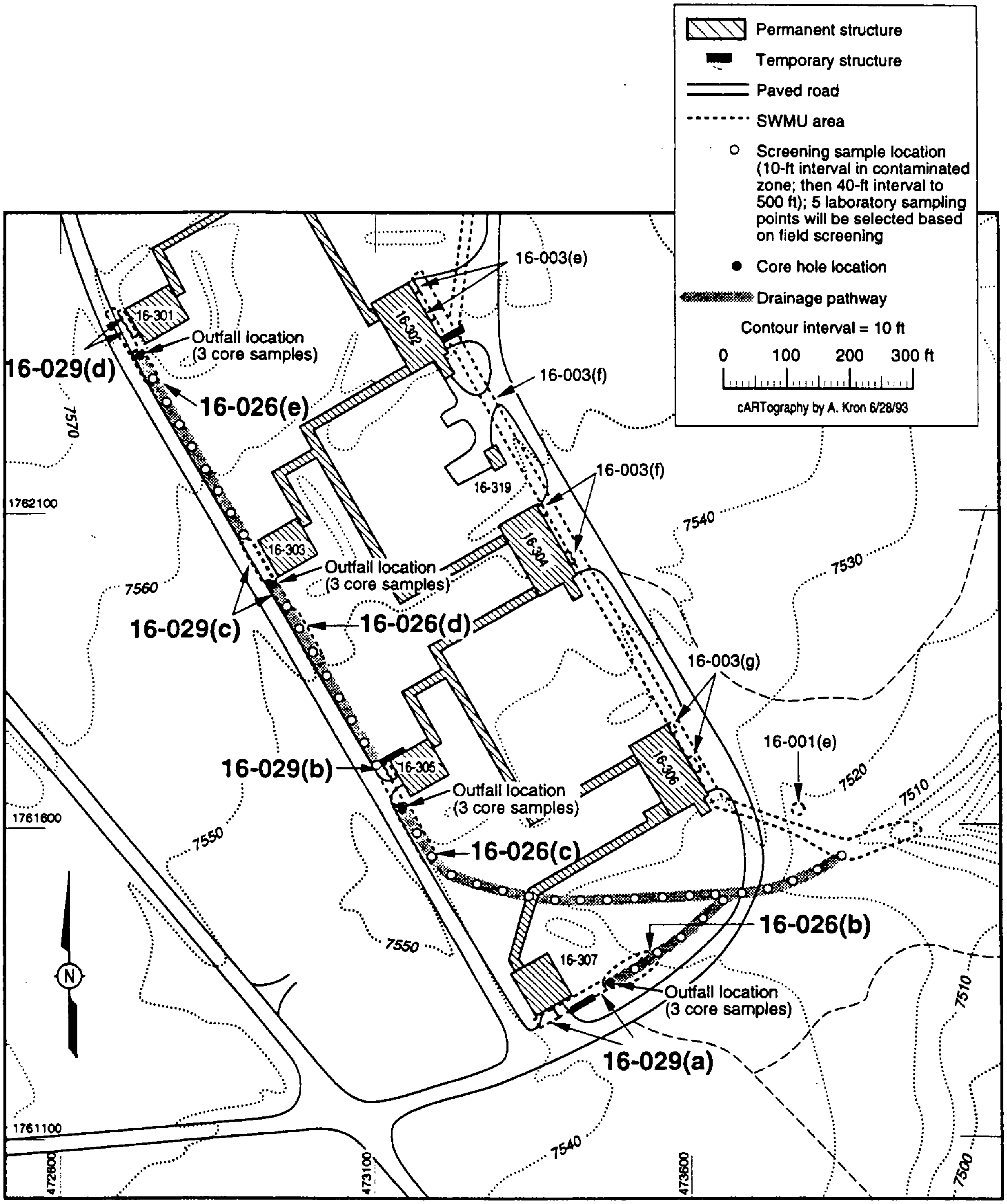


Fig. 5-21. Schematic field screening sampling locations for SWMUs 16-026(b–e) and 16-029(a–d).

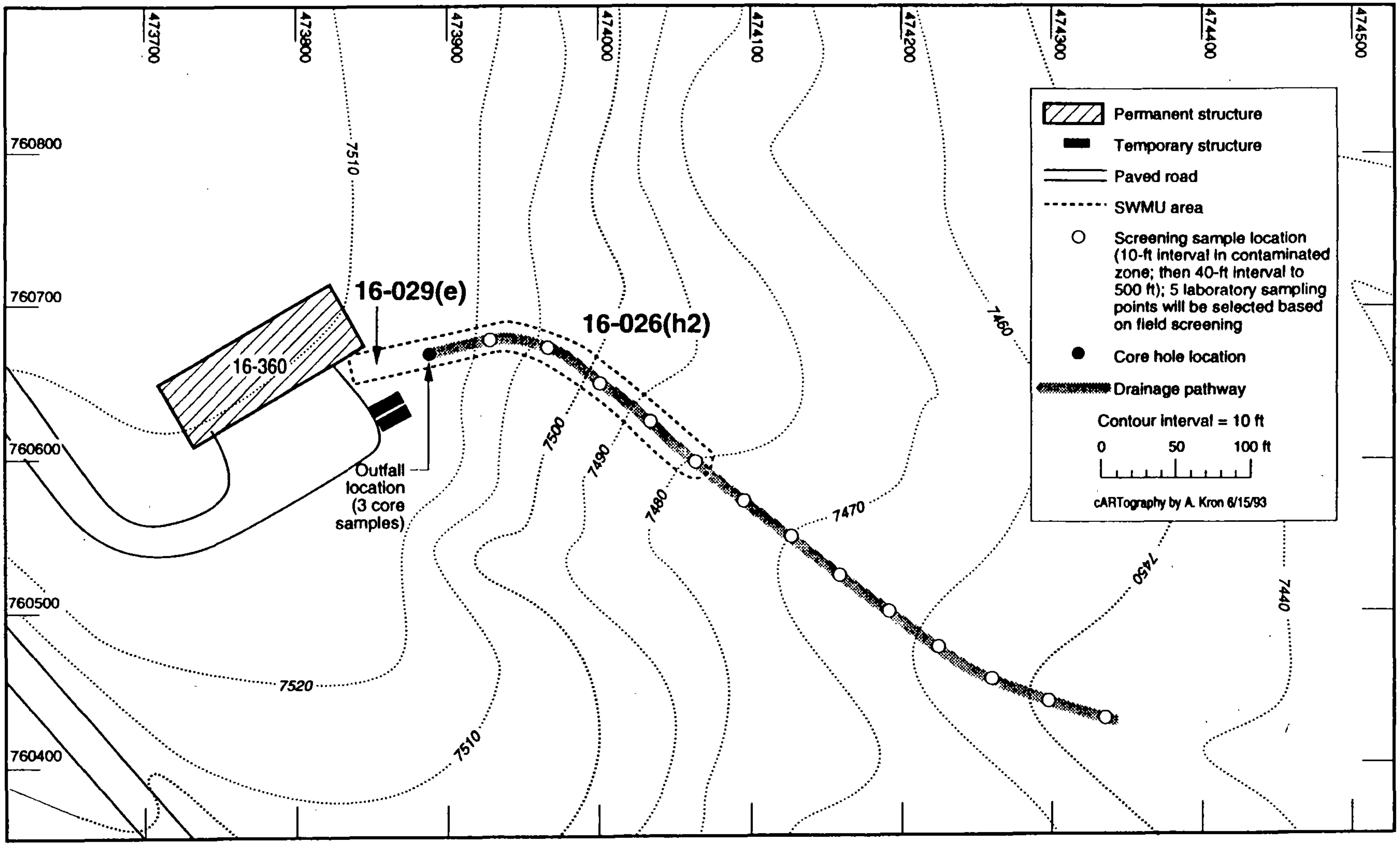


Fig. 5-22. Schematic field screening sampling locations for SWMUs 16-026(h2) and 16-029(e).

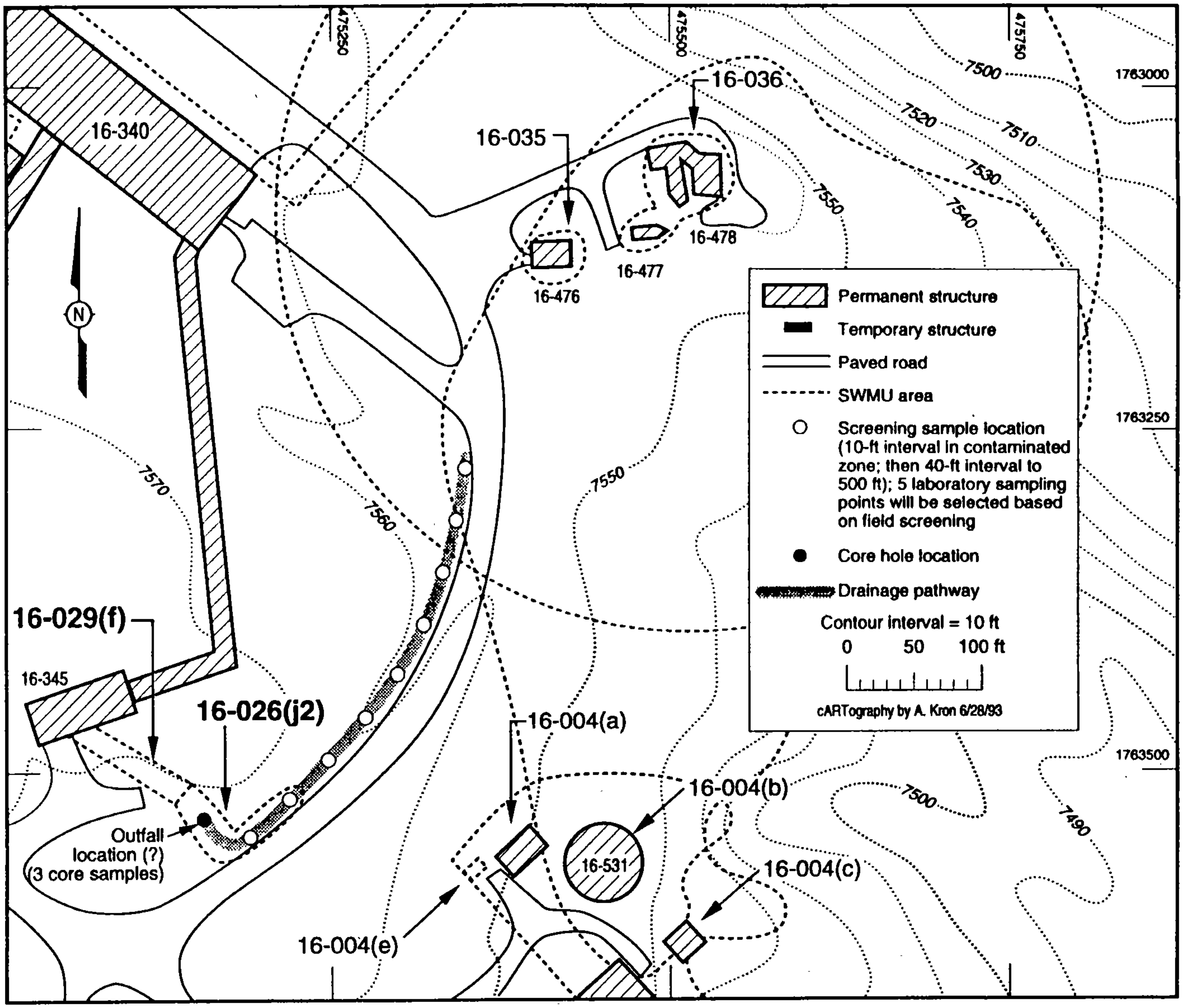


Fig. 5-23. Schematic field screening sampling locations for SWMUs 16-026(j2) and 16-029(f).

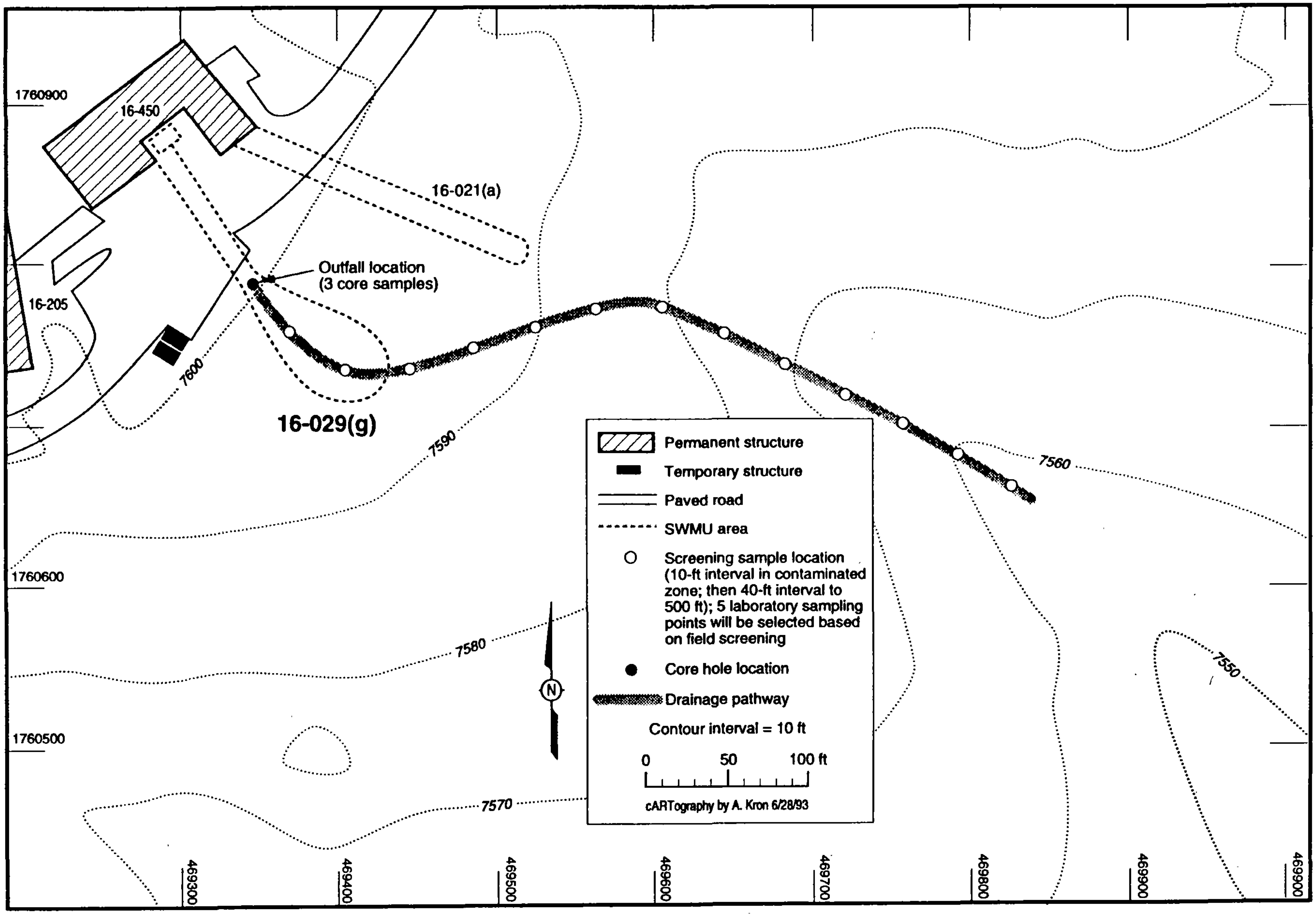


Fig. 5-24. Schematic field screening sampling locations for SWMU 16-029(g).

of the survey, an HE spot test will be conducted at each of these sample points.

2. At the point at which the HE spot test indicates that no HE remains at levels > 100 ppm, survey in a laboratory sample point. Two additional Laboratory points will be surveyed in 20 ft and 40 ft down the drainage from the initial Laboratory sample location.

3. Commencing with the third 20-ft spaced laboratory point continue to down-drainage survey, surveying screening points in sediment traps at roughly 40-ft intervals for a total distance of roughly 500 ft. These 40-ft-spaced points will also be field screened using the HE spot test.

All surveyed locations will be registered on a base map, scale 1:7 200. If, during the course of sampling, any sample points must be relocated, the new position will be resurveyed and the revised locations will be indicated on the map. The engineering survey will be performed by a licensed professional under the supervision of the field team leader.

5.2.4.2 Sampling

High explosives screening will begin directly at each outfall and continue down the drainage at the surveyed locations described above for 500 ft. This screening will be concurrent with the channel surveying described above.

Several of the HE sumps described in this section serve process buildings in which radioactive materials are processed or assembled into HE devices. These sumps will have radiation surveys as well as HE field screening at the surveyed points. The sumps and outfalls that require radiation screening are: SWMU 16-003(a), associated with TA-16-410; SWMU 16-003(b), associated with TA-16-400; SWMU 16-003(c), associated with TA-16-460; SWMU 16-003(h), associated with TA-16-280; SWMU 16-003(i), associated with TA-16-265; SWMU 16-003(j), associated with TA-16-267; SWMU 16-003(n), associated with TA-16-342; SWMU 16-003(o), associated with TA-16-340; and SWMU 16-029(a), associated with TA-16-307.

Three sediment (or soil) samples will be taken in each drainage commencing at the first clean sample defined through the HE screening, and continuing down the drainage at approximately 20 ft surveyed intervals. Two sediment samples will be taken at additional downstream surveyed natural catchments. Siting of these sediment trap samples may be based on the geomorphic survey, the radiation survey, visual evidence of possible contamination, and HE screening. Any samples that yield above-background radiation measurements will be sampled for laboratory analysis. At all of these sample locations, 0 to 6 in. of soil will be collected and analyzed for HE, metals, semivolatile organics, and radionuclides. An analysis will be made for radionuclides in drainages into which uranium may have been discharged.

At each sump outfall or at the first downstream sediment trap where the outfall daylights on bare tuff, one augered core sample will be taken to a depth of at least 2.5 ft into bedrock. At the TA-16-340 outfall channel, one sample will also be taken at the discharge of the aerator. A single augered core sample will be taken in dry well 16-001(e); it too will extend 2.5 ft into bedrock. Samples will be taken at depths of 0 to 6 in., 6 to 12 in., and 12 to 18 in. or 6 in. bracketing the soil/bedrock interface and analyzed for HE, organics, metals, and radionuclides.

5.2.4.3 Laboratory Analysis

Full laboratory analyses of samples will be at Level III by the following methods: radionuclides (LANL or DOE method), VOCs (SW-846 Method 8240), SVOCs (SW-846 Method 8270), metals (SW-846 Method 6010), and HE and its by-products (e.g., DNT, DNB, TNB) (SW-846 Method 8330). Principal COCs are HE (TATB, TNT, HMX, RDX), barium, any other metals, VOCs, and in some cases uranium

5.2.4.4 QA/QC Sampling

Field duplicates will be selected according the guidance provided in the latest version of the IWP (LANL 1992, 0768). Sampling parameters are summarized in Table 5-20, including a listing of appropriate QA/QC field duplicates.

5.3 HE Sumps and Active Outfall at TA-16-260, SWMUs 16-003(k), 16-021(c)

5.3.1 Background

This aggregate consists of 13 high explosive sumps, their drain lines, the outfall, and the well-defined drainage channel associated with TA-16-260 (Fig. 5-6; Tables 5-4, 5-5). The sumps have been designated SWMU 16-003(k) and the outfall as SWMU 16-021(c). The outfall is permitted as EPA 05A056. A general background discussion of sumps and their operating principles is given in Subsection 5.2.1.

The outfall receives effluent from the sumps, as shown on Laboratory drawing 13Y-1920756 (Palmer and Abercrombie 1991, 15-16-366). Each sump flows into a trunk line that discharges to the outfall. Sump S14, serving Bay 25 on the southeast end of TA-16-260, has been removed. The outlet of Sump S15 is plugged and the sump is no longer active.

TA-16-260 is a HE machining facility that processes large quantities of explosives. Machine turnings are routed to the sumps as waste. The drainage channel from the outfall is contaminated with explosive waste, including barium nitrate, the primary ingredient in the explosive baratol.

In 1966, the 10-ft wide loading dock on the rear (northeast) of TA-16-260 was removed. New sumps with water-tight aluminum liners were installed adjacent to the northeast wall of TA-16-260. HE-contaminated dirt under the old sumps was removed and replaced with clean, compacted earth. PCOCs are listed in Table 5-21.

5.3.1.1 SWMU Description and History

SWMU 16-003(k). SWMU 16-003(k) is 13 HE sumps and drain lines associated with TA-16-260. Sump dimensions are 90 in. by 36 in. by 31 in. (1 each) and 176 in. by 36 in. by 31 in. (12 each). The waste consists primarily of HE. In 1970, Wilder classed the use of HE as very high and the probability of contamination in the outfall as very high. As shown in Table 5-18, dimethyl sulfoxide was the only solvent found by Panowski and Salgado (1971, 15-16-038; LANL 1989, 15-16-361). Currently, solvents are drummed to prevent their reaching the sump.

TABLE 5-21

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, TA-16-260 AGGREGATE

				HE		RAD	METALS		ORGANICS		
PRS NO.	DESCRIPTION	PRIMARY ACTIVITY LEADING TO POTENTIAL PROBLEMS	ACTIVE	UNDETONATED HE	HE DEGRADATION PRODUCTS	URANIUM	METALS SUITE	BARIUM	VOLATILES	SEMIVOLATILES	CYANIDE
16-003(k)	HE sump	HE machining	Y	x	x	x	x	x	x	x	x
16-021(c)	TA-16-260 outfall	HE machining	Y	x	x	x	x	x	x	x	x

The two sumps serving machining Bays 22 and 23, and 24 and 25 receive barium precipitation treatment. After pH adjustment, barium is precipitated as insoluble barium sulfate by adding sodium sulfate to the sump solution. Barium residues are removed to the TA-16 burning ground when the sumps are serviced.

HE charges to which uranium has been fastened (e.g., glued) have been machined at TA-16-260. Generally, only the HE was machined. Uranium was left intact. Special precautions are taken to prevent uranium from entering the waste water system (LANL 1989, 15-16-361).

In 1955, H-Division reported concerns that airborne particulate levels for TNT exceeded permissible limits at TA-16-260 (H-Division 1955, 15-16-227; and H-Division 1955, 0482).

SWMU 16-021(c). SWMU 16-021(c) is the outfall associated with the 13 HE sumps on the northeast side of TA-16-260 (Fig. 5-6). Although listed as inactive in the SWMU Report, the outfall is active (LANL 1990, 0145).

The drainage channel from the outfall flows about 600 ft to the bottom of Cañon de Valle, a drop in elevation of 80 ft. The drainage channel from the outfall is well defined, with apparent high-water marks. The water flows over a 15-ft high cliff approximately 500 ft from the outfall. A small pond approximately 55 ft long is formed by a rock dam located 93 ft from the outfall. HE-contaminated water from the outfall enters the pond about 40 ft from the outfall. The longitudinal axis of the pond is oriented east-west with flow in the easterly direction. The dam is about 9 ft thick, but only the first 2 ft of rock are closely packed. At present, the water in the pond is less than 2 in. deep and covers only a small area, although the soil and sediment are wet throughout the pond. Rain water from the roadway on the northeast side of TA-16-260 also flows into the pond. Bioremediation and other experiments are presently being conducted in the pond.

5.3.1.2 Conceptual Exposure Model for HE Sumps and Active Outfalls

The conceptual model for TA-16-260 is identical for that of the inactive HE sumps described in Subsection 5.2.1.2 (see Fig. 4-9).

5.3.1.2.1 Nature and Extent of Contamination

Existing data for the TA-16-260 outfall are extensive and show widespread HE contamination extending from the discharge point to Cañon de Valle (Tables 5-22 through 5-25) (Baytos 1970, 15-16-278, etc.; Turner and Schwartz 1971, 15-16-284; King 1991, 15-16-381; and King 1992, 15-16-380). Values range up to three orders of magnitude greater than SALs.

Baytos analyzed sediment samples taken from the channel during the period 1970 through 1985 (Table 5-22). His study extended several hundred feet from the outfall. The highest concentrations of HMX-RDX and TNT were found in the pond. Concentrations of total HE in the pond have remained uniformly high, from a low of 10.8 wt % in 1971 to 27.0 wt % in 1976 (Baytos 1971, 15-16-277; and Baytos 1976, 15-16-271). Baytos cited an unpublished report from 1960 in which the total HE concentration was 9.8 wt % (Baytos 1972, 15-16-275). In 1991, Barr and King found concentrations as high as 34.1 wt % in the pond (King 1991, 15-16-381; King 1992, 15-16-380). Barr and King also found that HE concentrations were high (4.4 wt %) for a distance of over 200 ft down the drainage. In dry soil, such high concentrations could be considered explosive mixtures under certain conditions (Urizar 1984, 15-16-353). Turner and Schwartz found that waste material from TA-16-260 travels only a short distance down Cañon de Valle.

Baytos' distances from the outfall are approximate (i.e., within 10 ft). Distances the samples were taken from the center line of the pond were not recorded. Therefore, there may be some inconsistencies in the data. For example, two samples taken on March 11, 1960, from the center of the pond have significantly different HE concentrations. However, one sample was taken on the approximate center line of the pond while the other was taken near the edge of the pond.

In 1972, contaminants in TA-16-260 sump water ranged from 0 to 3.2 ppm HMX-RDX, 10 to 18 ppm TNT, and 70 to 1 587 barium nitrate (Roybal 1972, 15-16-439). As part of NPDES permit application, sump waters from TA-16-260 were analyzed for TNT, yielding values ranging from <0.4 to 78 ppm (LASL 1977, 15-16-426). In 1988, Baytos analyzed water samples taken from the outfall. His data are tabulated in Table 5-25.

TABLE 5-22

HIGH EXPLOSIVES IN THE TA-16-260 DRAINAGE CHANNEL

DATE	SAMPLE LOCATION	HMX/RDX	TNT	TOTAL HE
03/11/60	Pond center	8.5	1.3	9.8
03/11/60	Pond center	3.5	1.3	4.8
03/11/60	20 ft below dam	4.3	1.7	6.0
03/11/60	30 ft below dam	3.3	0.7	4.0
03/11/60	100 ft below dam	2.7	0.04	2.7
03/11/60	150 ft below dam	0.5	0.02	0.5
04/29/70	Outfall	7.0	0.0	7.0
04/29/70	Pond center	20.5	3.7	24.2
04/29/70	1 ft below dam	4.8	0.07	4.9
04/29/70	Between dam and cliff	12.9	0.12	13.0
04/29/70	Cliff	3.9	0.10	4.0
11/18/70	10 ft from outfall	3.2	0.0	3.2
11/18/70	Inlet to pond	14.1	0.1	14.5
11/18/70	10 ft above dam	22.1	0.5	22.6
11/18/70	5 ft below dam	14.5	0.2	14.7
11/05/71	10 ft from outfall	2.9	0.0	2.9
11/05/71	Pond inlet	10.8	0.0	10.8
11/05/71	10 ft above dam	25.7	0.0	25.7
11/05/71	10 ft below dam	22.5	0.0	22.5
08/22/73	10 ft from outfall	1.3	0.0	1.3
11/14/74	Outfall	1.7	0.0	1.7
11/14/74	1 ft above dam	17.1	0.1	17.8
11/14/74	50 ft below dam	13.7	0.2	13.9
12/05/75	10 ft from outfall	0.2	0.0	0.2
12/05/75	1 ft above dam	9.2	0.0	9.2
11/19/76	10 ft from outfall	0.2	0.0	0.2
11/19/76	50 ft from outfall	3.0	0.1	3.1
11/19/76	65 ft from outfall	26.7	0.3	27.0
11/19/76	250 ft from outfall	17.3	0.3	17.6
07/18/84	3 ft from outfall	0.3	0.0	0.3
07/18/84	30 ft from outfall	10.4	0.9	11.3
07/18/84	50 ft from outfall	16.7	2.3	19.0
09/12/85	30 ft from outfall	2.0	0.1	2.1
09/12/85	110 ft from outfall	26.6	4.8	31.4
09/12/85	230 ft from outfall	1.7	0.1	1.8

Quantities of explosives are given in weight percent (wt %). Surface samples were taken from the sediment. Most samples were taken along the center line of the drainage channel. Distances are approximate. The sampling technique and analytical method are described in Baytos 1972, 15-16-275. Data from Baytos (1970-1985, 15-16-278 to 15-16-268). Soil SALs: TNT = 40 ppm (0.004 wt %), HMX = 4 000 ppm (0.4 wt %), RDX = 64 ppm (0.0064 wt %), and barium = 5 600 ppm.

TABLE 5-23

HIGH EXPLOSIVES AND BARIUM IN SOILS AND WATER AT TA-16-260

SAMPLE	MEDIA	HMX/RDX	TNT	BARIUM
3	Sump water	0.3	33	4
19	Water	1.5	3	30
20	Soil	0.6	1	9

Data from Turner and Schwartz (1971, 15-16-284). All values in ppm. Soil samples represent 4-hour Soxhelt extractions. Soil SALs same as Table 5-22. Water SALs: HMX = 1.8 ppm, RDX = 0.00032 ppm, TNT = 0.0175 ppm, and barium = 1 ppm.

TABLE 5-24

HIGH EXPLOSIVES IN THE TA-16-260 DRAINAGE CHANNEL, BARR-KING DATA OF 1991*

SEDIMENT SAMPLE LOCATION	HMX/ RDX	TNT	TOTAL HE	BARIUM
1 ft from outfall	3.4	0.1	3.5	
20 ft from outfall	1.8	1.0	2.8	
40 ft from outfall	0.1	<0.1	0.1	
45 ft from outfall	2.9	<0.1	2.9	
50 ft from outfall, pond center line	4.9	<0.1	4.9	
60 ft from outfall, pond center line	6.4	0.1	6.4	
60 ft from outfall, north edge of pond	0.5	<0.1	0.5	
70 ft from outfall, pond center line	9.1	0.6	9.7	
70 ft from outfall, north edge of pond	19.0	2.0	21.0	
80 ft from outfall, pond center line	22.3	3.0	25.3	
90 ft from outfall, pond center line	26.7	2.0	28.7	
90 ft from outfall, 12 in. from north edge	7.6	<0.1	7.6	0.85
91 ft from outfall, pond center line	3.0	<0.1	3.0	0.43
91 ft from outfall, pond center line, 2 in. deep	7.6	<0.1	7.6	0.53
91 ft from outfall, pond center line, 8 in. deep	6.1	0.2	6.3	0.51
91 ft from outfall, pond center line, 13 in. deep	13.5	0.4	13.9	0.46
91 ft from outfall, 8 in. from edge, 13 in. deep	24.8	9.3	34.1	0.33
91 ft from outfall, 12 in. from edge, 13 in. deep	27.8	1.0	28.8	0.67
110 ft from outfall	7.6	0.3	7.9	
135 ft from outfall	2.3	<0.1	2.3	0.35
210 ft from outfall	4.4	<0.1	4.4	0.65

Quantities of explosives and barium are given in weight percent (wt %). Surface samples were taken from the sediment along the center line of the drainage channel, unless otherwise specified. Soil SALs same as Table 5-22.

* (King 1991, 15-16-381; and King 1992, 15-16-380).

TABLE 5-25

DAILY WATER TESTING FOR CONTAMINANTS IN HIGH EXPLOSIVES SUMPS, TA-16-260 OUTFALL*

DAY:	1	2	3	4	5	6	7	8	9	10	MEAN	STANDARD DEVIATION	SALs WATER (ppm)
pH	7.91	7.80	7.80	7.90	7.98	7.80	7.95	8.10	9.20	7.85	8.03	0.422	
Suspended solids	2.6	4.6	3.1	2.6	6.2	0.0	2.0	0.8	1.3	0.9	2.4	1.88	
TNT	0.06	0.0	0.0	0.02	0.0	0.04	0.0	0.0	0.01	0.19	.0.03	0.059	0.0175
RDX	2.25	0.0	0.03	0.02	0.0	0.34	0.0	0.04	0.03	1.19	0.39	0.751	0.00032
HMX	1.29	2.06	1.96	1.92	1.53	2.70	1.47	1.53	1.61	2.47	1.85	0.458	1.6
Acetone	nd	nd	nd	nd	nd	0.3	nd	0.1	0.2	0.1	-	-	3.5
MEK	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-	1.7
Bu-Ac	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-	
Toluene	nd	nd	nd	nd	nd	nd	7.7	0.1	nd	nd	-	-	0.75

* Baytos 1988, 15-16-266
Quantities are given in parts per million (ppm). Samples were taken on ten consecutive working days.
Mean and standard deviation computed by others.
nd: Not detected
MEK: Methyl ethyl ketone
Bu-Ac: n-Butyl acetate

5.3.2 Remediation Decisions and Investigation Objectives

Problem Statement (DQO Step 1)

The 13 sumps with a common outfall at TA-16-260 are all associated with HE processing activities. Archival data indicates extensive HE contamination is present, at levels as high as 30 wt% in soil. Other COCs include barium and other metals, uranium, semivolatiles, and volatiles. The primary goal of Phase I for these sumps will be to bound the region of contamination. A secondary goal is to detect PCOCs other than HE in those regions of this SWMU where HE contamination is minimal. All of these sumps are currently in active use. Their outfall has not been plugged, so the associated drain lines and their common outfall are also active. Current WX Division plans call for this drain line to be plugged by 1995 or at the latest by 1996. Field activities will be deferred until the drain line is plugged.

Sampling will be necessary to determine a boundary for the HE-contaminated zone. The extant information will be used to provide information for Phase II sampling plans, to proceed directly to a VCA followed by additional sampling, or possibly to proceed to a corrective measures study (CMS).

Since the sumps and their upstream feeder troughs are still in active use and the drain lines, in most cases, lie under paved areas, sampling will be confined to the outfall and drainage. Action on the sumps themselves and their associated drain lines will be deferred until decommissioning and decontamination.

Decision Process (DQO Step 2)

Based on the existing date, the highly contaminated central portion of the TA-16-260 drainage will undergo a VCA or CMS. A Phase I study will be conducted to determine which of the following should be recommended for the remainder of the TA-16-260 outfall: 1) Phase II study (if additional information is needed to bound HE-contaminated region); 2) VCA (if Phase I study provides enough data to select a viable and cost-effective remediation option); or, 3) CMS (if Phase I study provides enough data to determine nature and extent of contamination, but additional information on costs and treatment methods are needed before proceeding with remediation). A baseline risk assessment for this site is not deemed to be necessary, because existing data suggest a potential detonation hazard. Current operating procedures restrict worker access to this SWMU.

Possible remediation alternatives include: 1) removal of HE-contaminated soil to a permitted landfill after removal of sufficient HE at the TA-16 burning ground to eliminate any safety risk in transporting the soil off-site; 2) *in-situ* degradation of HE by composting; or, 3) thermal, chemical, or biological treatment of HE-contaminated waste followed by replacement of clean soil. Following remediation the area will be resampled to verify cleanup.

Fig. 5-25 illustrates the decision process.

5.3.3 Data Needs and Data Quality Objectives

Decision Inputs and Investigation Boundary (DQO Steps 3 and 4)

In Phase I, the decision process will be applied to the surface soils of the TA-16-260 outfall and the associated drainage located below the TA-16-260 outfall. In Phase I, the following questions will be addressed.

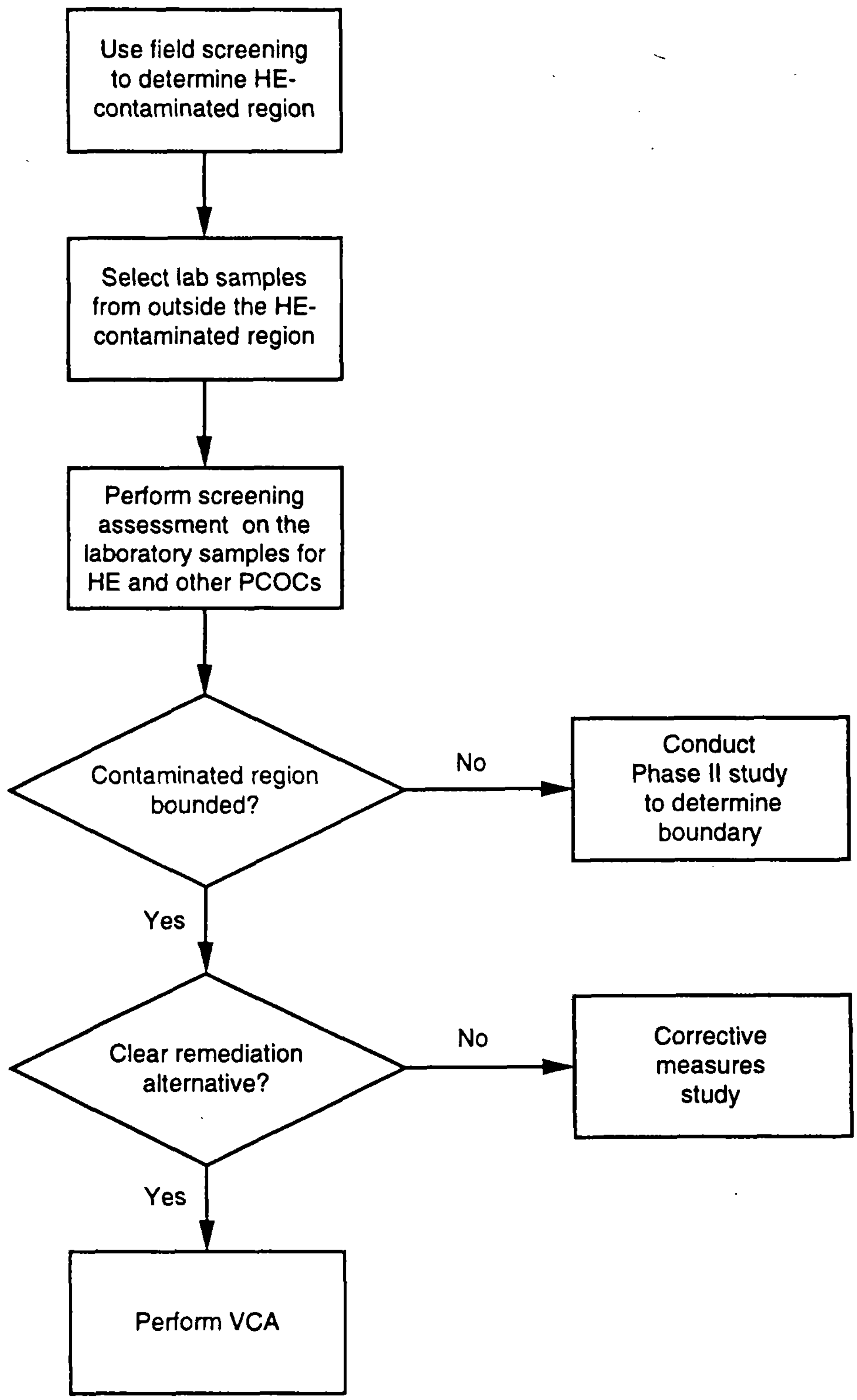


Fig. 5-25. Decision flow for TA-16-260 sumps.

1. How does the HE contamination vary in the TA-16-260 drainage and how far does it extend laterally and down the drainage?

2. Do the levels of semivolatiles, uranium, barium, or other metals differ from background, and if so, do they exceed SALs in the surface soils of the drainages associated with the TA-16-260 outfall in the area outside the HE-contaminated region, which will be remediated?

Additional questions regarding possible vertical transport of HE into the subsurface soils or into bedrock, and potential subsurface contamination from volatiles, semivolatiles, uranium, and other metals will be deferred until after VCA, due to the hazards of subsurface drilling in an area highly contaminated with HE.

The data needed to answer the first question are the concentrations of HE in the surface soils bounding the TA-16-260 drainage. The data needed to answer the second question are the concentrations of the other potential contaminants in the surface soils bounding the drainages. Surface contaminants will be assumed to be concentrated in the natural sediment traps of the drainage. The sampling will proceed downslope to Cañon de Valle, which will be sampled as described in Subsection 5.9.

The drainage channel for TA-16-260 is well defined, so lateral sampling is proposed at 5 ft from the drainage. The OU 1082 team considers it unlikely that contamination has reached a distance of 5 ft from the edge of HE-contaminated central drainage, but due to the magnitude of contamination in the site, the assumption will be verified.

Decision Logic (DQO Step 5)

The perimeter sample plan uses field screening to provide a bound on the HE-contaminated region, so laboratory samples directly outside the TA-16-260 drainage will be intended to confirm the absence of contamination outside the field-screened-clean region. The perimeter of the HE-contaminated region will be determined using a grid of HE field screening points, supplemented by additional field-screening points where needed to achieve negative HE spot tests. Laboratory samples will be taken outside the known HE-contaminated region. Based on the results of Phase I study, proceed as follows: 1) If the laboratory samples contain HE, barium, uranium, or other COCs at levels different from background and the sample maxima are above SALs, then initiate a Phase II study to further delineate the boundary of the HE-contaminated region; 2) if the HE-contaminated region has been bounded, perform VCA followed by cleanup verification monitoring within the remediated zone; and, 3) if sufficient information on the nature and extent of contamination is available, but additional data are needed prior to implementing remediation, perform a CMS. This study would involve feasibility studies focused on determining the most efficient, cost-effective, and safe method of remediating such a highly HE-contaminated area.

Design Criteria (DQO Step 6)

A 20 ft downslope spacing was selected for radiation and HE field screening, because such an interval roughly corresponds to a scoop distance for a small backhoe, which may be used during VCA. A 5 ft lateral spacing would detect contaminants transported from the well-defined central drainage during over-bank flooding events. The entire length of the drainage, from the outfall to Cañon de Valle, will be investigated, because existing data suggests that HE and barium discharged from TA-16-260 have reached Cañon de Valle.

Radiation screening: Radiation screening will be conducted to check for the presence of uranium. Based on the likely limited transport of uranium in the drainage (Becker et al. 1985, 0029) and the unlikely possibility of uranium discharge from TA-16-260, radiation field screening will be limited to the first 100 ft of the drainage during Phase I.

Surface samples: A perimeter sampling approach will be applied that combines measurements from HE field screening and analytical samples. Field screening will be applied as described in Subsection 5.3.4 to determine the edge of HE-contaminated area. Based on the results of HE field screening on a grid, 14 analytical samples will be taken outside the HE-contaminated region, as delineated by field-screening. A 100-ft interval for these laboratory samples should provide adequate coverage of the soils bounding the central drainage. These laboratory samples will be used to check for barium and for HE occurring at levels above SALs but below the limit of detection of the HE spot test. Additional samples will be taken where radiation field screening results yielded above background levels in order to examine the possible presence of uranium.

5.3.4 Sampling and Analysis Plans

The outfall from the sumps associated with machining building TA-16-260 are by far the most contaminated of any at S-Site (see Subsection 5.3.1.2.1).

The HE sumps described in this subsection are all active. In addition, the drain line for these sumps is in use, although WX-3 will soon plug the outfall (Barr 1992, 15-16-329). Thus, no sampling in the sumps or under and around the active drain line is proposed at this time.

SOPs that control field activities in this sampling plan are listed in Table 5-26. Sample numbers and necessary analyses are shown in Table 5-27. Field screening methods are described in Subsection 4.7. SOPs for field screening are currently in preparation.

TABLE 5-26

STANDARD OPERATING PROCEDURES FOR FIELD ACTIVITIES

LANL-ER-SOP	TITLE	NOTES
01.02, R0	Sample Containers and Preservation	Applied to all laboratory samples
01.04, R1	Sample Control and Field Documentation	Applied to all laboratory samples
06.11, R0	Stainless Steel Surface Soil Sampler	All 0 to 6 in. surface samples

5.3.4.1 Engineering Surveys

A detailed engineering survey is needed to delineate the boundaries of the drainage from the HE outfall accurately in the field, as well as to lay out sampling points for radiation screening, HE screening, and surface sampling along the channel boundaries.

All sample locations will be registered on a base map, scale 1:7 200. If, during the course of sampling, any sample points must be relocated, the new position will be resurveyed and the revised locations will be indicated

TABLE 5-27

SUMMARY OF SITE SURVEYS, SAMPLING, AND ANALYSIS FOR TA-16-260

PRS	PRS TYPE	Sampled Media	Laboratory Samples: Structure	Structure: Field dup	Surface	Surface: Field dup	Subsurface	Subsurface: Field dup	Field Screening: Gross Alpha	Gross Gamma/Beta	Organic Vapor	HE Spot Test	Geophysics Surface	Barium - LIBS	A: Geological Characterization	Field Lab.: Gross Alpha	Gross Gamma/Beta	Tritium	Volatile Organics	B: XRF	Soil Moisture	Laboratory Analyses: Alpha spectroscopy	Gamma spectroscopy	C: Beta spectroscopy	Total Uranium	Isotopic Plutonium	Isotopic Uranium	D: VOA (SW 8240)	E: Semivolatiles (SW 8270)	F: Metals (SW 6010)	G: PCBs (SW 8080)	H: High Explosives (SW 8330)	Cyanide
16-003(k)	HE sump	Sediments			14	1				30#		155#													14#				14#	14#		14#	14#
16-021(c)	HE sump outfall (a)	Sediments																															

(a) Both SWMUs are covered by the same sampling plan
A, B, C, G = not applicable; D, E, H = full suite; F = 1082 suite.
The actual number of points will depend on the results of the field screening as it defines the lateral boundaries of the contaminated area.

on the map. The engineering survey will be performed by a licensed professional under the supervision of the field team leader.

The field-screening points will be centered perpendicularly from the main drainage from the outfall behind TA-16-260 (Fig. 5-26). Points for field screening will be surveyed at 20 ft downstream intervals and 5 ft lateral intervals, for those areas where the drainage is wider than 5 ft, within the main channel downstream from the outfall egress point to Cañon de Valle. In addition, two points, spaced at 5 ft intervals, will be surveyed to the northeast and southwest of the edge of the main drainage channel and pond. The surveyed points will thus provide an approximately 31 x 5 ft grid for HE screening extending roughly 600 ft from the outfall to Cañon de Valle. Low-energy gamma radiation measurements for the detection of uranium and other radionuclides will be reported at the point surveyed above for a distance of 100 ft from the outfall at the grid intervals. Measurements will be examined for high values that would be used to guide the sampling described in the following sections. Field screening for HE (Baytos 1991, 15-16-339) will be performed at the points surveyed as described above. If positive HE or above-background radiation field-screening measurements are found in the points located at 10 ft from the drainage channel and pond, additional field-screened points, spaced at 5 ft intervals, will be surveyed and screened until the soils field screen as uncontaminated with HE or uranium. No field-screening for either HE or radiation will be done within the pond itself, because of the potential explosive risk to workers operating in this region. The goal of this HE field screening is to provide constraints on the downslope and lateral extent of the HE-contaminated region extending away from the central drainage channel and outfall to facilitate a VCA.

Thus, we will define a perimeter that bounds the highly HE-contaminated region using inexpensive field-screening techniques.

5.3.4.2 Sampling

Surface samples for laboratory analysis will be taken to investigate PCOC concentrations in areas abutting the channel, which is slated for VCA. Thus, if the environmental transport mechanisms for HE and other PCOCs such as barium are significantly different, there should be evidence of any other PCOCs that were transported from the channels. These laboratory samples

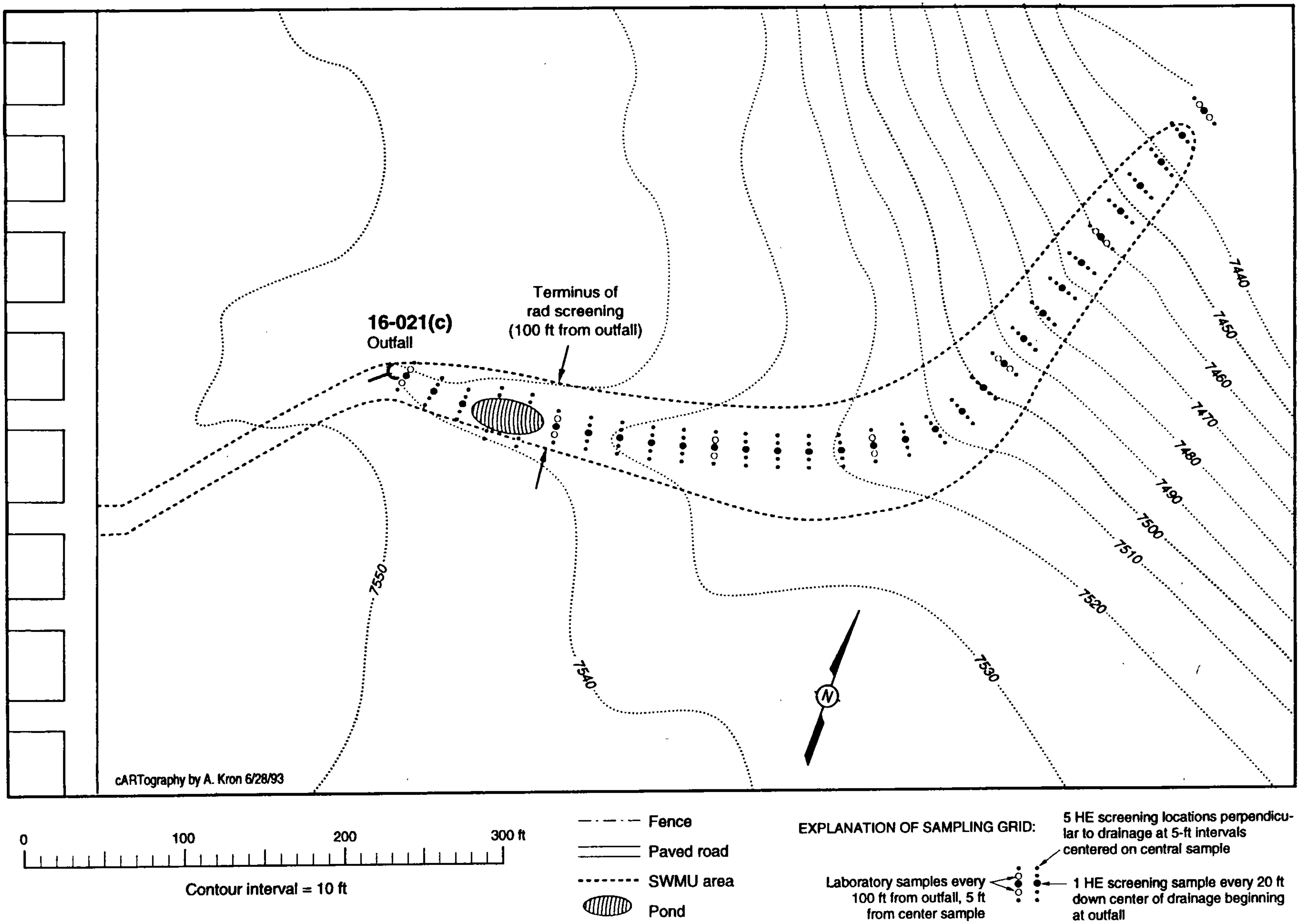


Fig. 5-26. Schematic TA-16-260 sampling grid.

will also provide quantitative information on any low-level HE contamination outside the drainage channels and information on any HE by-products outside the drainage channel. The laboratory surface samples will investigate HE levels in soils near the TA-16-260 outfall that may be present at a level between background and the detection limit for the HE screening.

After determination of the HE-contaminated region using the HE field spot test, laboratory samples will be taken at field-screening points at a distance of 5 ft from the edge of the main drainage on both the northwest and southeast of the drainage channel. These laboratory samples will be taken every 100 ft from the outfall point to Cañon de Valle, for a total of 14 samples. In addition, any points that yield positive results for radiation during the field surveys will be sampled for laboratory analysis. At all of these surface sampling locations, 0 to 6 in. of soil will be collected. The sampling strategy is delineated schematically in Fig. 5-26.

No subsurface sampling is proposed until after VCA, due to the hazards associated with drilling in regions highly contaminated with HE.

5.3.4.3 Laboratory Analysis

Full laboratory analyses of samples will be at Level III using the following methods: uranium (LANL or DOE method), VOCs (SW-846 Method 8240), SVOCs (SW-846 Method 8270), metals (SW-846 Method 6010), and HE and its by-products (SW-846 Method 8330). SOPs used in this sampling plan are listed in Table 5-26. The metal of particular concern for this sampling plan is barium; HE of principal concern are HMX, RDX, TATB, and TNT; HE by-products of concern are HE degradation products and HE impurities such as DNT, DNB, and TNB (See Appendix D).

5.3.4.4 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the latest revision of the IWP. Sampling parameters are summarized in Table 5-27, including a listing of appropriate QA/QC field duplicates planned to be collected during the course of the field investigations.

5.4 TA-11 and TA-16 Septic Systems Aggregate, SWMUs 11-005(a,b), SWMUs 13-003(a,b), and SWMUs 16-006(a,c,d,e)

5.4.1 Background

The following active septic systems, and one inactive system where the tank was probably removed, have been aggregated as a result of their common construction details, the character of the facilities that each serves or served (laboratory, process, office facilities), and the common sampling methods to be used. The inactive septic system [SWMUs 13-003(a,b)] includes a septic tank and drain field that were located in TA-13, now designated as part of TA-16. It should be stressed that all of these SWMUs were considered for deferred action including SWMU 13-003(a,b), which lies partially under an existing building. Our intent here, therefore, is to detect only significant and widely dispersed amounts of contaminants in these systems through a very nominal sampling approach prior to decommissioning and demolition (D&D). The concentration of potential contaminants in the septic drain field or outfall will be an indicator of the risk posed by the system. If contaminants are detected in the septic system, then further characterization or a VCA will be proposed prior to D&D.

5.4.1.1 Description and History

SWMU 11-005(a): TA-11-20. SWMU 11-005(a) is an active septic system to the south of TA-11-1 serving TA-11-4 and TA-11-1 since 1944 (Fig. 5-52). This septic system served the sinks and rest room facilities in TA-11-4 and a sink in TA-11-1. The TA-11-1 drain line is now capped and the only source from TA-11-4 is a rest room. As shown on Fig. 5-52, the septic system consists of drain lines from TA-11-4 and TA-11-1, a septic tank, and an open joint tile drain in an 18 in. rock-filled trench from the septic tank to the outfall. The discharge from the outfall is to a slightly sloped area of unconsolidated porous soil. Thus, potential contaminants from this outfall would be concentrated in the discharge area and/or under the open tile drain line.

TA-11-4, currently the control room for the vibration test facility located in TA-11-30, formerly housed a photoprocessing facility. TA-11-4 also contained a machine shop. A single 1950 K-Site safety inspection memo indicated that a mercury spill occurred in TA-11-4 (Ogle 1950, 15-11-011). The exact location, source, and extent of the spill are not known.

TA-11-1, currently a storage area for electronic equipment, formerly served as a control room for buildings TA-11-2 and TA-11-3.

It should be noted that all HE formulation, casting, pressing, and machining was, and continues to be, performed at the main TA-16 HE area. Therefore, no HE or its detonation, burn, or decomposition by-products are expected in any TA-11 building, drain, septic system or associated outfall.

SWMU 11-005(b): TA-11-43. SWMU 11-005(b) is an active septic system constructed in 1963 that serves only the rest room facility added to the exterior of TA-11-3; only sanitary waste is expected from this rest room. As shown on Fig. 5-52, the septic system consists of a drain line from TA-11-3 to a septic tank, a drain line from the tank to an outfall, and a leach field to the west of the drain line. While no engineering as-built drawings have been found, site personnel recall that some drains in TA-11-24 were also connected to this septic tank. Formerly housing the air gun facility, TA-11-24 currently contains offices and a small machine shop. For a detailed description of the air gun facility see Subsection 6.2.1. Both the air gun and machine shop activities at TA-11-24 could have produced contaminants that entered this septic system.

The outfall discharges to a slightly sloped area consisting of porous soil. Thus, potential contaminants from this outfall would be concentrated in the area of the discharge opening and/or the leach field.

SWMU 13-003(a). SWMU 13-003(a) is a decommissioned septic tank, TA-13-12, that served TA-13 (P-Site) during the 1940s and early 1950s (Fig. 5-9). This tank served P-1, an office and shop building associated with early implosion and initiator testing. It was then decommissioned and removed in 1951 (LANL 1990, 0145). Engineering drawing, ENG-C 1641 Sheet 1 of 7, shows the location of the septic tank at about 100 ft north of P-1, formerly designated TA-16-475. However, the entire area was leveled in the early 1950s when the 340 complex was built. Portions of the 340 complex were built on top of the original location of the septic tank. The location of the removed septic tank was northeast of TA-16-343. Specific details on the removal of this tank and possible contamination, as well as possible contamination from its drain field, are unavailable (LANL 1990, 0145). A report states that either HE or radionuclide contamination might be present in the subsurface soil of the adjacent area (Buckland 1948, 15-13-011). The types of liquid wastes discharged to this tank are unknown. Engineering drawing, ENG-C 1642 Sheet 2 of 7, shows that building P-1 had a toilet, lavatory, and small darkroom adjacent to the sewer hookup. Information on possible releases from the tank and its associated drain field, SWMU 13-003(b), is unavailable.

SWMU 13-003(b) is the drain field associated with the septic tank (TA-13-12) (Fig. 5-9). According to construction drawings, ENG-C 1641 Sheet 1 of 7, the drain field is approximately 100 ft northeast of the septic tank. The drain field allowed the contents of the septic tank to discharge through 4-in. vitreous clay tile and leach into the soil beneath the drain lines. The Engineering drawing ENG-R 5111. Sheet 2 of 7, indicates the removal of the septic tank but does not indicate removal of the drain field.

SWMU 16-006(a) was a 10 x 5 ft reinforced-concrete septic tank, TA-16-175, with a 500-gal. capacity (Fig. 5-1). There is a 4-in. diameter vitreous clay pipe from TA-16-54 to the septic tank. The septic tank was constructed in 1946 and replaced some time in 1988; the drain line was abandoned in place (drawing ENG-C 45512). The original tank served TA-16-54, formerly a barium nitrate grinding facility. No drawings have been found that show what drains and fixtures the original septic tank served. The building was used as an environmental testing laboratory in the late 1950s but these activities were discontinued in 1988. The environmental laboratory contained various physical testing machines including a vibration table as well as shock-testing and drop-impact machines. Various weapons and non-weapons components, some of which may have contained hazardous materials, were tested at this facility. The OUPL believes it is possible that common organics used for lubrication and cleaning may have entered the septic system. An environmental survey of TA-16-175 (November 1988) detected volatiles, but did not detect EP toxic metals (LANL 1990, 0145).

SWMU 16-006(c) is a 1 200-gal., reinforced-concrete septic tank, TA-16-371, with its associated drain field (LANL 1990, 0145) (Fig. 5-7). This system was installed in 1953. In a phone interview with Lynn Parkinson (WX-3), Weston personnel document in the CEARP Report that TA-16-370 originally functioned as a barium nitrate facility but was later converted to carbon steel, stainless steel, and aluminum metal forming in the late 1950s (DOE 1987, 0264; Palmer and Abercrombie 1991, 15-16-366). A 1971 memo indicates that at that time, trichloroethylene and acetylene were being used in the building served by this system. (Panowski and Salgado 1971, 15-16-038). The tank served six floor drains, three water closets, and two lavatories on the third floor (LANL 1991, WX Outfall Drawing 13Y-192147). These units are connected to a common line that empties into manhole TA-16-831, which then drains into the septic tank. A 4-in. vitreous-clay pipe drain line empties to daylight at the canyon rim approximately 260 ft south of the septic tank. The outfall drains to a soil/cobble surface for a few feet before going into the canyon.

SWMU 16-006(d) is a 540-gal., reinforced-concrete septic tank with associated drain lines, distribution box, and tile drain field; it was constructed in 1952 (LANL 1990, 0145) (Fig. 5-7). This system serves TA-16-380, a high explosives inspection building. The tank serves five floor drains, two lavatories, two water closets, and one deep sink on the first floor (LANL 1991, WX Outfall Drawing 13Y-192091).

SWMU 16-006(e) is a 385-gal. steel septic tank that was constructed in 1963. It has an associated drain field and outfall which serves TA-16-389, a control shelter at the burning ground (Fig. 5-34). The septic tank serves a water closet, lavatory, and a floor drain (Engineering drawing ENG-C 23442, Sheet 2 of 4). Large quantities of HE and barium are processed through this area. Drawing ENG-C 23442 indicates that the outfall is associated with the overflow line from the tank.

5.4.1.2 Conceptual Exposure Model

The conceptual exposure model for this aggregate is presented in Chapter 4, Fig. 4-7. Subsection 5.4.1.2.1 presents the potential sources of contamination and PCOCs. PRS-specific information on migration pathways and potential receptors is discussed in Subsection 5.4.1.2.2.

5.4.1.2.1 Nature and Extent of Source

Table 5-28 summarizes the PCOCs for this aggregate. In all cases, the list of potential contaminants and the volume of potentially-contaminated soil are unknown. Most of the septic systems had an outfall which had low flow.

SWMU 11-005(a). Potential contaminants from photoprocessing activities include organics, silver, and cyanide. Potential contaminants from the machining activities include organic cleaning agents, cutting oils, and metals. Residual mercury from the spill is another potential contaminant.

SWMU 11-005(b). Potential contaminants from TA-11-24 activities include organic cleaning agents, cutting oils, and metals used in routine machine shop activities.

SWMUs 13-003(a,b). The principal PCOCs for SWMUs 13-003(a,b) are HE and their decomposition products, barium, radionuclides, and photographic chemicals (silver and cyanide).

SWMUs 16-006(a,c). The principal PCOCs for SWMUs 16-006(a,c) are barium, volatile organics, and semivolatile organics.

SWMUs 16-006(d,e). The principal PCOCs for SWMUs 16-006(d,e) are HE and volatile organics. Large amounts of barium nitrate were processed through the burning ground area, so barium is a PCOC at SWMU 16-006(e).

5.4.1.2.2 Potential Pathways and Exposure Routes

The septic systems are located in portions of TA-11 and TA-16 that have no public access. The constituents do not pose a current public health risk. The site will continue to be used as an industrial (research and development) facility for the foreseeable future. It is possible that the site may eventually be transferred for recreational use. Future receptors could include construction workers and recreational users. A general discussion of the migratory pathways, conversion mechanisms, potential human receptors, and exposure routes is presented in Chapter 4.

Subsurface components of septic systems (septic tank, drain lines and the drain field) may potentially release constituents to the surrounding soils

TABLE 5-28

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, TA-11 AND TA-16 SEPTIC SYSTEMS AGGREGATE

PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	HE: UNDETONATED HE	HE: HE DETONATION PRODUCTS	HE: HE DEGRADATION PRODUCTS	HE: HE BURN PRODUCTS	RAD: URANIUM	METALS: METALS SUITE	METALS: SILVER	METALS: BARIUM	METALS: MERCURY	ORGANICS: VOLATILES	ORGANICS: SEMIVOLATILES	ORGANICS: CYANIDE
11-005(a)	Septic system serving Buildings TA-11-1 and -4 (drain lines, septic tank, drain field, outfall)	Machine shop, photoprocessing laboratory, mercury spill	Y						x	x		x	x	x	x
11-005(b)	Septic system serving Building TA–11-3 (drain lines, septic tank, drain field, outfall)	Air gun, machine shop	Y						x				x	x	
13-003(a)*	Septic tank, TA-13-12, serving Building TA-16-475	Implosion/initiator testing, shop activities	N	x	x	x	x	x	x	x	x		x	x	x
13-003(b)*	Drain field associated with septic tank, TA-13-12	Implosion/initiator testing, shop activities	N	x	x	x	x	x	x	x	x		x	x	x
16-006(a)	Septic system serving Building TA–16–54 (original septic tank TA–16-175 replaced, new tank, old and new drain fields)	Barium nitrate grinding facility	Y								x		x	x	
16-006(c)	Septic system (drain lines, septic tank TA-16-371, drain field, outfall)	Barium nitrate facility/steel and aluminum forming facility	Y								x		x	x	
16-006(d)	Septic system serving Building TA–16-380 (drain lines, septic tank, drain field, distribution box)	High explosives inspection facility	Y	x		x							x		x
16-006(e)	Septic system serving Building TA–16-389 (drain lines, septic tank, drain field, outfall)	Burning ground control shelter	Y	x		x					x		x		x

*Components of the same septic system.

through leaks or cracks in the pipes and structures. The highest PCOC concentrations are expected to be in the drain field and/or outfall. Surface soil may be contaminated around the outfalls from tank or drain field overflow. Once contaminants are released into the environment they can potentially migrate into the surrounding soils.

5.4.2 Remediation Decisions and Investigation Objectives

Problem Statement (DQO Step 1)

Historical activities at TA-11 and TA-16 may have resulted in release of PCOCs into septic systems. The main problem is to quantify the concentration of PCOCs in these systems. Based on the design of the septic systems, it is expected that the highest concentrations of PCOCs will occur in the drain fields or outfalls. All of these septic systems are currently active with the exception of SWMUs 13-003(a,b). The septic tank [SWMU 13-003(a)] may have been removed when TA-16-340 was built in 1951, but the drain field [SWMU 13-003(b)] was left in place. Thus, it is not practical to sample the soil surrounding the septic tank, but the drain field and/or outfall for each septic system can be sampled.

Decision Process (DQO Step 2)

The Phase I environmental data will lead us to one of four actions: 1) propose NFA for the septic system, 2) conduct a baseline risk assessment, 3) perform a VCA, or, 4) collect additional data in a Phase II environmental survey to better quantify the risk or understand the cost consequences of a VCA. Data that represent the drain fields and outfalls will be the primary determinant for selecting an action. The SAL will be used as a trigger value for the NFA option. Additionally, if any PCOC concentration is measured above SAL, then a Phase II survey will be conducted that will collect subsurface soil samples around the septic tank.

5.4.3 Data Needs and Data Quality Objectives

Decision Inputs (DQO Step 3)

Data on PCOCs for the soils and tuff associated with the septic tank drain fields and outfalls are needed to evaluate whether concentrations are different from background or below SALs. Concentrations of potential contaminants will be measured by a method in which the detection limit is less than the SAL (see Table 5-28 for a list of PCOCs).

Investigation Boundary (DQO Step 4)

Samples will be taken to represent the drain field and the outfall. Some septic systems include a subset of these components, but all systems include a septic tank and a drain field or outfall (see Table 5-28 for a list of the components in each septic system).

Subsurface cores will be collected a minimum of 2.5 ft into bedrock. These cores will represent the concentration in the drain field. The highest PCOC concentrations should occur at either near the backfill-bedrock interface or in the backfill just below the drain line (McLin 1989, 15-16-405). The cores will be taken as close as possible to active lines, and will go through inactive lines. The drain lines probably rest in a bed of backfill. Segments of the core will be submitted for full laboratory analysis of PCOCs to represent the health risk posed by the core.

The septic system outfalls have very low flow, which implies that PCOCs should be confined to the soil adjacent to the outfall.

Decision Logic (DQO Step 5)

If the concentrations are less than the SALs, then NFA will be proposed. If concentrations are equal to or greater than the SAL, then a baseline risk assessment will be conducted. If Phase I sampling detects concentrations above the SAL, then either additional Phase II samples will be collected at the tank to evaluate the extent of the contamination or a VCA will be proposed prior to D&D.

Design Criteria (DQO Step 6)

The proposed septic system sampling plan is designed to detect potential contaminants in the two most likely areas: the drain field and the drain field outfall (Fig. 5-27). Samples collected for the drain field or outfall will be indicators for possible actions for the entire septic system. Because there are no existing data for these systems, the approach for both drain fields and outfalls will be reconnaissance sampling. Reconnaissance sampling relies on being able to bias the samples sent for full laboratory analysis by

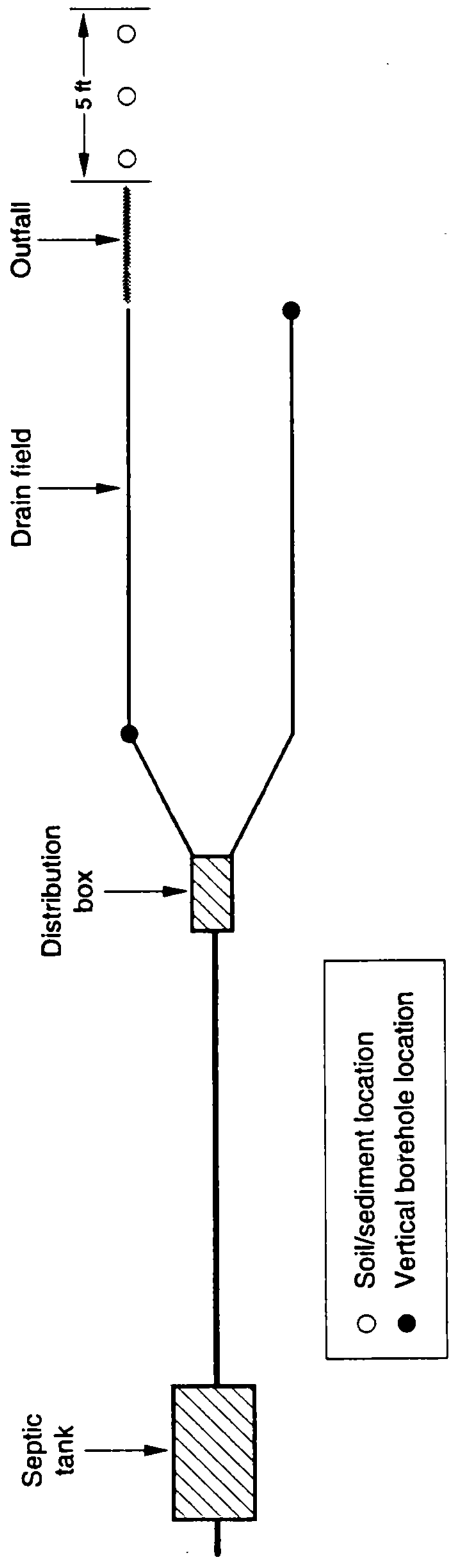


Fig. 5-27. Generic septic system sampling locations for Aggregate 5.4.

field screening, the mobile laboratory, or a physical understanding of the distribution of PCOCs. An understanding of septic system operation is used to bias borehole locations. Field screening will bias sample collection for laboratory analysis. If field screening yields no positives, then use the soil-bedrock interface to represent PCOC concentration in the soil core.

The main design question is to determine the number and placement of boreholes in the drain field to meet the Phase I screening objectives. The purpose of the distribution box was to uniformly distribute flow and, therefore, potential contaminants over the drain field. Thus, the most likely case is that potential contaminant concentrations would be uniform laterally (and perhaps horizontally). The most likely exception to a uniform distribution is that potential contaminant concentrations would be greater at either the proximal or distal end of the drain field (near or far from the distribution box). Such deviations from a uniform distribution could be due to variation in flow rate. Thus, boreholes should be drilled at both ends of the drain field to detect these likely deviations. Boreholes will be drilled adjacent to the drain field lines to maximize the probability of finding potential contaminants at either end of the drain field. Blockages in the drain field lines would disrupt potential contaminant flow, but these septic systems have simple drain fields with a maximum of two lines in the drain field. A blockage in such a simple system should create an obvious swampy area. If such an area is observed during sampling activities, the proposed core nearest the swampy area may be moved to the swampy spot. All of the single drain line systems had an outfall, which will also be sampled (Fig. 5-27). Two laboratory analyses per borehole are recommended, which will result in a total of four full laboratory analyses per drain field. Four analyses may also be adequate to drive a baseline risk assessment. The portion of the soil core sent for full laboratory analysis will be based on field screening of each 6-in. core segment. A positive field screening reading for HE is based on the HE spot test, and a positive reading for volatiles is based on the photoionization detector (PID). A positive reading for radioactivity or metals is based on observing an above-background level. If no positive readings for HE, radioactivity, volatiles, or metals are recorded, then the soil-bedrock interface and the soil adjacent to the drain line will be sent for laboratory analysis. The first positive reading will replace the sample adjacent to the drain line, and the second positive reading will replace the soil-bedrock sample. If more than two positive samples are observed, then all positive samples will be analyzed by the mobile laboratory and the highest two values will be sent for full laboratory analysis.

PCOCs released through the drain field outfall sampling are not expected to travel far from the end of the pipe. Little flow went through these lines to the outfalls, and there are no other drivers for contaminant movement (no outfall is in a storm water runoff drainage). Three boreholes will be taken for each outfall: one proximal to the outfall, and two downstream in sediment traps (or other parts of the drainage where sediment may collect).

5.4.4 Sampling and Analysis Plan

SOPs that control field activities in this sampling plan are listed in Table 5-29. Sample numbers and required analysis are shown on Table 5-30.

TABLE 5-29

STANDARD OPERATING PROCEDURES FOR FIELD ACTIVITIES

LANL-ER-SOP	TITLE	NOTES
01.02, R0	Sample Containers and Preservation	Applies to all laboratory analytical samples
01.04, R1	Sample Control and Field Documentation	Applies to all laboratory analytical samples
06.11, R0	Stainless Steel Surface Soil Sampler	Applies to surface soil sampling
04.01, R0	Drilling Methods and Drill Site Management	Applies to core drilling
12.01, R0	Field Logging, Handling, and Documentation of Borehole Materials	All core samples, soil and lithologic logging

5.4.4.1 Engineering Surveys

The SWMUs in the septic system aggregate will be field surveyed, which will consist of site engineering (geodetic) mapping and geomorphologic mapping. Site mapping is required to accurately record the location of the SWMUs. In the field, the engineering survey will locate, stake, and document the location of the SWMUs. Sample locations will be registered on a base map, scale 1:7 200. If during the course of sampling, any sample points must be relocated, the new position will be surveyed and the revised locations will

TABLE 5-30

SUMMARY OF SITE SURVEYS, SAMPLING, AND ANALYSIS FOR SEPTIC SYSTEMS AGGREGATE

PRS	PRS TYPE	Sampled Media	Laboratory Samples								Field Screening							Field Lab.						Laboratory Analyses											
			Structure		Surface		Sub-surface										A					B				C				D	E	F	G	H	
				Field dup		Field dup	Cores	Samples per core	Total	Field dup	Gross Alpha	Gross Gamma/Beta	Organic Vapor	HE Spot Test	Geophysics Surface	Barium - LIBS	Geological Characterization	Gross Alpha	Gross Gamma/Beta	Tritium	Volatile Organics	XRF	Soil Moisture	Alpha spectroscopy	Gamma spectroscopy	Beta spectroscopy	Total Uranium	Isotopic Plutonium	Isotopic Uranium	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCBs (SW 8080)	High Explosives (SW 8330)	Cyanide
11-005(a)	Septic system	Soil/tuff			3*		2	2	4				7#		x						7#	7#			7**					4	7**	7**			7**
11-005(b)	Septic system	Soil/tuff			3*		2	2	4				7#		x						7#	7#			7**					4	7**	7**			
13-003(a,b)	Drain field	Soil/tuff					3	2	6	1		6#	6#	6#	x	6#					6#	6#			6**		6**			6	6**	6**		6**	6**
16-006(a)	Septic system	Soil/tuff					2	2	4				4#		x	4#					4#	4#			4**					4	4**	4**			
16-006(c)	Septic system	Soil/tuff			3*	1	2	2	4	1			7#		x	7#					7#	7#			7**					4	7**	7**			
16-006(d)	Septic system	Soil/tuff					2	2	4				4#	4#	x						4#	4#			4**					4		4**		4**	4**
16-006(e)	Septic system	Soil/tuff			3*		2	2	4	1			7#	7#	x	7#					7#	7#			7**					4		7**		7**	7**

* Or one composite sample if field screening suggests no PCOCs are present.
** Or five total samples if field screening suggest no PCOCs present in outfalls.
# The number of field-screening samples for subsurface will depend on the depth to bedrock.
A, C, G = not applicable; D, E, H = full suite; D volatile samples in subsurface samples only; F =silver, mercury, barium.

be indicated on the map. The engineering survey will be performed by a licensed professional under the supervision of the field team leader.

Geomorphologic mapping will provide an accurate picture of where outfall sediment sampling locations should be placed. The geomorphologic survey will consist of the mapping of the first-order stream channels downslope of any identified drain outfall. The geomorphologic mapping will verify the existence of the suspected outfalls and will facilitate the selection of outfall sediment sample collection points for all outfalls.

5.4.4.2 Geophysical Surveys

If necessary, geophysical surveys will be conducted to precisely determine the boundaries of the septic tanks, distribution boxes, or drain lines. The Geosciences Technical Team will provide guidance as to the appropriate geophysical methods. Once located, the sites will be surveyed in and permanently marked in the field and the data registered on the base map scale 1:7 200.

5.4.4.3 Sampling

Drain fields. All drain fields will be sampled by drilling two vertical core holes, one installed at the proximal end and one at the distal end of the drain field (Fig. 5-27). These core holes will be advanced at least 2.5 ft into bedrock. At SWMU 13-003(b), the decommissioned system, three cores will be taken.

Each core will be field screened at 0.5 ft intervals for HE by swipe, radioactivity by field instrument for detection of low-energy radiation (FIDLER), volatiles by PID, and metals by x-ray fluorescence (XRF) or laser-induced breakdown spectroscopy (LIBS). This screening will be performed to guide the selection of samples submitted for laboratory analysis. Field screening methods are described in Subsection 4.7 of this work plan.

The two highest field screening readings compared to soil SALs will dictate the selection of two analytical samples for each core. If the screening of the core results in negative results, then analytical samples will be removed from the cores 0.5 ft straddling the soil-bedrock interface and 0.5 ft at the interval adjacent to the drain lines.

Outfalls. Three sediment/soil samples (0 to 6 in.) will be collected at each outfall (Fig. 5-27). At SWMUs 11-005(a), 11-005(b), and 16-006(c) the first sample will be taken immediately below the outfall, the second and third samples will be taken at a distance of 2.5 ft and 5 ft down the drainage from the outfall. At SWMU 16-006(e) the overburden that has hidden the drain line will first be excavated to expose the outfall. The excavation will be only as deep as needed to access the soil level immediately beneath the outfall and will extend at this depth laterally down the drainage for a distance of 5 ft. The exposed soil layer will be the starting position for the collection of 6-in. deep sediment/soil samples. As for the other outfall SWMUs in this aggregate, a total of three soil samples equally distributed from the outfall to 5 ft down the drainage will be gathered.

Each sediment/soil sample will be field screened for HE by swipe, radioactivity by FIDLER, and metals by XRF or LIBS. This screening will be performed to guide the selection of samples submitted for laboratory analysis.

If field screening results in positive indications for HE, radionuclides, or barium (> SAL by XRF) in any sample, then all three samples at an outfall will be submitted for laboratory analysis. Otherwise, the three samples will be composited and submitted for laboratory analysis.

5.4.4.4 Laboratory Analysis

Laboratory analyses of samples will be at Level III for radionuclides (LANL or DOE method), metals (SW-846 Method 6010), VOCs (SW-846 Method 8240), SVOCs (SW-846 Method 8270), and HE (SW-846 Method 8330). The principal radionuclides of concern are uranium isotopes, the principal VOCs are hydrocarbon solvents, and the metals of concern are barium, mercury, and silver. Cyanide is also of concern.

5.4.4.5 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the latest revision of the IWP (LANL 1992, 0768). Any QA/QC duplicate samples that are to be collected during the course of the field investigation are outlined in Table 5-30.

5.5 Materials Testing Laboratory, SWMU 16-021(a)

5.5.1 Background

The materials testing laboratory aggregate consists of SWMU 16-021(a).

5.5.1.1 Description and History

SWMU 16-021(a) is associated with TA-16-450 (Fig. 5-8), a materials testing laboratory, and is an area where metals are suspected to have been released to ephemeral stream channel sediments and soils. The facility currently has a discharge drain that opens east of the facility to a small, overgrown, gently sloping area. Visual inspection of the area surrounding the discharge point indicates that, although the drain is still open, it has not been actively used for some time. Recent visual inspection of the facility has revealed oil stains on the concrete near the drain opening in the floor.

In 1950, the facility was commissioned to be built to house electroplating operations. Early in 1951, the design criteria for the building were revised. Although it is not clear from historical change orders if the building was designated as an electroplating facility, the information contained within these documents suggests that the intended purpose of the building had been revised.

The change order included modifications to allow access for heavy equipment and the electrical equipment for the operating bay was designated for general purpose use only (Wilson 1951, 15-16-390). This electrical layout is not considered adequate to support the type of equipment employed in electroplating operations. This change order also required heated and forced air and space for the future installation of humidity control equipment. According to a March 6, 1951, review of preliminary plans for TA-16-450 sufficient fresh air was provided to permit future installation of exhaust equipment, such as that required by spray paint booths (Wilson 1951, 15-16-390). The revised design criteria also stated that an eye washer and Bradley washers were not required in the operating bay. This further suggests that the purpose of the facility had been redesignated.

Richard J. Daly began working as a staff member with Laboratory Group GMX-3 at S-Site in 1956. He was promoted to Deputy Group Leader of WX-3 in 1977, and to Group Leader in 1980. GMX-3 (later WX-3) was technically and administratively responsible for TA-16-450 (Griffin 1992, 15-16-341). According to Daly, TA 16-450 was built as a chemical engineering laboratory, but was never used for that purpose. In addition, Daly states that electroplating operations were never conducted in the facility. It is common knowledge that for many years this building functioned as a materials testing laboratory.

5.5.1.2 Conceptual Exposure Model

The relevant conceptual exposure model is presented in Fig. 4-3. Site-specific information on potential release sources, chemicals of concern, migration pathways, and potential receptors is presented below.

5.5.1.2.1 Nature and Extent of Contamination

The extent of the area potentially affected by discharges to the environment is unknown. Table 5-31 summarizes the PCOCs for this aggregate. The principal source of chemical release to the environment is the potential historical and possible recent discharge of chemicals to the drain. It is highly unlikely that this facility was ever used for electroplating, but discharges from a facility of this nature may have included metals, cyanide, and acids from electroplating operations. Assuming that the facility was used as a chemical engineering laboratory, a paint shop, and as a materials testing laboratory; then paints, paint solvents, and machine oils may be present as contaminants.

5.5.1.2.2 Potential Pathways and Exposure Routes

Any chemicals released via this drainage system could have been further transported by storm water into the drainages and bound to the sediments. Although paint solvents could have volatilized into the atmosphere, there is some possibility that discharges may have reached the subsurface environment. The area at the mouth of the outfall is overgrown. Thus, the current transport of released chemicals downstream would be mitigated. It is possible that the character of this area may have changed since construction, when soils may have been exposed. No stream channel has been cut into the soils, so it is reasonable to expect that large volumes of waste have not been discharged via this drain system.

TABLE 5-31

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, MATERIALS TESTING LABORATORY AGGREGATE

				METALS	ORGANICS		
PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	METALS SUITE	VOLATILES	SEMIVOLATILES	CYANIDE
16-021(a)	Building TA-16-450, laboratory	Materials testing	N	X	X	X	X

Because the waste outfall area is overgrown, the potential for wind or water erosion is remote. In addition, these conditions mitigate the potential exposure to current on-site workers. SWMU 16-021(a) is located within a highly-industrialized area and land use in the foreseeable future is likely to continue to be industrial. Chapter 4 of this RFI work plan contains a detailed discussion of exposure routes that may be associated with recreational use of the site should it ultimately be released.

5.5.2 Remediation Decisions and Investigation Objectives

Problem Statement (DQO Step 1)

The available historical data indicate that the probability of significant discharges to the environment was low. However, a Phase I investigation will be required to determine the type and magnitude of PCOCs in the sediments and soils on site. This information will be used to evaluate whether concentrations of chemicals at the site exceed SALs.

Decision Process (DQO Step 2)

Determine if the PCOCs for the discharge at the site are different from background or above SALs. If not different, then propose NFA. If PCOCs are at background or are all below SALs, then propose NFA. If PCOCs exceed the SALs, a Phase II investigation will be initiated to resolve any PCOCs above background.

5.5.3 Data Needs and Data Quality Objectives

Decision Inputs (DQO Step 3)

Data on PCOCs for the site sediments and soils are needed to evaluate if their concentrations are different from background or below SALs. These data will be obtained by broad spectrum analytical methods to provide for the greatest possibility of determining known PCOCs or identifying additional PCOCs.

Investigation Boundary (DQO Step 4)

No visible stream channel has been cut into the soils at SWMU 16-021(a). Therefore, it is unlikely that large discharges of liquids have been introduced to the environment via this drain system. Thus, the principal area of concern is considered to be next to the waste outfall mouth. Soil and sediment will be taken in the Phase I investigation at the outfall. Note that the drainage downstream from this operational release outfall will be sampled as part of the sampling plan for SWMU 16-029(g) (see Fig. 5-24).

Decision Logic (DQO Step 5)

The maximum concentration identified in the soil samples will be used to compare to background and SALs for metals, cyanide, semivolatiles, and solvents.

If all potential contaminant concentrations in all samples overlap background, then NFA can be proposed. If the concentration of each potential contaminant, in all samples is below the SAL, then NFA or DA can be proposed. If the sample concentrations exceed the SALs, a Phase II investigation must be performed.

Design Criteria (DQO Step 6)

The soil and sediment sample will be biased (i.e., located at an outfall mouth which is a diffuse area with no well-defined drainage) and will reflect the area most likely to contain PCOCs. For this reason, reconnaissance sampling will be used for the soil surrounding the outfall.

5.5.4 Sampling and Analysis Plan

SOPs that control field activities in this sampling plan are listed in Table 5-32. Sample numbers and required analysis are shown on Table 5-33.

TABLE 5-32

STANDARD OPERATING PROCEDURES FOR FIELD ACTIVITIES

LANL-ER-SOP	TITLE	NOTES
01.02, R0	Sample Containers and Preservation	Applies to all laboratory analytical samples
01.04, R1	Sample Control and Field Documentation	Applies to all laboratory analytical samples
06.10, R0	Hand Auger and Thin-Wall Tube Sampler	Applies to augered soil samples

TABLE 5-33

SUMMARY OF SITE SURVEYS, SAMPLING, AND ANALYSIS FOR MATERIALS TESTING LABORATORY

		Laboratory Samples							Field Screening							Field Lab.						Laboratory Analyses										
PRS	PRS TYPE	Sampled Media	Structure	Structure Field dup	Surface	Surface Field dup	Subsurface	Subsurface Field dup	Gross Alpha	Gross Gamma/Beta	Organic Vapor	HE Spot Test	Geophysics Surface	Barium - LIBS	Geological Characterization A	Gross Alpha	Gross Gamma/Beta	Tritium	Volatile Organics	XRF B	Soil Moisture	Alpha spectroscopy	Gamma spectroscopy	Beta spectroscopy C	Total Uranium	Isotopic Plutonium	Isotopic Uranium	VOA (SW 8240) D	Semivolatiles (SW 8270) E	Metals (SW 6010) F	PCBs (SW 8080) G	High Explosives (SW 8330) H	Cyanide
16-021(a)	Outfall	Sediment					1	1																				1	1	1			1

A, B, C, G, H = not applicable; D = full suite ; E = full suite (includes total petroleum hydrocarbons); F = 1082 suite

5.5.4.1 Engineering Surveys

SWMU 16-021(a) will be field surveyed, which will consist of site engineering mapping. Site mapping is required to accurately record the location of the SWMU. In the field, the engineering survey will locate, stake, and document the location of the SWMU. Sample locations will be registered on a base map, scale 1:7200. If during the course of sampling, any sample points must be relocated, the new position will be surveyed and the revised locations will be indicated on the map. The engineering survey will be performed by a licensed professional under the supervision of the field team leader.

5.5.4.2 Sampling

One hand-augered sample hole will be bored at SWMU 16-021(a) and will be located at the mouth of the waste outfall (Fig. 5-28). The hole will be cored to a depth of 18 in. or the soil-tuff interface, whichever is encountered first.

A sufficient volume of soil will be removed from the entire length of the core to yield 500 ml. This 500 ml analytical sample will be submitted for laboratory analysis for volatiles, semivolatiles, metals, and cyanide.

5.5.4.3 Laboratory Analysis

Laboratory analyses of samples will be full metals suite (SW-846 Method 6010), VOCs (SW-846 Method 8240), and semivolatiles (SW-846 Method 8270).

5.5.4.4 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the latest revision of the IWP (LANL 1992, 0768). Any QA/QC duplicate samples planned to be collected during the course of the field investigation are outlined in Table 5-33.

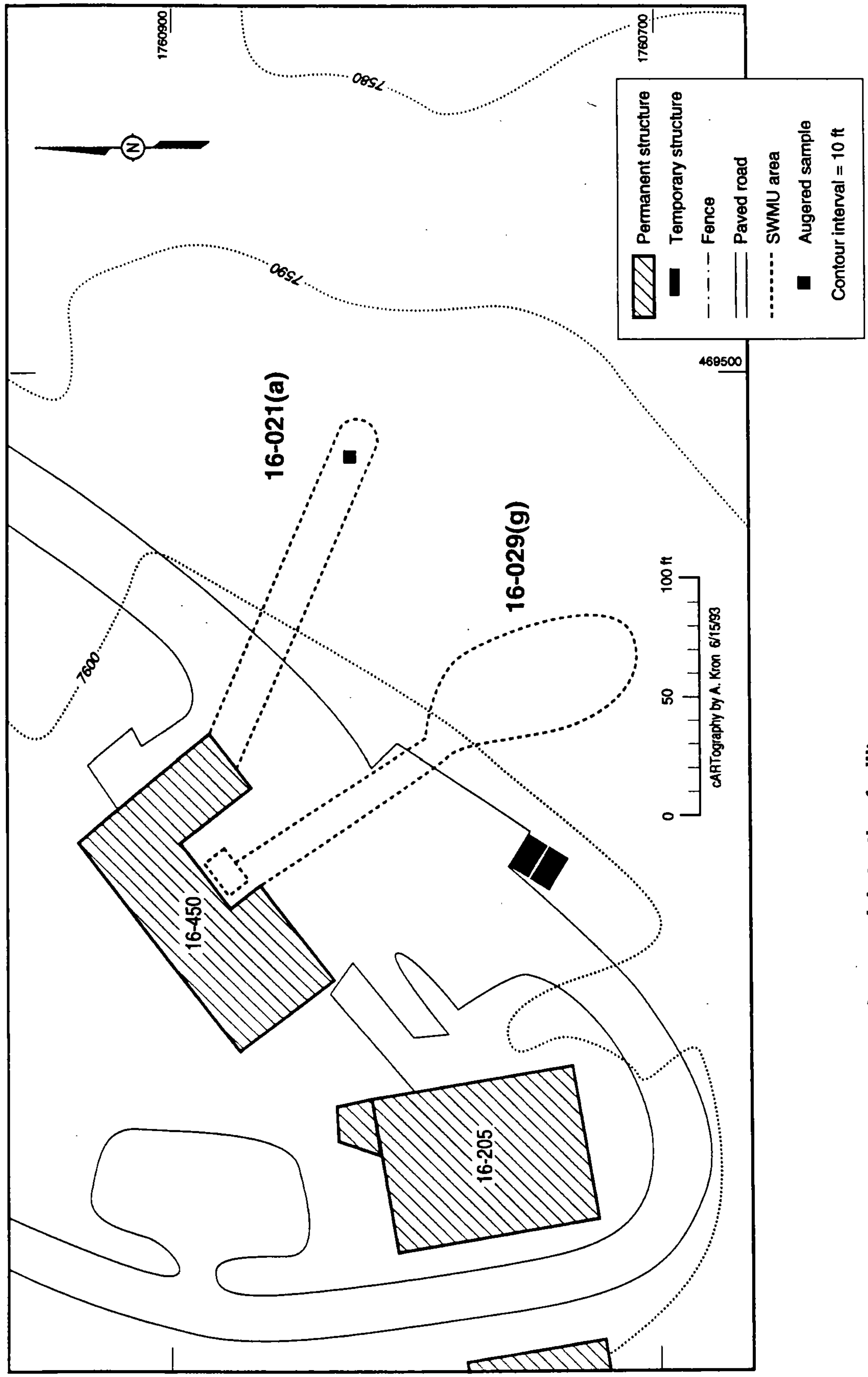


Fig. 5-28. Schematic sampling plan for materials testing facility.

5.6 Photoprocessing Facility, SWMU 16-020

5.6.1 Background

The photoprocessing facility consists of SWMU 16-020, which is associated with TA-16-222, an x-ray film-processing laboratory. SWMU 16-020 is an active, permitted operational release area where untreated, spent photographic chemicals (e.g., silver thiosulfate) have been released to the soils and stream sediments.

5.6.1.1 Description and History

Currently, permitted, treated photoprocessing wastes are discharged to a surface discharge point on the south side of TA-16-222, approximately 10 ft below building grade. A small stream channel slopes gently for approximately 295 ft to a confluence with the main channel of Cañon de Valle (Fig. 5-29).

In general, the volume of waste discharged during a single operation is insufficient to maintain surface flow more than 230 to 262 ft downstream before infiltrating into the sediments and underlying alluvium (Kasunic et al. 1985, 0134).

For a period of 20 years, SWMU 16-020 received significant quantities of silver, > 12 g/L, as silver thiosulfate complexes in untreated, spent x-ray fixing solutions. In 1979, the facility began to recover the silver before discharging the waste. The current release is governed by NPDES Permit EPA 06A073.

5.6.1.2 Conceptual Exposure Model

The relevant conceptual exposure model is presented in Fig. 4-3. Site-specific information on potential release sources, chemicals of concern, migration pathways, and potential receptors is presented below.

5.6.1.2.1 Nature and Extent of Contamination

The principal source of chemical release to the environment is untreated spent photofixing bath solutions. Table 5-34 summarizes the PCOCs for this aggregate. Chemicals reported to have been used include: silver thiosulfate, sodium thiosulfate or "hypo", sulfuric acid, boric acid, and cyanide (Kasunic et al. 1985, 0134). Based on relative toxicity, the PCOCs for evaluating

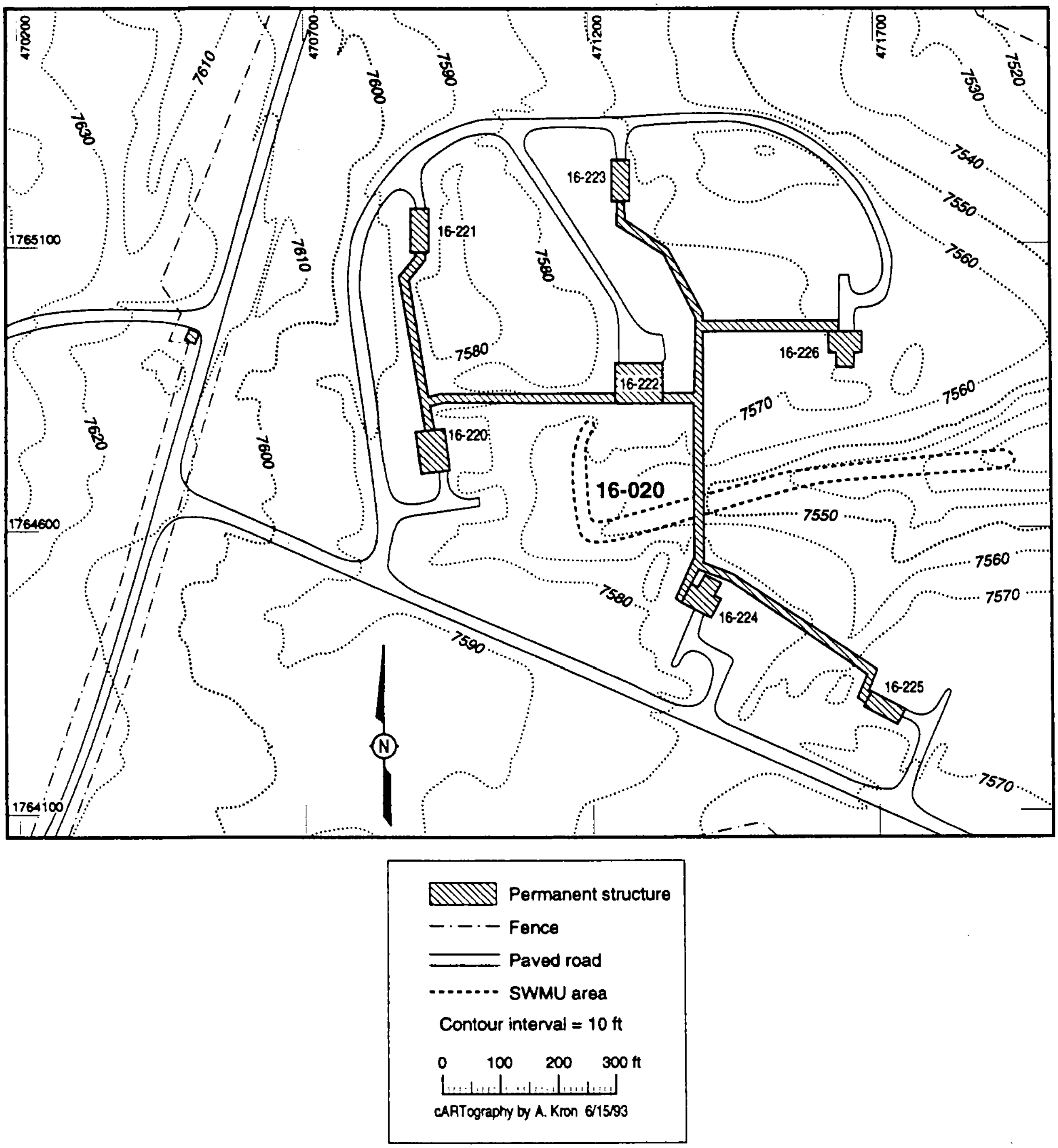


Fig. 5-29. Silver recovery outfall region.

TABLE 5-34

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, MATERIALS TESTING LABORATORY AGGREGATE

PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	METALS	ORGANICS
				SILVER	CYANIDE
16-020	Building TA-16-222, laboratory	X-ray film processing	Y	x	x

human health effects from environmental exposure are silver and cyanide. The outfall water from TA-16-222 was analyzed several times during the late 1970s as part of the NPDES application process. Silver ranged from 2.16 to 7.30 mg/L and cyanide ranged from <0.004 to 2.080 mg/L (Keenan 1977, 15-16-441). The silver SAL in water is 0.050 ppm and the cyanide SAL in water is 0.2 ppm.

A site transport study included an examination of the vertical distribution of silver in soils and the downstream distribution of silver in sediments, soils, and plants. Silver analysis of sediments and soils defined the vertical and horizontal extent of silver in the stream. The silver content of the sediments and the soils decreased with increasing distance from the mouth of the waste outfall. Sediment silver concentrations ranged from 14 500 ppm at the outfall to 4 ppm at 1 378 ft, decreasing fairly linearly. The silver SAL in soil is 400 ppm. Sharp drops in the silver concentration occurred at 295 ft, where the waste outfall converges with Cañon de Valle, and at 984 ft, where a side canyon converges with Cañon de Valle. Silver concentration in the soils followed a much more erratic pattern and was always lower in silver than the sediment. Subsurface soil analyses at 33 and 66 ft from the mouth of the outfall indicated that subsurface concentrations decreased with increasing distance from the mouth of the outfall and with increasing depth from the surface. At 33 ft, silver concentrations ranged from 1 400 ppm at the surface to 182 ppm at the 3-ft depth (Kasunic et al. 1985, 0134).

Silver thiosulfate is highly mobile in the soil environment and is extremely stable and mobile in neutral or alkaline conditions. The factors determining silver mobility are the amount of oxygen and reducing substances in the soil and the drainage condition of the soil.

The soils in SWMU 16-020 are sodium saturated from photoprocessing activities and this reduces soil porosity and drainage. Under a high evaporative demand, the surface soil will tend to dry. Under a low evaporative demand, water will tend to remain at the surface in high sodium soils. Subsurface soil will have a reduced oxygen level and a higher pH, which increases silver thiosulfate mobility. Under a high oxidation potential, such as at the soil surface, the ultimate sink for silver from the spent fixing bath solution may be the clay fraction in the soil.

5.6.1.2.2 Potential Pathways and Exposure Routes

Based on Kasunic's fieldwork, the number of ways and the manner in which silver may be mobilized or transported downgradient are believed to be limited. Most of the site is under a low evaporative demand; the soils remain wet and the swollen clays are not readily eroded. Therefore, silver and cyanide are most likely transported via subsurface water (Kasunic et al. 1985, 0134). Silver released from SWMU 16-020 may have also migrated downgradient via snowmelt and storm water runoff. Silver has accumulated in sedimentation areas and subsequently may have infiltrated into subsurface water and soils. During Kasunic's investigation, silver above its SAL was found 492 ft downstream from the outfall. Thus, surface water runoff due to snowmelt and thunderstorms is not expected to transport PCOCs off site, which is approximately 7 miles downstream.

SWMU 16-020 is located within a highly industrialized area, and land use in the foreseeable future is likely to continue to be industrial. In the future, the site may eventually be decommissioned and released for recreational use. The exposure potential related to on-site maintenance workers is limited to incidental soil ingestion and dermal exposure. Chapter 4 of this RFI work plan contains a detailed discussion of exposure routes that may be associated with recreational use of the site. These two risk scenarios will be evaluated if a baseline risk assessment is required.

5.6.2 Remediation Decisions and Investigation Objectives

Problem Statement (DQO Step 1)

As described above, the facility is still actively discharging waste water from the photoprocessing activity. Further sampling and analysis with the potential for remedial action may be required before the property could be decommissioned and transferred for possible recreational use. Data for this SWMU are not available to determine if cyanide is below its SAL in sediments. Under NPDES Permit EPA 06A073, the facility is permitted to discharge concentrations of silver between 0.5 ppm and 1.0 ppm (daily average and daily maximum, respectively) and 0.2 ppm (daily average and maximum concentration) cyanide to the environment (ESG 1989, 0308). Although the area could be backfilled with clean soils, these clean soils would continue to receive permitted discharges from the outfall and would accumulate these permitted concentrations of silver and cyanide. In evaluating the problem, several factors should be considered. Currently, there are no surface erosion pathways for silver. The only release mechanism considered to be of potential consequence is possible subsurface saturated flow of silver- and cyanide-laden waters downgradient. There are no historical data for the concentrations of cyanide in sediments or soils and these potential contaminants could be affected by this type of flow. The risk to on-site maintenance workers from silver and cyanide in the sediments and soils is unknown, but probably small. Potential exposure and risk related to remedial work will be governed under OSHA guidelines and will not be addressed under the Phase I investigation. The Phase I investigation objectives include:

- Confirm historical silver data for soil and sediment
- Collect data to determine the nature and extent of cyanide distribution.
- Evaluate the potential risk to on-site maintenance workers from silver and cyanide in the sediments and soils in areas of concern
- Collect data to determine if there is possible subsurface saturated flow of silver and/or cyanide-containing waters moving downgradient at levels of concern.

Decision Process (DQO Step 2)

The primary investigation goal for the photoprocessing outfall at this time is to determine whether concentrations of potential contaminants exceed acceptable risk limits and, if so, what action would be appropriate to take at this time. The principal actions under consideration for this site include: 1) deferring action until the site is decommissioned; 2) proposing NFA for the SWMU, if acceptable risk limits are not exceeded; or, 3) initiating a VCA if a contaminant concentration level exceeds an acceptable risk limit. There are concentrations of silver on site that are approximately one order of magnitude above the residential SAL. Currently, the only population potentially exposed to silver or cyanide on site are those maintenance workers who may need to dig in the soils to correct plumbing or electrical problems, or make installations.

Data are only available on silver concentrations. Thus, the site problem determination will require a Phase I investigation to gather data on cyanide concentrations in sediments and soils on site and to confirm the previous silver data. If SALs are exceeded for cyanide and a risk analysis shows unacceptable risks from either contaminant (or both together), then an action will be taken. If risk is below acceptable levels, then further action will depend on the existence of a subsurface pathway for off-site silver or cyanide migration. Should the Phase I investigation indicate unacceptable contaminant levels or the potential for saturated flow of subsurface waters off site, a Phase II investigation will be conducted to evaluate the need for a VCA or CMS. Decision flow for this aggregate is shown in Fig. 5-30.

5.6.3 Data Needs and Data Quality Objectives

Decision Inputs (DQO Step 3)

Subsurface data on water saturation levels and PCOCs are needed to evaluate if there is a potential for saturated flow of contaminated water downgradient. Data gathered on the concentrations of cyanide and silver in on-site sediments and soils are needed to evaluate potential risk to maintenance workers.

Investigation Boundary (DQO Step 4)

The domain of the worker includes those areas where plumbing or electrical conduits may lie or be buried in the future beneath affected soils.

Area of Concern

The vertical domain of the potential for saturated flow of water off site is considered to be at approximately 20 in. below the surface at the interface of the gravelly clay horizon and the underlying clay horizon or at approximately 4 ft below the surface at the clay/tuff interface. The horizontal domain would include the mouth of the outfall to 492 ft downstream where the silver content of the sediments and the soils drop below the SALs. Should the cyanide concentration exceed its SAL at this boundary (i.e., 492 ft) the horizontal domain will be extended downstream to a location where the

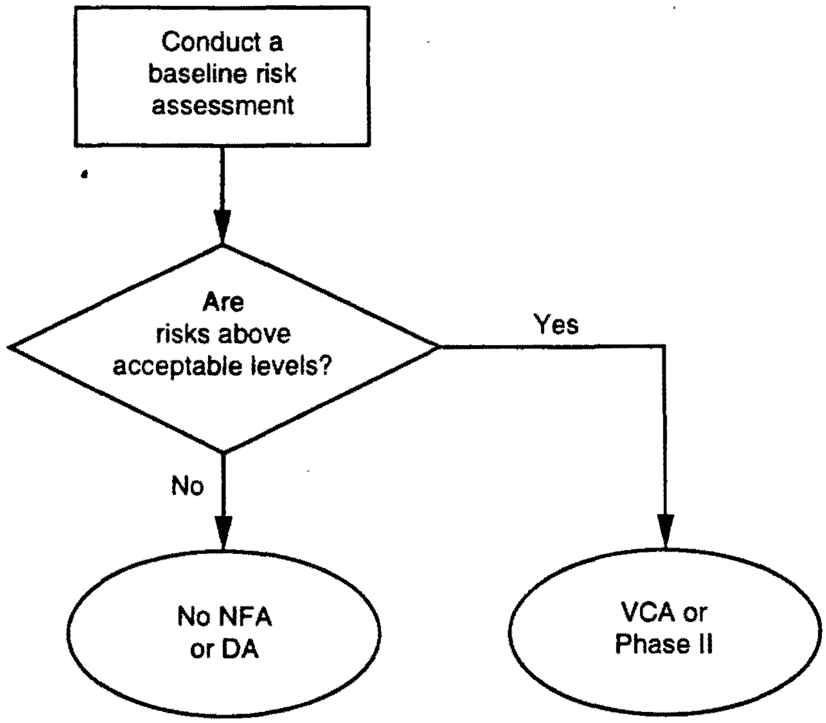


Fig. 5-30. Logic flow for photoprocessing facility.

cyanide concentration drops below the SAL (Kasunic et al 1985, 0134). The lateral domain will be limited to the stream center for Phase I sampling.

The vertical domain for a VCA includes the soil surface to a depth where the concentrations of silver and cyanide in soils and sediments is below the SALs, probably not more than 4 ft. The horizontal domain for a VCA is at 492 ft downstream, where the concentration of silver in sediments and soils drops below the SAL. The lateral domain will be limited to the ephemeral stream high water line.

Decision Logic (DQO Step 5)

Should cyanide concentrations exceed SALs at this boundary location (i.e., 492 ft) the horizontal domain will be extended downstream to a location where the cyanide concentrations drop below the SAL. Cyanide SAL concentrations are being used only to define the horizontal extent of contamination in support of the baseline risk assessment. The vertical domain includes the soil surface to a depth where chemical concentrations of silver and cyanide in soils and sediments drop below SALs, probably not more than 4 ft. The horizontal domain of the potential for saturated flow of water off site is at 492 ft downstream, where the concentration of silver in sediments and soils drops to below the residential SAL. The lateral domain will be the ephemeral stream center where the highest PCOC (silver or cyanide) concentrations are anticipated based on existing data. If it is present, data on the extent of the alluvial aquifer will be used in the risk assessment for this aggregate. If the observed concentration of silver or cyanide for the SWMU is determined to be less than an acceptable risk level, then deferring action until the site is decommissioned or proposing NFA will be considered.

In the event that VCA is chosen, the conservative risk limits will be used as surrogates for remedial action levels. If, however, cleanup levels are to be based on a recreational exposure scenario, a remedial cleanup level based on this scenario will be developed. Should the area be remediated to a level considered to be inappropriate for residential use, a deed restriction may be required.

Design Criteria (DQO Step 6)

The potential for subsurface saturated flow of water off site will be evaluated by placing two augured holes to a 6 ft depth or the soil-tuff interface at 492 ft and/or 738 ft downstream (this is half the distance to the canyon convergence at 984 ft and was chosen as a reasonable point to define potential subsurface flow of PCOCs). Water saturation levels, and silver and cyanide concentrations at the interface between the gravelly clay and clay horizons at approximately 20 in. and at approximately 4 ft below the surface at the clay/tuff interface, will be used to determine if subsurface transport is occurring.

Should corrective action be required, biased samples will be taken to confirm the boundaries of silver and cyanide contamination. Samples will be taken at the historically-defined downstream boundary for silver (i.e., at approximately 492 ft downstream). Samples to evaluate the area surrounding the stream channel will be taken at the ephemeral stream high water line (typically 3 to 7 ft outside the historical horizontal boundaries of the stream bed). Concentrations from these samples will bound other areas of potential concern.

5.6.4 Sampling and Analysis Plan

SOPs that control field activities in this sampling plan are listed in Table 5-35. Sample numbers and required analysis are shown on Table 5-36.

TABLE 5-35

STANDARD OPERATING PROCEDURES FOR FIELD ACTIVITIES

LANL-ER-SOP	TITLE	NOTES
01.02, R0	Sample Containers and Preservation	Applies to all laboratory analytical samples
01.04, R1	Sample Control and Field Documentation	Applies to all laboratory analytical samples
06.10, R0	Hand Auger and Thin-Wall Tube Sampler	Applies to augered soil/sediment samples
06.11, R0	Stainless Steel Surface Soil Sampler	All 0 to 6 in. surface samples

TABLE 5-36

SUMMARY OF SITE SURVEYS, SAMPLING, AND ANALYSIS FOR PHOTOPROCESSING FACILITY AGGREGATE

		Laboratory Samples									Field Screening							Field Lab.						Laboratory Analyses											
			Structure		Surface		Sub-surface										A					B				C				D	E	F	G	H	
PRS	PRS TYPE	Sampled Media		Field dup		Field dup	No. of cores	No. of samples per core	Total	Field dup	Gross Alpha	Gross Gamma/Beta	Organic Vapor	HE Spot Test	Geophysics Surface	Barium - LIBS	Geological Characterization	Gross Alpha	Gross Gamma/Beta	Tritium	Volatile Organics	XRF	Soil Moisture	Alpha spectroscopy	Gamma spectroscopy	Beta spectroscopy	Total Uranium	Isotopic Plutonium	Isotopic Uranium	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCBs (SW 8080)	High Explosives (SW 8330)	Cyanide
16-020	Outfall	Soil/tuff			6	1																										6			6
16-020	Outfall	Soil/tuff					3	2	6	1							3						6									6			6

A = lithologic logging; B, C, D, E, G, H = not applicable; F = silver.

5.6.4.1 Engineering Surveys

SWMU 16-020 will be field surveyed, which will consist of site engineering and geomorphic mapping. Site mapping is required to accurately record the location of the SWMU and its associated drainage. In the field, the engineering survey will locate, stake, and document the location of the SWMU. Sample locations will be registered on a base map, scale 1:7 200. If during the course of sampling, any sample points must be relocated, the new position will be surveyed and the revised locations will be indicated on the map. The engineering survey will be performed by a licensed professional under the supervision of the field team leader.

5.6.4.2 Sampling

Three hand-augered sample holes will be bored at SWMU 16-020 and will be positioned at biased points within the stream center, which is the location where the highest concentrations of silver have been observed. These points will be the outfall and at 492 and 738 ft downstream (Fig. 5-31). The holes will be bored to the depth of 6 ft or the soil-tuff interface, whichever is encountered first.

Analytical samples will be collected from the 0.5 ft immediately above the clay-rich layer and from the 0.5 ft immediately above the soil-tuff interface. The analytical samples will be submitted for laboratory analysis for silver, cyanide, and saturation.

A set of two surface soil samples (0 to 6 in.) will be collected adjacent to the three hand-augered sample holes. One surface soil sample will be collected at the high-water line upslope from the center of the stream bed and one will be collected at the high-water line downslope of the center of the stream bed. These six surface soil samples will be submitted for laboratory analysis for silver and cyanide.

5.6.4.3 Laboratory Analysis

Laboratory analyses of samples will be at Level III for metals (silver by SW-846 Method 6010) and for cyanide. Core samples will be analyzed for water content (saturation).

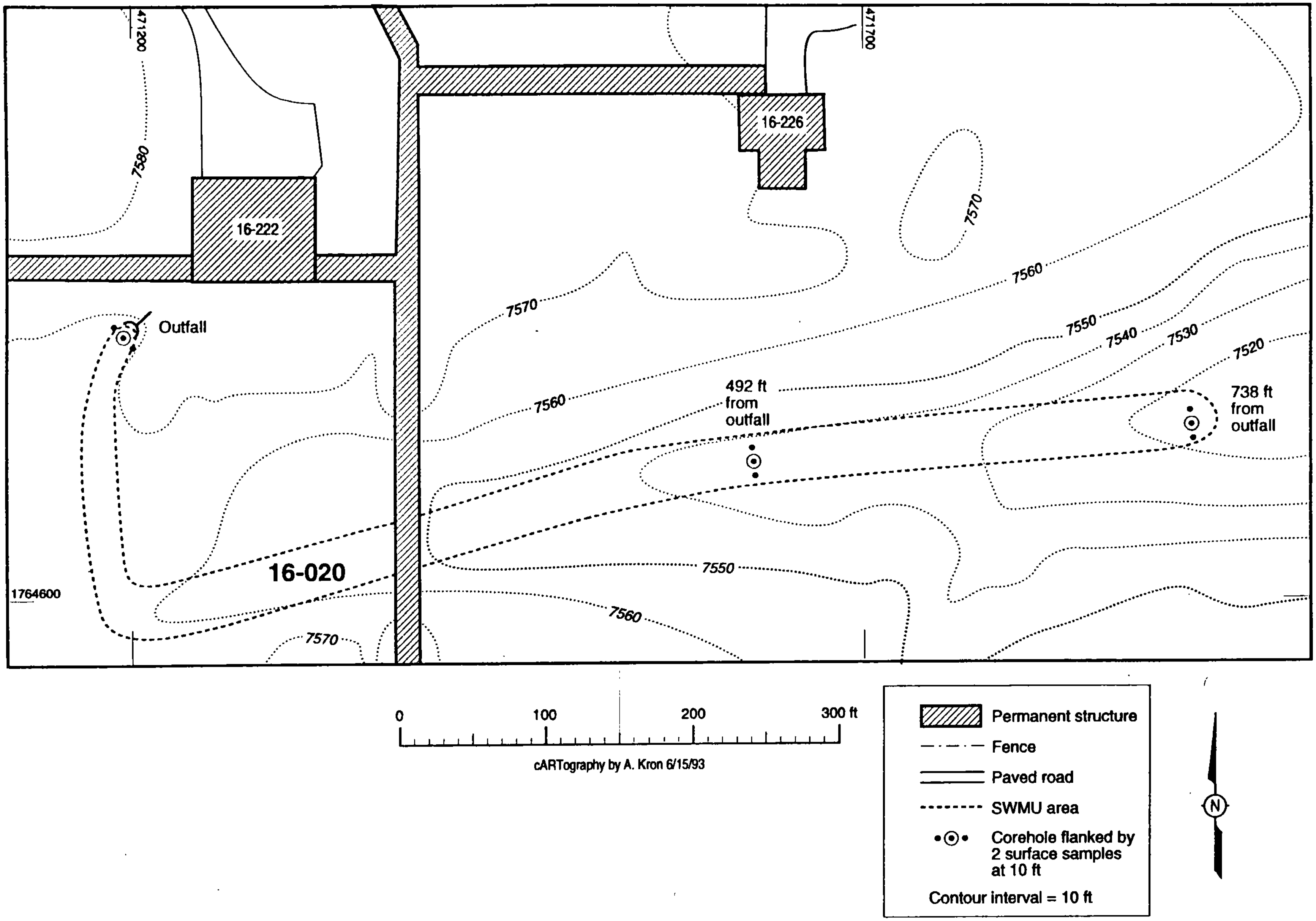


Fig. 5-31. Schematic sampling plan for photoprocessing building outfall.

5.6.4.4 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the latest revision of the IWP. Any QA/QC duplicate samples planned to be collected during the course of the field investigation are outlined in Table 5-36.

5.7 Sanitary Waste Treatment Plant, SWMUs 16-004(a-f)

5.7.1 Background

Six SWMUs compose the sanitary waste treatment plant at TA-16 (Fig. 5-9). These SWMUs were aggregated based on function and geographical proximity. The treatment plant is of standard design and its components are listed in Table 5-37. Sampling of the SWMUs will occur in 1995 after the Laboratory central sanitary waste system is activated and the TA-16 sanitary waste treatment system is decommissioned.

TABLE 5-37

COMPONENTS OF SANITARY WASTE TREATMENT PLANT

STRUCTURE	DESCRIPTION	SWMU	FUNCTION
TA-16-530	Imhoff tank	16-004(a)	Settling
TA-16-531	Trickling filter	16-004(b)	Filtering/digesting
TA-16-532	Final tank	16-004(c)	Clarifying
TA-16-533	Sludge bed	16-004(d)	Drying
TA-16-534	Screen	16-004(e)	Replaced
TA-16-535	Sludge bed	16-004(f)	Drying

5.7.1.1 Description and History

The sanitary waste treatment plant receives waste from the TA-16 sewer system, which consists of thousands of feet of piping, as well as numerous lift stations and manholes. System details are shown on Engineering drawings ENG-R 854 through ENG-R 891 (38 sheets). Waste water enters the system through the comminutor box designed to shred incoming solid matter into fine particles, then flows to the Imhoff tank, which functions as a settling box and offers some sludge digestion capability. Effluent water flows though a dosing siphon to the trickling filter, which contains organisms that digest organic waste. Effluent from the filter is routed to a final clarifying tank before discharge to the environment. Sludge that collects in the Imhoff tank is periodically discharged to two drying beds. Dried sludge is trucked to the Laboratory disposal area MDA G at TA-54.

The TA-16 Sanitary Waste Treatment Plant, as shown on Engineering drawings ENG-R 873 and ENG-R 880, lies at the eastern edge of the mesa separating Cañon de Valle and Water Canyon, where a small projection of the mesa slopes into a tributary of Water Canyon. The southern end of the site is paved with asphalt. Much of the remaining area is bare or covered with invasive plants.

At the top of the slope is the comminutor, housed in a concrete box about 5 x 10 x 3 ft high covered with a metal lid. The comminutor replaces a screen [SWMU 16-004(e)] which once filtered out large solids. The screen, 5 ft square, constructed of round 1 in. diameter bars, has been discarded at the northwest corner of the site. The Imhoff tank [SWMU 16-004(a)] is located about 15 ft north of the comminutor. The tank is a concrete structure about 18 x 35 x 22 ft deep, with nine open interconnected compartments which function as settling boxes. Effluent water from these boxes flows over a weir into a dosing siphon. An emergency overflow pipe from the Imhoff tank outfalls onto the slope northeast of the tank.

When a sufficient volume of water has accumulated, the dosing siphon discharges to the trickling filter [SWMU 16-004(b)] which lies about 20 ft below the Imhoff tank and is of standard design, about 56 ft in diameter with a rotating arm that distributes water from the Imhoff tank over the pebble bed. The trickling filter has a capacity of 100 000 gal./day. From here the water moves to the final tank [SWMU 16-004(c)] which is a concrete box about 20 ft square located 45 ft below (east of) the trickling filter. Discharge water from the trickling filter enters an insert in the bottom of the tank. Water spills over the insert into a surrounding trough and flows to an outlet at the southeast corner of the clarifier. The clarifier is rated at 117 600 gal./day. Discharge from the clarifier flows through a metering concrete outfall box, EPA SSS03S, then through an 8-in. corrugated pipe onto the face of a fill at the lower end of the site.

Periodically, sludge is siphoned from the bottom of the Imhoff tank to two sludge drying beds, TA-16-533 and TA-16-535 [SWMUs 16-004(d,f)]. The beds are adjacent concrete rectangles about 15 x 30 x 1 ft deep. They lie about 100 ft below the Imhoff tank. Each has an inlet valve at the west end of the bed (JCI 1991, 16-337).

The treatment system is designed for gravity flow; effluent flow rate is about 35 gal./minute (or 280 cfs). The outfall lies at the east edge of the site atop unstabilized fill about 20 ft high. Discharge has carved an erosion gully through the fill into an unlined drainage channel leading into a tributary of Water Canyon.

The waste treatment plant was built in 1953 during the expansion of TA-16. It has served its intended function since that time, handling only sewage from TA-16. Water is released without disinfectant treatment. The plant was disconnected when the Laboratory sanitary waste system consolidation (SWSC) was placed in service in 1992 (Sneesby 1992, 15-16-406). If the plant is not contaminated, then the responsibility for decommissioning and disposal will rest with the current operator, Johnson Controls.

5.7.1.2 Conceptual Exposure Model

The on-site conceptual exposure model for the sanitary waste treatment plant is presented in Chapter 4, Fig. 4-7. Subsection 5.7.1.2.1 presents the source and extent of contamination, and PCOCs. PRS-specific information on migration pathways and potential receptors is discussed in Subsection 5.7.1.2.2.

5.7.1.2.1 Nature and Extent of Contamination

Possible contaminants at the sanitary waste treatment plant include HE, solvents, metals, and radionuclides. Table 5-38 summarizes the PCOCs for this aggregate. Historical data on sludge and effluent showed that only one constituent (beryllium in sludge, Tables 5-39 and 5-40) measured above SALs. Since sludge is regularly removed from the beds and disposed of at MDA G in TA-54, the structures are expected to have no residual contamination.

As part of the NPDES Permit for Outfall EPA SSS03S (EPA 1986, 15-16-391) a total analysis for metals, organics and pesticides was done on effluent water. Data submitted for the application indicate that all hazardous constituents were well below acceptable NPDES levels for water [Permit Application MN0890010515, nd]. All values for organic compounds were below detection limit. Effluent water at TA-16 is monitored bimonthly for radionuclides and standard parameters for waste water systems - biological oxygen demand, chemical oxygen demand, total dissolved solids, and anions.

TABLE 5-38

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, SANITARY WASTE TREATMENT PLANT AGGREGATE

				HE		RAD		METALS	ORGANICS	
PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	UNDETONATED HE	HE DEGRADATION PRODUCTS	URANIUM ISOTOPES	PLUTONIUM ISOTOPES	METALS SUITE	VOLATILES	SEMIVOLATILES
16-004(a)	Imhoff tank (TA-16-530)	S-Site waste water treatment	N	x	x	x	x	x	x	x
16-004(b)	Trickling filter (TA-16-531)	S-Site waste water treatment	N	x	x	x	x	x	x	x
16-004(c)	Final tank (TA-16-532)	S-Site waste water treatment	N	x	x	x	x	x	x	x
16-004(d)	Sludge bed (TA-16-533)	S-Site waste water treatment	N	x	x	x	x	x	x	x
16-004(e)	Screen (TA-16-534)	S-Site waste water treatment	N	x	x	x	x	x	x	x
16-004(f)	Sludge bed (TA-16-535)	S-Site waste water treatment	N	x	x	x	x	x	x	x

The Sanitary Waste Treatment Plant was decommissioned in late 1992. Sampling will not occur until 1995.

TABLE 5-39

SUMMARY OF SLUDGE ANALYSES, 1981-1986

	ALPHA (pCi/g)	BETA (pCi/g)	GAMMA (NCPM/g)	TRITIUM (pCi/ml)
n	14	14	20	9
min.	6.0	3.9	2.0	1
max.	140.0	93.0	14.6	400
mean	30.9	21.3	6.2	98.6
std dev	40.1	26.1	2.8	130.5

WWTP Sludge Rad Report (Williams 1991, 15-16-383).

TABLE 5-40

RESULTS OF ENVIRONMENTAL PROBLEM #10 ANALYSES AT SANITARY WASTE TREATMENT PLANT SLUDGE BEDS

CONSTITUENT	CONCENTRATION RANGE (ppm)	LOCAL BACKGROUND (ppm)	SCREENING ACTION LEVEL, SOIL (ppm)[d]
Methylene chloride	1.1-1.8		5.6 ppm
Toluene	4.8-32		890 ppm
Chloromethane	.4		6.4 ppm
Chloroethane	.6		3 300 ppm
Carbon disulfide	.2		7.4 ppm
Dimethyldisulfide	.1		c
Barium	609-1180	120-810	5 600 ppm
Chromium	60-144	1.17-136	400 ppm
Silver	73-108	1.61	400 ppm
Beryllium	7	1-3	0.16 ppm
Copper	223-428		3 000 ppm
Zinc	973-1,830		16 000 ppm
Thorium-232[a]	< .590 - < .860		8.8×10^{-1}
Uranium-238[a]	< .420 - < .510		5.9×10^{1}
Uranium[a]	8.46-9.17[c]	3-13	5.9×10^{1}
Plutonium-238[a]	.009-.016	0-0.01	2.7×10^{1}
Plutonium-239, -240[a]	.072-.168	0.01-0.07	2.4×10^{1}
Cesium-137[a]	.040-.063	0.01-0.82	4.0

a Unit is pCi/g.
b Assumes a residential scenario and a 10 mrem/yr dose.
c Measured at 12-13 ppm, converted to pCi/g assuming natural uranium. Depleted uranium conversion 5.598-6.064 pCi/g. All SALs will be added when finalized.

Sludge from the drying beds is monitored four times per year for alpha, beta, gamma, and tritium before being delivered to MDA G. Ten to twelve subsamples are collected at random from throughout the beds then composited into a single sample for analysis (Hoard 1992, 15-16-338). A summary of data collected between 1981 and 1986 is shown in Table 5-39 (Williams 1991, 15-16-383).

As part of Environmental Problem #10 (DOE 1989, 15-16-344), samples from the sludge beds were analyzed as follows: three grab samples were taken from sludge drying bed TA-16-535. Two samples were taken at the west end of the bed 4 ft from each wall. The third sample was taken in the center of the bed about 10 ft from the inlet valve at the west end. The sludge had been in the bed one day at the time of sampling. Results are summarized in Table 5-40. The historical data from the sludge samples indicates that most constituents, except beryllium, are well below SALs. SALs are discussed in IWP Chapter 4, Section 4.4 and Appendix J (LANL 1992, 0768).

5.7.1.2.2 Potential Pathways and Exposure Routes

The sanitary waste treatment plant at TA-16 has received nearly 40 years of waste. One potential problem is the contamination of the structures (including the discarded screen near the comminutor) and the adjacent soil (from historical overflow of waste from structures or leaks from the structures). Another concern is the potential contamination of soil downstream of the plant, especially where sediment collects in the sedimentation area below the outfall canyon. Storm water infiltration can carry potential contaminants into deeper soils or to surface soil beyond the original release site. Volatilization of organics and wind dispersion of soil as dust are additional migration pathways.

Current human receptors are limited to on-site workers. Because of the highly-developed, research and development activities in the surrounding area, land use in the foreseeable future is likely to continue to be industrial. However, future recreational use of the site is possible. All of the exposure routes apply to the current and future on-site worker. The future recreational user could be exposed to all the pathways listed in Fig. 4-7.

5.7.2 Remediation Decisions and Investigation Objectives

Problem Statement (DQO Step 1)

The sanitary waste treatment plant was deactivated in 1992 when the Laboratory central sanitary waste system was brought on line. Since the plant has been decommissioned, the risk posed by the structures and the surrounding soil must be determined.

A separate problem is the possible historical release of constituents from two plant outfalls. The main flow of treated waste water leads down a drainage to a sedimentation area. The sedimentation area is the most likely place for deposition and collection of potential contaminants. Another outfall receives untreated overflow from the Imhoff tank. The Imhoff tank overflow would most likely overflow during periods of high flow (e.g., during a storm).

Decision Process (DQO Step 2)

For the structures, if PCOC levels are measured above SALs, then remedial alternatives will be evaluated. If these levels are below SALs, then standard decommissioning of the structure will be undertaken. For the surface soils beneath the outfall, a PCOC finding above SALs will lead to a baseline risk assessment; otherwise, NFA will be proposed. There are several remediation alternatives for the plant and surrounding soil. These include proposing NFA, institutional control, destruction and removal of structures, and removal or *in-situ* remediation of any contaminated soil. Land disposal restrictions are an important part of the decision-making process for the plant, which may significantly affect removal costs. Selecting an action for the sanitary waste treatment plant will be based on the health risk posed by the structures and the surrounding soil.

The soil below the plant outfalls has a more limited set of remedial actions, which include NFA, removal to a permitted disposal site, or remediation (*in situ* or off site). The decision will be based on the health risk posed by potential contaminants in the surface and subsurface soil.

Fig. 5-32 depicts the decision logic for the structures in this aggregate.

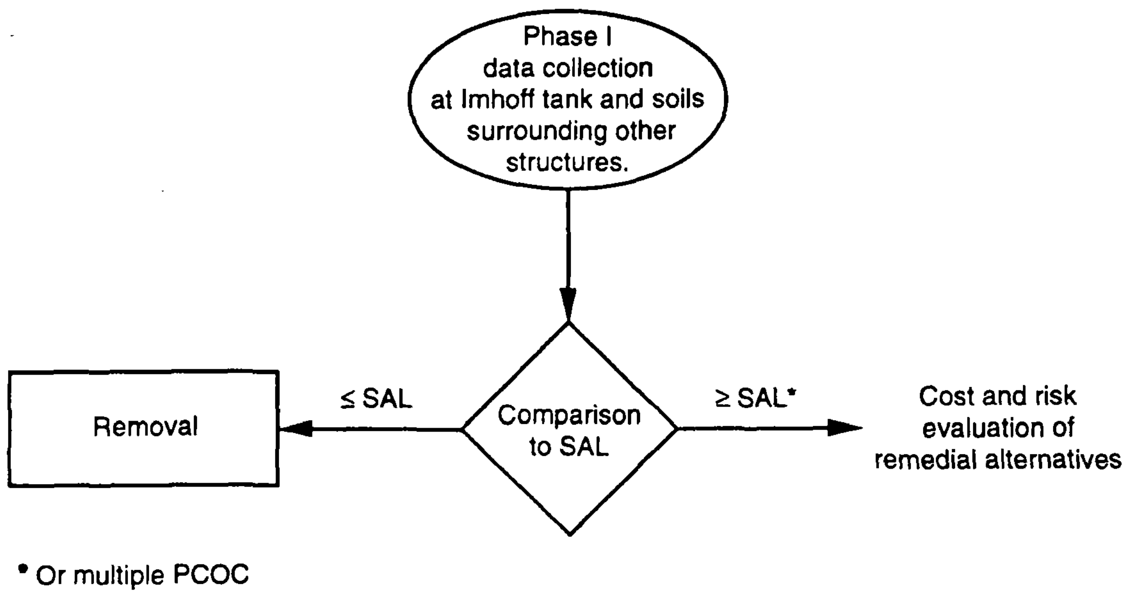


Fig. 5-32. Logic flow for Sanitary Waste Treatment Plant structures.

5.7.3 Data Needs and Data Quality Objectives

Decision Inputs (DQO Step 3)

Table 5-38 lists the PCOCs for the sanitary waste treatment plant. The goal of Phase I of the RFI is to collect data that are representative of PCOC concentration in the plant and the soil below the outfalls. These data will be obtained by full analytic techniques as well as field screening techniques. Field screening will be used to identify regions of high PCOC concentrations.

Investigation Boundary (DQO Step 4)

Samples will be taken to represent the concentration in the plant (including the surrounding soil), the drainages, and the soil in the sedimentation area below the waste treatment plant outfall. If cracks in the plant components are discovered, then the soil under those components will be sampled. Otherwise, only the soil surrounding the structures will be sampled. This soil is operationally defined to be within 5 ft of the structures, based on the estimated splash zone for the water in the treatment plant. Sampling will occur after the plant is decommissioned so that the structures, surrounding soil, plant outfall drainage, and sedimentation area below the outfall will be dry.

Decision Logic (DQO Step 5)

Two separate decisions will be made for the waste treatment plant and the potential historical release of contaminants to the sedimentation area below the sanitary waste treatment plant outfall.

The decision will be based on both the risk posed by the structures and the cost of remedial actions. If the concentration of all PCOCs is below SALs in the Imhoff tank and soil surrounding other structures, then NFA will be proposed (Fig. 5-32). If some PCOCs are observed above SALs, then a risk and cost evaluation will be made of the remedial alternatives will be made (Fig. 5-32). Phase II data may be needed to complete this evaluation.

For the surface soil below the outfalls, the maximum concentration of each PCOC will be compared to the SAL. If any concentration is greater than the SAL, then a baseline risk assessment will be conducted. If the baseline risk assessment shows unacceptable levels of risk, a CMS or a VCA will be proposed. If all constituent concentrations are below SALs, then NFA will be proposed.

Design Criteria (DQO Step 6)

There are historical data on the PCOC concentrations in the effluent water and in the sludge, but there are no data on the structures, the soil adjacent to structures, or the soil downstream from either outfall. For this reason, reconnaissance sampling will be used for the structures, surrounding soil, and soil downstream of the outfalls. Samples for the structures, surrounding soil, and the drainages will be biased by likely physical process. The presence-absence diagram approach will be applied to the sedimentation area below the main effluent outfall.

In the event that some PCOCs are measured above the SAL, then the Phase I data will have to be adequate for a baseline risk assessment. It is expected that the surface soil samples adjacent to the structures, at the Imhoff tank outfall, and in the sedimentation area can be aggregated for the baseline risk assessment. The samples in the drainage below the main effluent outfall will likely represent another exposure scenario, but these data should be adequate for a baseline risk assessment.

The Imhoff tank is the structure that has the longest contact with waste water at the plant. Therefore, it is expected that this structure has the potential for the most contamination. The design of the plant should make potential contaminants uniformly distributed over the bottom of the Imhoff tank. The most likely exception to a uniform PCOC concentration would be the presence of cracks or other structural failures in the structures. For this reason, all structures must examined for structural flaws.

Given that historical data indicate low concentrations of potential contaminants in the sludge, the probability of serious contamination of the structures is unlikely. Because PCOC concentrations are expected to be uniform over the bottom of the Imhoff tank, a single core sample in the structure will be used to determine whether the Imhoff tank is contaminated. This core will not exceed three-quarters of the thickness of the tank at the location of the core. Two surface soil cores will also be taken in the soil adjacent to each structure. The splash zone from the plant operations is expected to distribute PCOCs within 5 ft of the structures. These data (the structure core and the soil cores) will bound for the level of potential contamination of plant structures.

The outfalls differ greatly in the amount of flow. The overflow from the Imhoff tank receives low flow, which means that PCOCs are expected to be most concentrated near the end of the overflow pipe. Two soil cores should be taken between the end of the pipe and the steep portion of the drainage below the outfall. The main outfall of treated waste water should tend to distribute PCOCs down the steep portion of the drainage into the sedimentation area. The sedimentation area has a much larger surface area, and is the most likely place for sediment collection. Three soil core samples will be adequate to sample the drainage below the outfall. Soil core sampling in the sedimentation area will be biased by extensive field screening (a 24 station sampling grid) for metals, radioactivity with beta-gamma and alpha counters, HE, and volatiles. The desired performance was a 90% probability of detecting whether 25% (or more) of the sedimentation area was contaminated. The presence-absence diagram approach indicated that nine laboratory analyses for the sedimentation area are required.

5.7.4 Sampling and Analysis Plan

SOPs that control field activities in this sampling plan are listed in Table 5-41. Sampling numbers and required analysis are shown on Table 5-42.

TABLE 5-41

STANDARD OPERATING PROCEDURES FOR FIELD ACTIVITIES

LANL-ER-SOP	TITLE	NOTES
01.02, R0	Sample Containers and Preservation	Applies to all laboratory analytical samples
01.04, R1	Sample Control and Field Documentation	Applies to all laboratory analytical samples
06.10, R0	Hand Auger and Thin-Wall Tube Sampler	Applies to augered soil/sediment samples
06.11, R0	Stainless Steel Surface Soil Sampler	Applies to surface soil sample

TABLE 5-42

SUMMARY OF SITE SURVEYS, SAMPLING, AND ANALYSIS FOR SANITARY WASTE TREATMENT PLANT AGGREGATE

PRS	PRS TYPE	Sampled Media	Laboratory Samples: Structure	Structure: Field dup	Surface	Surface: Field dup	Sub-surface: No. of cores	Sub-surface: No. of samples	Sub-surface: Total	Sub-surface: Field dup	Field Screening: Gross Alpha	Gross Gamma/Beta	Organic Vapor	HE Spot Test	Metals - LIBS	Barium - LIBS	Geological Characterization (A)	Field Lab.: Gross Alpha	Gross Gamma/Beta	Tritium	Volatile Organics	XRF (B)	Soil Moisture	Laboratory Analyses: Alpha spectroscopy	Gamma spectroscopy	Beta spectroscopy (C)	Total Uranium	Isotopic Plutonium	Isotopic Uranium	VOA (SW 8240) (D)	Semivolatiles (SW 8270) (E)	Metals (SW 6010) (F)	PCBs (SW 8080) (G)	High Explosives (SW 8330) (H)	Cyanide
16-004(a)	Imhoff tank	Soil			2	1	2	1	2		2	2	2	2	2			2	2		2	2			4			4	4	4	4	4		4	
16-004(a)	Imhoff tank	Concrete	1																						1			1	1	1	1	1		1	
16-004(b)	Trickling filter	Soil			2																				2			2	2	2	2	2		2	
16-004(c)	Final tank	Soil			2																				2			2	2	2	2	2		2	
16-004(d)	Sludge bed	Soil			2																				2			2	2	2	2	2		2	
16-004(f)	Sludge bed	Soil			2																				2			2	2	2	2	2		2	
16-004(c)	Outfall stream	Soil					3	1	3		3	3	3	3	3		x	3	3		3	3			3			3	3	3	3	3		3	
16-004(c)	Sedimentation area	Sediment							9	1	72*	72*	72*	72*	72*		x	72*	72*		72*	72*			9			9	9	9	9	9		9	

A = lithologic logging; C, G = not applicable; B, D, E, H = full suite; F = 1082 suite.
* = This is the field screening of all cores to determine the nine laboratory samples.

5.7.4.1 Engineering Surveys

The SWMU aggregate will be field surveyed, which will consist of site engineering (geodetic) and geomorphologic mapping. Site mapping is required to accurately record the location of the SWMUs. In the field, the engineering survey will locate, stake, and document the location of the SWMUs. Sample locations will be registered on a base map, scale 1:7 200. If during the course of sampling, any sample points must be relocated, the new position will be surveyed and the revised locations will be indicated on the map. The engineering survey will be performed by a licensed professional under the supervision of the field team leader.

The geomorphologic survey will consist of the mapping of the first-order stream channels downslope of any identified drain outfall. There are two identified at this time; one from the Imhoff tank, and the other from the final tank (EPA SSS03S). There are also two overflow lines that drain the sludge beds. This mapping will facilitate the selection of outfall sediment and sedimentation area sample collection points. This mapping will establish a sampling grid in the sedimentation area. The surface drainage mapping will include the sediment catchment sites adjacent to any identified outfall.

5.7.4.2 Sampling

Two surface soil samples (0 to 6 in.) will be collected within 5 ft of all treatment plant structures. One surface sample on the upgradient and one on the downgradient side will be collected. Structures include the Imhoff tank, trickling filter, final tank, and the two sludge beds. All sampling locations are shown on Fig. 5-33.

Three cored soil samples will be collected in the drainage below the drying bed outfall, equally distributed between the outfall and the start of the sedimentation area. These soil samples will be 0 to 6 in. unless field team observations prove the depth of sediments would allow hand-augered cores to be bored to 18 in. or bedrock. These three samples as well as the two cored surface soil samples collected at the Imhoff tank outfall will be field screened and analyzed in the field laboratory to formulate an indicator constituent for the cores that are to be drilled in the sedimentation area. The two samples collected at the Imhoff tank outfall will be at the mouth of the outfall and 30 ft down the drainage.

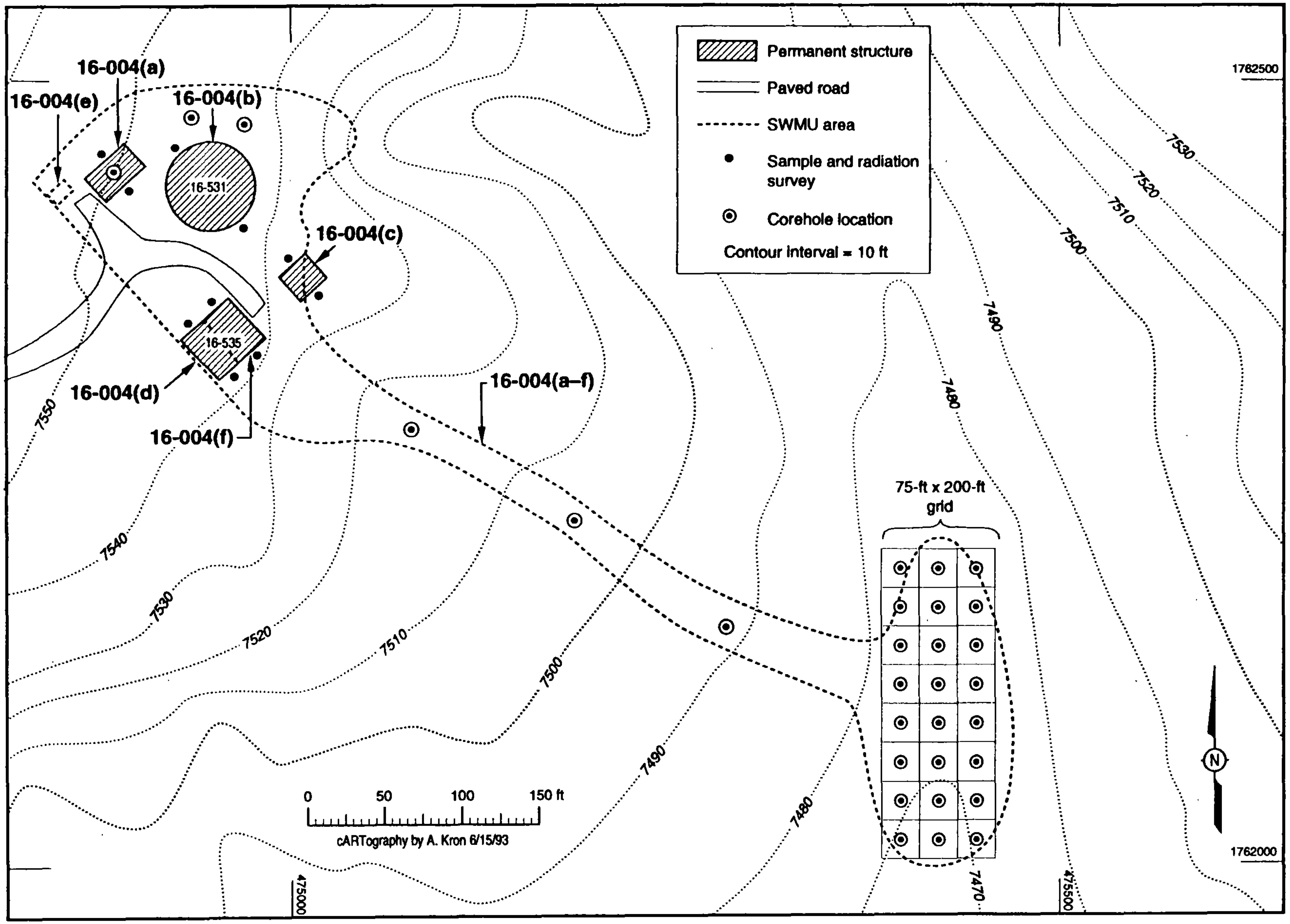


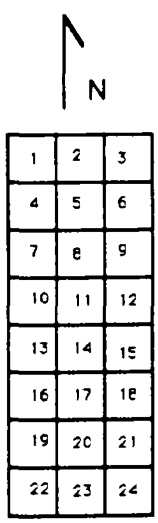
Fig. 5-33. Schematic sampling plan for sanitary waste treatment aggregate.

One core hole will be drilled into and through the center of the Imhoff tank to three-quarters of the thickness of the concrete structure. The entire core sample will be sent to the laboratory for analysis of the full suite of PCOCs.

A 200 by 75 ft, 24 station sampling grid will be established in the sedimentation area; each grid square measuring 25 ft (Table 5-43). Hand-augered core holes will be bored in the center of each grid square. The cores will be bored to a depth of 3 ft or tuff. Field screening and field laboratory analysis will be carried out on all 24 cores at depths intervals of 0 to 6 in., 15 to 21 in., and 30 to 36 in. Field screening will consist of metals by XRF or LIBS, HE by swipe test, VOC by PID, and radionuclides by gross beta/gamma. If field screening results in the detection of a PCOC relative to SALs, then the analytical samples with the nine highest readings will be submitted for full laboratory analysis. If the field screening yields negative results, then analytical samples for both VOC and non-VOC PCOCs will be taken from the same cores according to Table 5-43.

TABLE 5-43

SAMPLING POINTS IF FIELD SCREENING YIELDS NEGATIVE RESULTS



Screening and sampling grid

SAMPLING STATION	VOC SAMPLE LOCATION	NON-VOC SAMPLE LOCATION
7	18"	0"
15	36"	18"
14	18"	36"
10	36"	0"
16	18"	18"
17	36"	36"
23	18"	0"
5	36"	18"
9	18"	36"

Sampling points for VOC and non-VOC where field screening finds no indicator analytes

5.7.4.3 Laboratory Analysis

Laboratory analyses of samples will be at Level III for radionuclides (LANL or DOE method), metals (SW-846 Method 6010), VOCs (SW-846 Method 8240), SVOCs (SW-846 Method 8270) and HE (SW-846 Method 8330). The principal radionuclides of concern are uranium and plutonium isotopes, the principal VOCs are hydrocarbon solvents, and the full analytical suite of OU 1082 metals.

5.7.4.4 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the latest revision of the IWP (LANL 1992, 0768). Any QA/QC duplicate samples planned to be collected during the course of the field investigation are outlined in Table 5-42.

5.8 Active/Inactive Burn and Treatment Areas, SWMUs 16-010(a,h-n), 16-016(c)

5.8.1 Background

There are a total of 17 SWMUs in this aggregate. Six of the SWMUs, 16-010(b,c,d,e,f,j) are operated under interim status as open burning/open detonation facilities within the Laboratory's RCRA Part B Permit Application and are covered in Chapter 6 as No Current RFI Investigation SWMUs. SWMU 16-005(g) is at the present location of TA-16-406, so it will be treated along with SWMU 16-010(f) in Chapter 6. SWMU 16-008(b) is currently under closure and is covered in Subsection 6.1.2.1. The remaining eight SWMUs, 16-010(a,h,i,k-n) and 16-016(c), will be addressed with a Phase I sampling plan. Aggregation of these SWMUs is based on geography, common contaminants (particularly HE and barium), and common processes that take place at the TA-16 burning ground. The interim status units are included under Subsection 5.8.1.1, so that the complete TA-16 burning ground process can be understood in context.

5.8.1.1 Description and History

The TA-16 burning ground is located in the northeast corner of TA-16. It is located on a level portion of the mesa and drains to the north, east, and south. The three principal drainages are to the south, to the northwest due west of MDA P, and to the northeast due east of that MDA (Fig. 5-34).

The TA-16 burning ground was constructed in 1951 for high explosive treatment and disposal. Over the years many hundreds of thousands of pounds of HE and HE-contaminated material have been burned at this location. The remaining non-combustible material was subsequently placed in the Area P landfill north of the burning ground (through 1984) or taken to TA-54 for disposal (1984 to present). Several different types of treatment units exist at the burning ground. For completeness of understanding, all units are discussed below, but only those covered in this subsection will be identified by SWMU number. See Fig. 5-34 for location of all of the units described below.

Former flash pad TA-16-386, SWMU 16-010(a), is now used for storage. TA-16-387 is a flash pad. TA-16-388 and TA-16-399 are burn tables. TA-19-394 is an open burning tray. Flash pads consist of a layer of sand

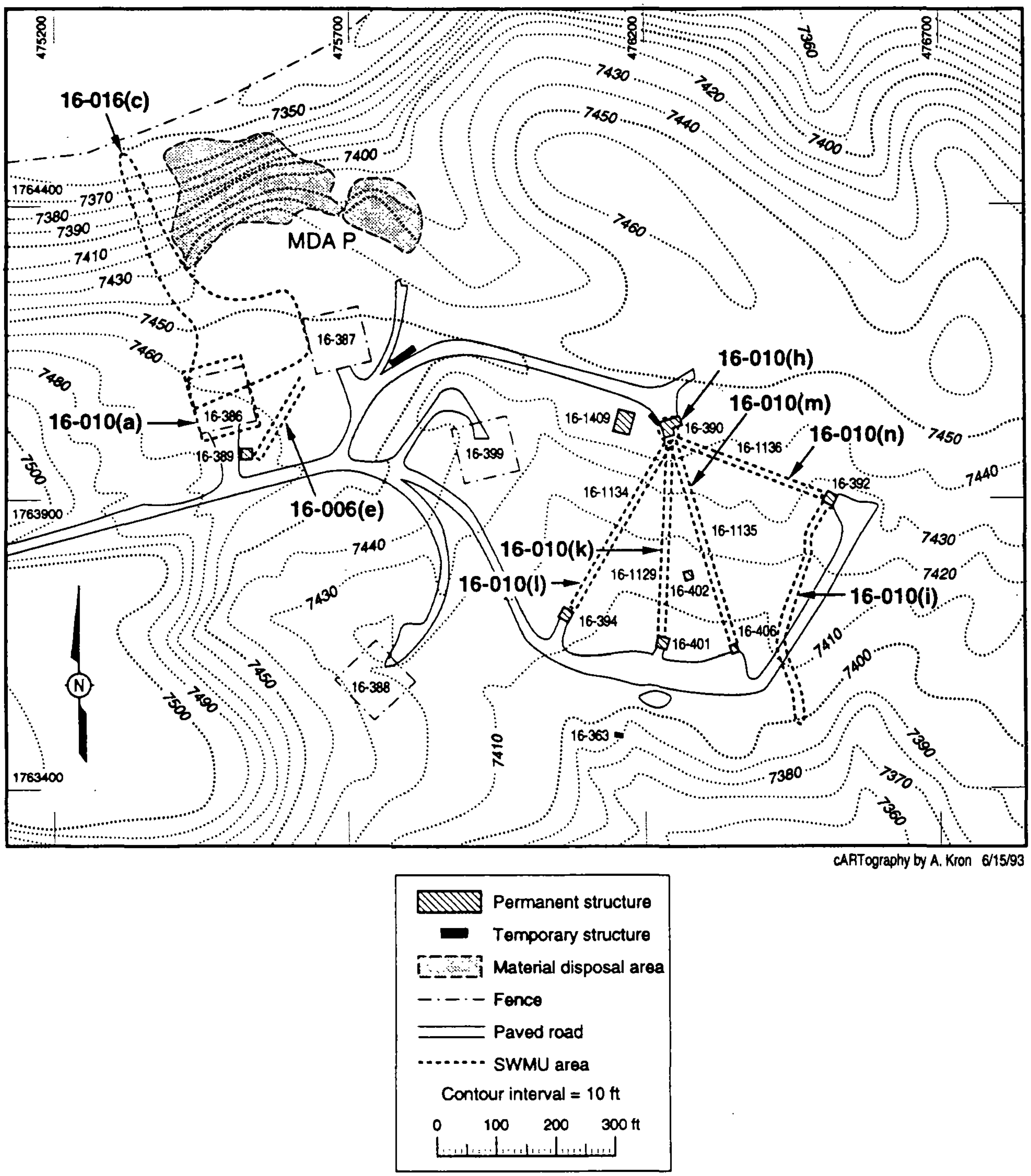


Fig. 5-34. TA-16 burning ground map.

several inches thick over a soil surface surrounded by a 100 x 100 x 8 ft high cyclone fence. The burn tables are elevated steel trays 4 by 16 ft covered by roll-away rain covers. The open burning tray is used to burn HE-contaminated oils and solvents from site operations (LANL 1990, 0145).

Also located at the burning ground is a basket wash facility, TA-16-390, SWMU 16-010(h), which was in operation from 1951 to 1966. The purpose of the facility was to clean filters from HE sumps located site wide and to divert the residual wash water to troughs [TA-16-1129, TA-16-1134, TA-16-1135, and TA-16-1136, SWMUs 16-010(k-n)]; then to pressure filter tanks (TA-16-401 and TA-16-406); next to filter beds [TA-16-392 (now an inactive burning pad) SWMU 16-010(i), TA-16-393 (removed)]; and last to TA-16-394, now an open burning tray (LANL 1990, 0145).

The basket wash facility and the troughs are decommissioned and have not been used for their intended purpose since the basket wash facility suspended operations in 1966. The basket wash facility is used by WX Division for storage.

Currently, sludge from site-wide HE sumps is trucked to the burning ground, filtered, then dried at structures TA-16-401 and TA-16-406 and burned (Barr 1992, 15-16-371). The filter bed sand is scraped up after burning and placed in drums for disposal. During past operations of the above units, filtrate was allowed to drain in such a way that it ultimately reached the canyon to the south of the burning ground (LASL 1956, 15-16-240).

Prior to 1986, the wash water drainage from filtering tanks TA-16-401 and TA-16-406, emptied into a field located approximately 100 ft south of the tanks; from 1986 until 1988 a Hypalon pond accepted filtrate from these two units. This pond has since undergone a RCRA closure (Ellvinger 1990, 15-16-372). More detail on this unit and its closure is provided in Subsection 6.1.2.1. In 1988, a carbon filter/treatment unit, TA-16-228, was built to treat the filtrate from TA-16-401 and TA-16-406 before discharging into a tributary of Cañon De Valle. The filter/treatment unit has since been renumbered TA-16-363. The filtrate from TA-16-394 and TA-16-392 was drained southward from the pads (Barr 1992, 15-16-371).

SWMU-specific information for SWMUs covered in this subsection is given below.

SWMU 16-010(a). TA-16-386, SWMU 16-010(a), is an inactive flash pad now used for storage. This structure is located 35 ft north of TA-16-389 (LANL 1990, 0145). This structure was designated as a barium nitrate storage site. A large pile of barium nitrate was stored at this location during the late 1960s [see SWMU 16-016(c)]. This barium nitrate pile is shown on a 1959 photo.

SWMU 16-010(h). TA-16-390, SWMU 16-010(h), is a decommissioned basket wash facility. HE residues from basket filters from sumps site-wide were emptied into a floor drain located on the south end of the building. An operator in the building controlled a manifold that diverted the wash water to one of four troughs, TA-16-1129, -1134, -1135, or -1136, which then carried the effluent to one of four filtering units, TA-16-401, -394, -406, or -392 respectively (LANL 1990, 0145). Three troughs were originally connected to the building, and in 1961, an additional trough, TA-16-1136 was installed. In 1966, operations at the basket wash facility ceased when the use of filter baskets was discontinued.

SWMU 16-010(i). TA-16-392, SWMU 16-010(i), is a currently inactive burning pad, which received wash water from the basket wash facility. Former filter bed, TA-16-392, received suspected uranium-contaminated wash water from filter baskets being cleaned at TA-16-390. In 1988 the bed was modified to a burn pad for the purpose of burning suspected uranium-contaminated objects (Barr 1992, 15-16-371); the trough, TA-16-1136, that once fed this bed was dismantled at that time (LANL 1990, 0145).

SWMU 16-010(k). TA-16-1129, SWMU 16-010(k), is a steel trough with a V-shaped cross section that once carried wash water from the basket wash facility to pressure filter tank TA-16-401. This structure is open at the top, elevated approximately 3 ft from the ground on a steel framework, and approximately 370 ft long. Structure TA-16-1129 was built in 1951 (LANL 1990, 0145).

SWMU 16-010(l). TA-16-1134, SWMU 16-010(l), is a trough, similar in construction to TA-16-1129, that carried wash water from the basket wash facility to filter bed TA-16-394 (LANL 1990, 0145).

SWMU 16-010(m). TA-16-1135, SWMU 16-010(m), is a trough, similar in construction to TA-16-1129, that carried wash water from the basket wash facility to filter bed TA-16-393. In 1965 pressure filter tank TA-16-406 replaced TA-16-393, which was dismantled and sent to TA-54 for disposal (LANL 1990, 0145).

SWMU 16-010(n). TA-16-1136, SWMU 16-010(n), was a trough, similar in construction to TA-16-1129, that carried wash water from the basket wash facility to filter bed TA-16-392. This trough was the only one of the four troughs in which wash water associated with potentially uranium-contaminated materials was transported. The trough was dismantled in 1988 (LANL 1990, 0145).

SWMU 16-016(c). SWMU 16-016(c) is a barium nitrate storage area that was located in and possibly near decommissioned burning pad TA-16-386. The SWMU Report (LANL 1990, 0145) suggests that the barium nitrate pile was initially placed NE of TA-16-386 during the late 1940s (Fig. 5-34). Early air photos (1948, early 1950s, and 1958) do not show clear evidence for the location of the pile, primarily because many of these photos were taken during the winter when snow was on the ground. Photographs taken in 1965 suggest that the pile was within TA-16-386. A current burning ground employee states that the pile was within the confines of TA-16-386 during the late 1960s (Martin 15-16-474) and that it had been removed by the early 1970s. He describes the pile as roughly two dump truck loads of material resembling a large pile of snow. The pile is not visible on air photos taken in 1974 and 1977, but is shown on a 1959 photo.

5.8.1.2 Conceptual Exposure Model

The conceptual exposure model is presented in Fig. 4-8. Site-specific information on potential release sources, chemicals of concern, migration pathways, and potential receptors is presented below.

5.8.1.2.1 Nature and Extent of Contamination

The contaminants of concern in and around the burning ground are those associated with the storing, burning, and disposal of S-Site solid wastes, particularly HE. These are barium, other metals, depleted uranium, HE by-products, and HE (Table 5-44). Semivolatiles may include HE burn and detonation products, as well as petroleum products probably used to initiate combustion. During one year in the late 1970s, approximately 41 500 lbs of HE, consisting of roughly 10% cyclotol and octol, 20% TATB and 70% RDX and HMX were disposed of at the burning ground (Ferenbaugh circa 1980, 15-16-424).

A limited amount of qualitative and quantitative data exist for soils in and around the burning ground. Turner and Schwartz (1971, 15-16-284) reported 14 ppm soluble barium 30 ft west of TA-16-389. An analysis of soil near TA-16-406 showed 23.7+/-2.1 wt % of explosive in 1984 (Baytos 1984, 15-16-269). Subsequently, cleaned sand from this locality gave a negative result on an HE field spot test. Analyses of liquid effluent from the pressure filter beds (TA-16-401 and TA-16-406) as part of the NPDES permit application yielded 33 to 112 ppm of HE in 1977 (LASL 1977, 15-16-426).

Three EP toxicity soil analyses for soluble barium in the drainage south of the Hypalon pond taken in February 1987 yielded 26 mg/L at 3 ft from the outfall, 6.6 mg/L at 40 ft, and 2.7 mg/L at 40 ft with a background value of 0.8 mg/L (Ellvinger 1990, 15-16-372). Five soil samples taken from below the liner of the Hypalon pond in November 1987 yielded concentrations of EP toxicity metals, VOCs, and SVOCs below the detection limits of the analytical methods, except for one sample, which yielded an EP toxicity cadmium value of 0.19 mg/L. Twelve post-closure samples taken in soils from beneath the Hypalon pond in March 1990 yielded levels for EP toxicity metals, VOCs, and SVOCs that were generally beneath detection limits for the analytical methods chosen. However, one sample yielded trichloroethylene at 29 ppb. A risk assessment was performed by NM Environmental Improvement Division (NMEID), and the NMEID determined that clean closure could be certified with trichloroethylene at such a level.

A scoping study of metals in the north drainage from SWMU 16-016(c) and in the drainage south of the decommissioned Hypalon pond was performed

TABLE 5-44

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, BURNING GROUND AGGREGATE

PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	HE: UNDETONATED HE	HE: HE DETONATION PRODUCTS	HE: HE DEGRADATION PRODUCTS	HE: HE BURN PRODUCTS	RAD: URANIUM	METALS: BARIUM	METALS: METALS	CYANIDE
16-010(a)	Burn pad, storage TA-16-386	Burning HE	N	x	x	x	x		x	x	x
16-010(h)	Basket washing TA-16-390	Basket washing facility	N	x		x		x	x	x	x
16-010(i)	Burning pad TA-16-392	Basket wash water, HE burning	N	x		x	x	x	x	x	x
16-010(k)	Trough TA-16-1129	Basket wash water	N	x		x			x	x	x
16-010(l)	Trough TA-16-1134	Basket wash water	N	x		x			x	x	x
16-010(m)	Trough TA-16-1135	Basket wash water	N	x		x			x	x	x
16-010(n)	Trough TA-16-1136	Basket wash water	N	x		x		x	x	x	x
16-016(c)	Surface storage area	Barium nitrate pile	N	x		x			x		

during the summer of 1992 (Brown et al. 1992, 15-16-389). Six soil samples were collected from the western drainage flowing northward through SWMU 16-016(c) and three were collected from the drainage due south of the site of the decommissioned Hypalon pond, 16-008(b). Barium concentrations ranged from 1 700 ppm to 6 252 ppm in the drainage from SWMU 16-016(c) and from 941 ppm to 1 420 ppm in the southern drainage. The barium concentrations in the northern drainage rise to their highest values downstream from the former barium nitrate storage pile, but upstream from MDA P. This result suggests that barium derived from the pile has slowly been transported down the drainage since removal of the barium nitrate pile in the early 1970s.

The existing data above SALs at the burning ground are from a single soil HE analysis by V. Raper. SALs for TNT (40 ppm), HMX (4 000 ppm), and RDX (64 ppm) are exceeded, and one barium in soil value (Brown et al. 1992, 15-16-389) in the drainage from the barium nitrate pile is above the soil SAL of 5 600 ppm.

5.8.1.2.2 Potential Pathways and Exposure Routes

This aggregate consists of potential surface and subsurface contamination as a result of solid and liquid surface disposal, burning, spills, leaks, and waste burial. In the northeast corner of TA-16, three principal drainages run south, northwest, and northeast of the PRSs. These drainages discharge into a tributary of Cañon de Valle. The primary migration pathway at this site is surface water runoff resulting in the potential accumulation in sedimentation areas in these major drainages. Potential subsurface contamination could be brought to the surface via excavation or erosion.

Currently, human receptors are limited to on-site workers. Chapter 4 contains a detailed discussion of the migration pathways, conversion mechanisms, human receptors, and exposure routes.

5.8.2 Remediation Decisions and Investigation Objectives

Problem Statement (DQO Step 1)

Much of the burning ground is an active site, operating under an open burn/ open detonation permit. Those SWMUs discussed in this section are portions of the burning ground that are inactive, and hence could be proposed for NFA or VCA without fear of recontamination. The inactive SWMUs at the burning ground can further be subdivided based on the potential contaminants that may have been released at the sites: 1) SWMUs 16-010(a) and 16-016(c) were potentially contaminated with barium due to leaching of barium nitrate from a barium nitrate storage pile, and 2) the other SWMUs are all associated with former HE disposal activities at the basket wash facility [SWMU 16-010(h)] and its associated troughs and inactive burning pads.

The primary PCOC at SWMU 16-010(a), SWMU 16-016(c), and in their associated drainage is barium. Existing data suggest that at least portions of the drainage are contaminated above SALs for barium. The objective of Phase I for this area will be to determine the nature and extent of contamination in order to perform a baseline risk assessment. A subsidiary problem is to determine if other PCOCs are associated with these SWMUs.

For the remaining SWMUs at the burning ground, the objective of Phase I will be to perform screening assessment to determine whether any PCOCs are at levels which are different from background and above SALs. PCOCs associated with burning ground activities at these SWMUs include barium, other metals, HE (particularly TNT, HMX, RDX, and TATB), depleted uranium, HE burn products, and HE by-products.

Decision Process (DQO Step 2)

For SWMU 16-010(a) and SWMU 16-016(c) and their associated drainage, a Phase I study will be conducted to allow performance of a baseline risk assessment to determine which of the following should be recommended:

1. Phase II study if the baseline risk assessment suggests that risks to human health are present given realistic exposure scenarios, but that additional information on nature and extent is required prior to recommendation of VCA.

2. VCA if the baseline risk assessment suggests the site needs remediation and a clear remediation option exists that will not conflict with active operations.

3. NFA if the baseline risk assessment suggest that no danger to health exists given realistic exposure scenarios.

For the remaining group of SWMUs at the burning ground, biased reconnaissance screening assessment will be performed that uses Phase I data to determine whether contaminant levels are different from background and, if so, whether SALs are exceeded. If screening assessment indicates contaminant levels which do not warrant further study, then propose NFA for the group. Otherwise, use the Phase I data to perform a baseline risk assessment on the group as a whole if contaminant levels are sufficiently uniform. Based on the baseline risk assessment, either 1) NFA the group; 2) implement a VCA; or, 3) design a Phase II study to collect additional data for those SWMUs where contaminant levels are different from background and above SALs and further information is needed to design a VCA. If Phase I data are not adequate to perform a baseline risk assessment, then design a Phase II study to collect data for a baseline risk assessment and to determine nature and extent of contamination at those SWMUs that are shown to be potentially contaminated by the screening assessment.

In the event that risk-based levels indicate remediation is necessary, possible remediation alternatives include: 1) removal of contaminated soil to a permitted landfill, following reduction of HE to levels required for worker safety; 2) thermal or bioremediation of contaminated soils; or 3) deferral of action to D&D of the burning ground. Additional laboratory samples will be analyzed to verify cleanup.

The decision logic for this aggregate is shown in Fig. 5-35.

5.8.3 Data Needs and Data Quality Objectives

Decision Inputs and Investigation Boundary (DQO Steps 3 and 4)

Based on historical process knowledge, some specific questions have been identified to address in Phase I, along with the general goal of identifying potential contaminants (e.g., SVOC burn products) from burning ground activities.

1. For SWMU 16-010(a) and SWMU 16-016(c), what is the nature and extent of barium contamination in surface soils in the

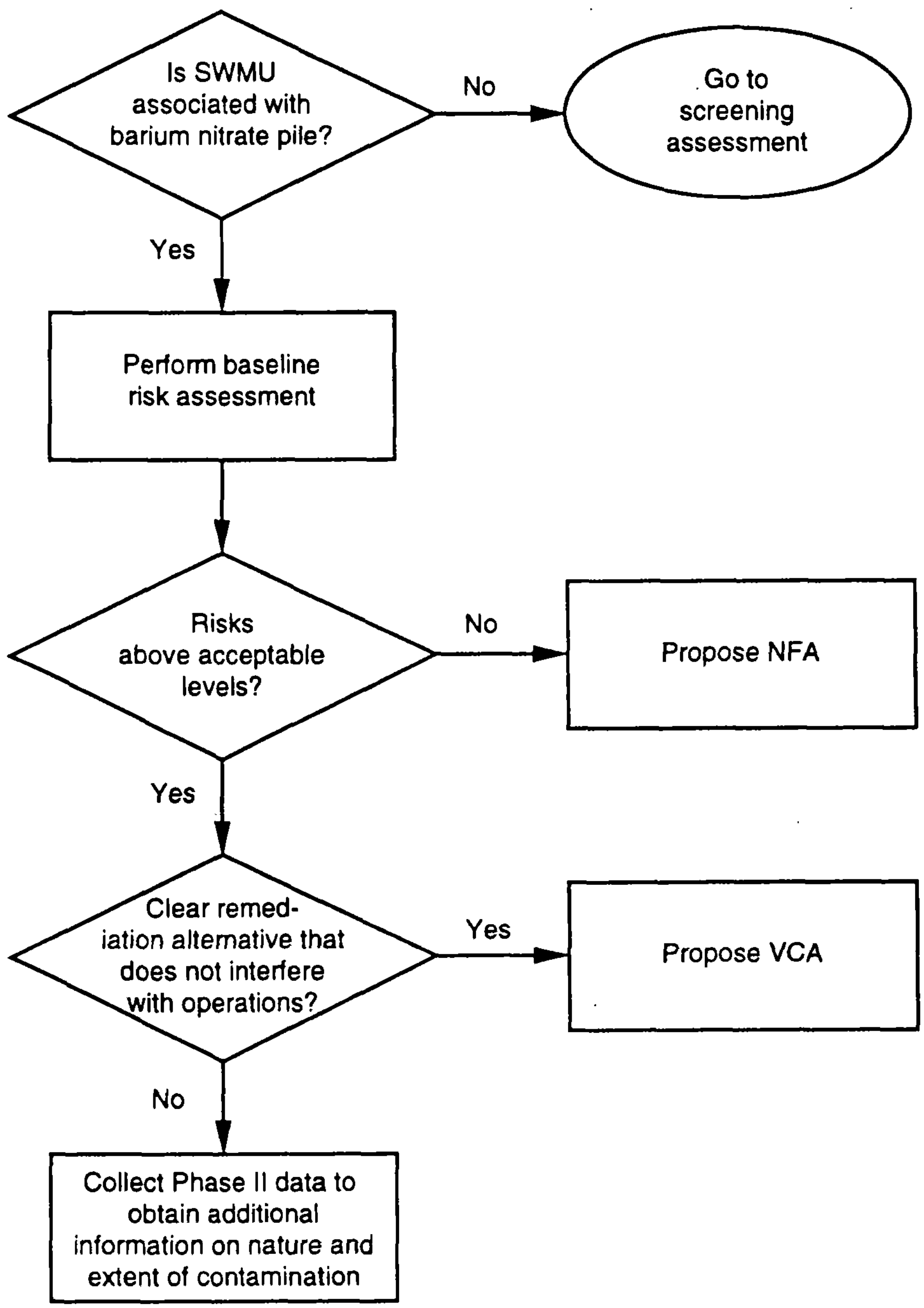
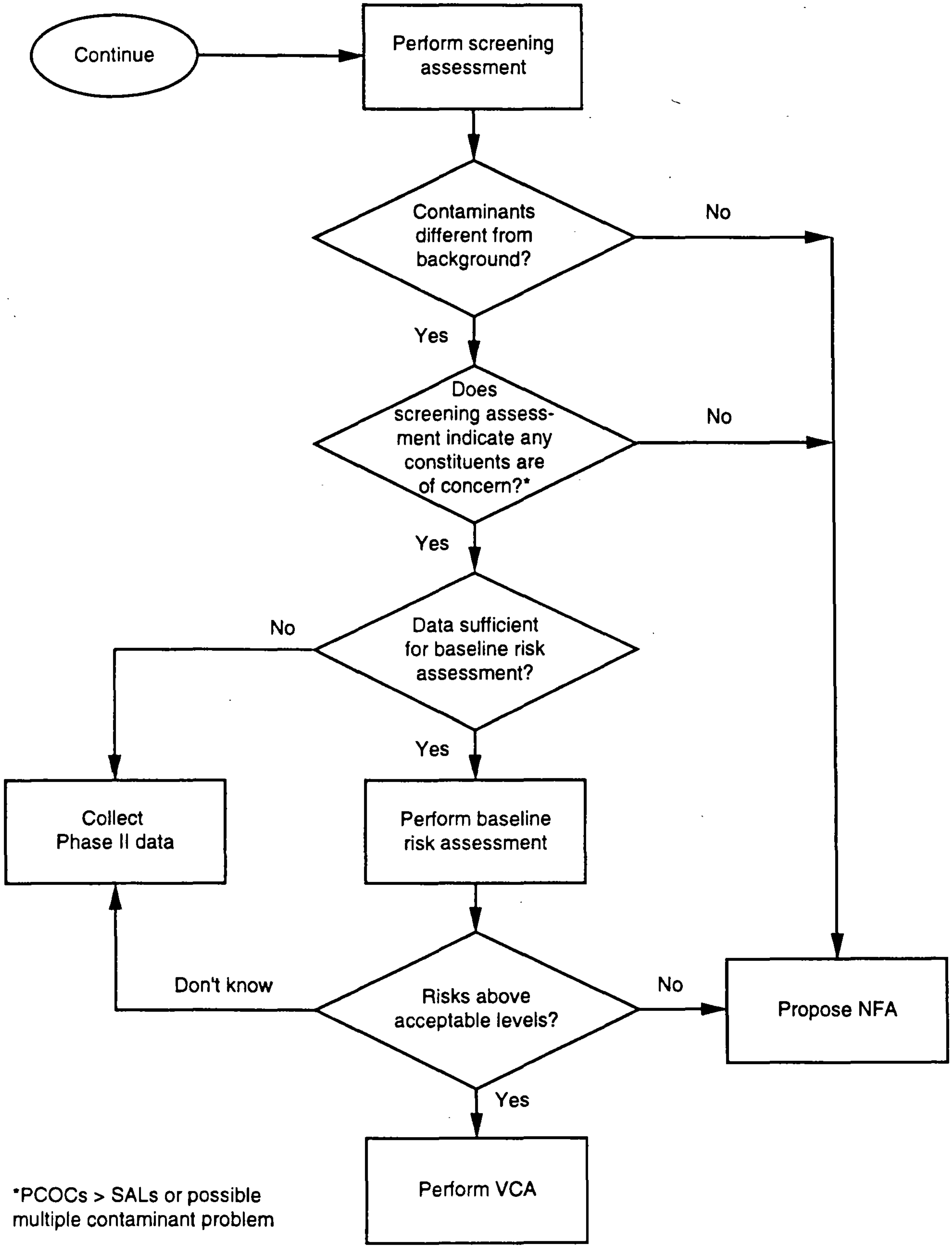


Fig. 5-35. Decision flow for burning ground.



*PCOCs > SALs or possible multiple contaminant problem

Fig. 5-35 (continued). Decision flow for burning ground.

vicinity of the flash pad, possible previous location of the barium nitrate pile, and the associated drainage?

2. For troughs 16-010(k,l,m,n), do HE, barium, or other PCOC levels exceed SALs in the surrounding soils?

3. For trough 16-010(n), do uranium levels exceed SALs in the surrounding soils?

4. Do barium, HE, or other PCOC levels in the drainage south of the decommissioned Hypalon pond exceed SALs?

5. Do levels of PCOCs exceed SALs in the surface soils surrounding the basket wash facility?

6. Do levels of HE, uranium, barium, and other PCOCs exceed SALs at filter bed SWMU 16-010(i)?

The data required to answer these questions are the concentrations of contaminants of concern in the surface and subsurface soils of each of the SWMUs.

Assumptions made include: 1) that HE and barium concentrations will be highest directly adjacent to those structures involved in HE disposal or material storage; 2) that the drainages serve as the primary mechanism for transport of PCOCs from the burning ground and may concentrate contaminants in their sediment traps; and, 3) that the secondary contaminants of concern (semivolatiles, metals other than barium) do not have different deposition and transport mechanisms than HE, uranium, and barium, so field screening for these three contaminants will allow us to locate probable high concentrations of other PCOCs. The third assumption is clearly false in detail; however, the most likely semivolatiles of potential concern, such as DNT, are not strongly fractionated from TNT by environmental processes (Layton et al. 1987, 15-16-447). In addition, HE and barium are by far the most likely PCOCs to present a health risk at the burning ground.

Decision Logic (DQO Step 5)

Following Phase I investigation of the areas associated with the former barium nitrate pile, perform a baseline risk assessment. For these areas, recommend Phase II study if additional information on nature and extent of contamination is required. If baseline risk assessment suggests that remediation is necessary and a clear remediation alternative exists that would not interfere with operations, recommend VCA. If risk is shown to be negligible, recommend NFA.

For the remaining group of SWMUs, perform screening assessment for the combined group of SWMUs. If contaminant levels are not different from background, or if the sample maxima do not exceed SALs, propose NFA for the group. Otherwise, if sufficient data exist, perform a baseline risk assessment for the group as a whole to determine whether the group can be recommended for NFA. If the group as a whole cannot be recommended for NFA based on either the screening assessment or the baseline risk assessment, then recommend additional Phase II study to determine nature and extent of contamination at those sites where screening assessment indicates potential contamination. Screening data at the individual SWMUs may be used in the analysis phase to establish information on the variability and distributions of contaminant levels at the individual SWMUs. This information will also be helpful in designing Phase II data collection.

Design Criteria (DQO Step 6)

SWMUs 16-010(a) and 16-016(c), barium nitrate pile: The goal of sampling at the site of the former barium nitrate pile is to determine the nature and extent of contamination in order to perform a baseline risk assessment.

16-010(a). The inactive flash pad is the most likely location of the former barium nitrate pile. A field randomized grid with a 20 ft grid spacing will be used to collect barium, HE, and radiation field screening data. The 20 ft grid spacing provides adequate coverage of the area of concern, with a resolution similar to the likely cleanup unit, assuming a backhoe is used for remediation. Surface samples for laboratory analysis will be selected at the locations of the 3 highest barium readings and at up to 10 additional locations where staining is visible or where positive HE or above-background radiation concentrations are detected by field screening. The selection of these judgmental samples is based on barium being the primary contaminant of concern at this site, with HE screening, radiation screening, and visible stains being additional criteria for sample selection. Although the barium nitrate pile was most likely located in SWMU 16-010(a), one stain-biased sample and two out of four field screened samples at SWMU 16-016(c) will be submitted for laboratory analysis to confirm that contaminant levels are not of concern at this location which was suggested in the SWMU Report (LANL, 1990, 0145).

To check for possible off-SWMU migration and conservatively bias the risk calculations, the drainage channel will be field screened for barium, HE, and radiation with three 10-ft-spaced points on a transect every 30 ft for a distance of 210 ft. The sampling will cease at 210 ft, because beyond this distance significant PCOC contributions from MDA P are possible. A distance of 10 ft on either side of the center of the drainage was selected for the transect points because it is unlikely that runoff in the drainage would have overflowed the drainage banks more than this amount. A 30 ft downgradient spacing provides reasonable coverage of the potentially contaminated area, based on professional judgment. Overall, this spacing will provide information about contaminant distribution in the lateral direction as well as down the length of the channel. Based on the results of field screening, the five highest barium locations and up to ten additional locations based on staining, positive HE, or above-background radiation concentrations will be selected for laboratory analysis.

A reconnaissance sampling approach incorporating biased location of samples will be applied to the remaining group of burning ground SWMUs (IWP, Appendix H). For screening and risk assessment purposes, these SWMUs will be grouped together, based on commonality of function and expected contaminants. At least 27 laboratory samples will be collected over the group of six SWMUs. With 27 samples, the probability of detecting contamination is greater than .96 if 10% or more of the site is contaminated. The use of field screening and judgmental sampling locations has the effect of making the reconnaissance sampling probability statement very conservative. To obtain samples representative of all of these SWMUs, a stratified sampling approach will be adopted, placing most of the samples at the identified SWMUs. The allocation of samples to the individual areas is based on professional judgment. Preliminary baseline risk assessment will be performed on the entire group of SWMUs, with any future sampling efforts focused on those SWMUs where contaminant levels are found to be different from background and above SALs.

SWMU 16-010(h), basket wash facility. Field screening at five points on the south side of the building will be used to select two surface samples for laboratory analysis, based on the highest barium values, plus any samples testing positive for HE. One additional laboratory sample will be selected adjacent to the sloping cement pad, resulting in a total of at least three laboratory samples.

SWMU 16-010(i), filter bed. A total of ten field-screened samples will be taken at judgmental locations selected to represent worst-case exposure scenarios. Three judgmental samples will be taken on the surface of the sand in the filter bed, one at the center of the pad, and two additional samples selected on the basis of radiation field screening or field randomization. Three foot core samples at each of these locations will be field screened to determine the interval for core analysis. Three additional samples will be taken at the end of the drainage pipe at the depth of the buried pipe. Four additional surface samples will be taken in the drainage.

SWMUs 16-010 (k,l,m,n), troughs. Field screening for HE and barium will be used to select up to ten laboratory samples of the soils in the vicinity of each trough. A minimum of three laboratory samples will be selected at each of the troughs. Field screening will be performed at ten evenly-spaced locations to provide uniform coverage of the soils for SWMUs 16-010(k,l,m,n). At SWMU 16-010(l), the field screening will be performed at biased locations based on previous field inspection.

South Drainage. Since the Hypalon pond has already been tested clean as part of its formal closure plan, only the drainage will be sampled. Contaminants will be assumed to concentrate in the sediment traps. Barium field screening of ten randomly selected sediment traps will be used to select the five locations with the highest barium concentrations for laboratory analysis. Any locations with positive HE field tests will also be sent in for laboratory analysis, resulting in a total of at least five laboratory samples.

Existing data for many HE open burn/open detonation facilities suggest that subsurface contamination is frequently present at such units, along with surface contamination. Subsurface contamination may be at higher concentrations than surface contamination, but these are almost invariably collocated (Layton et al. 1987, 15-16-447). Thus, surface field screening as described above will be used to bias subsurface sampling at the burning ground. Seven augered subsurface samples will be collocated with the 27 surface sampling points proposed for the six SWMUs associated with the basket wash facility. These seven samples will be biased by positive HE screening; if more have HE, then they will be chosen randomly from within the group of 27 surface samples. Seven samples provides a 75% probability of detecting contamination if 20% of the subsurface is contaminated (see Subsection 4.5), although biasing makes this statement conservative.

5.8.4 Sampling and Analysis Plans

Phase I sampling is intended to determine if releases have occurred from these units. The Phase II sampling plan, if necessary, will define the complete nature, extent, and rate of migration of any release identified in Phase I.

SOPs for procedures used in this sampling plan are listed in Table 5-45. Sample numbers and necessary analyses are in Table 5-46. Field screening methods are described in Subsection 4.7. SOPs for these procedures are in preparation.

TABLE 5-45

STANDARD OPERATING PROCEDURES FOR FIELD ACTIVITIES

LANL-ER-SOP	TITLE	NOTES
01.02, R0	Sample Containers and Preservation	Applied to all laboratory samples
01.04, R1	Sample Control and Field Documentation	Applied to all laboratory samples
06.10, R0	Hand Auger and Thin-Wall Tube Sampler	VOC-bearing soil samples
06.11, R0	Stainless Steel Surface Soil Sampler	All 0 to 6 in. surface samples

TABLE 5-46

SUMMARY OF SITE SURVEYS, SAMPLING AND ANALYSIS FOR BURNING GROUND

PRS	PRS TYPE	Sampled Media	Laboratory Samples: Structure	Field dup	Surface	Field dup	Subsurface	Field dup	Field Screening: Gross Alpha	Gross Gamma/Beta	Organic Vapor	HE Spot Test	Geophysics Surface	Barium - LIBS	Geological Characterization (A)	Field Lab.: Gross Alpha	Gross Gamma/Beta	Tritium	Volatile Organics	XRF (B)	Soil Moisture	Laboratory Analyses: Alpha spectroscopy	Gamma spectroscopy	Beta spectroscopy (C)	Total Uranium	Isotopic Plutonium	Isotopic Uranium	VOA (SW 8240) (D)	Semivolatiles (SW 8270) (E)	Metals (SW 6010) (F)	PCBs (SW 8080) (G)	High Explosives (SW 8330) (H)	Cyanide
16-010(a)	Storage (ex-flash pad)	Soil			3#					30		30		30															3#	3#		3#	3#
16-010(h)	Basket wash	Soil			3#	1	*			5		5		5											3#					3#		3#	3#
16-010(i)	Burning pad	In			3		3	1		10	3	10		10											6			3	6	6		6	6
16-010(j)	Drainage	Soil			4		*																		4				4	4		4	4
16-010(k)	Steel trough	Soil			3#	1	*			10		10		10																3#		3#	3#
16-010(l)	Steel trough	Soil			3#		*	1*		16		16		16																3#		3#	3#
16-001(m)	Steel trough	Soil			3#		*			10		10		10																3#		3#	3#
16-010(n)	Trough	Soil			3#		*			10		10		10											3#					3#		3#	3#
16-016(c)	Barium nitrate pile	Soil			8#	1				24		24		24																8#		8#	
	South drainage	Soil			5#					10		10		10											5#				5#	5#		5#	5#

* = Seven subsurface samples will be chosen from within this group of SWMUs.
A, B, C, G = not applicable; D = full suite; D = subsurface samples only; E = full suite (PAH); F = 1082 suite.
= This is the minimum number of laboratory samples that could be taken. Additional samples may be taken based on field-screening results.
An additional seven collocated samples will be chosen from within this group of samples for subsurface sampling.

5.8.4.1 Engineering Surveys

An engineering survey will be completed before sample collection. This survey will include site engineering mapping (geodetic) and geomorphologic mapping in order to identify and define drainage paths from these SWMUs. Site mapping is also required to accurately locate the SWMUs and to position surface and subsurface sample points. All sample locations will be registered on a base map, scale 1:7 200. If, during the course of sampling, any sample points must be relocated, the new position will be resurveyed and the revised locations will be indicated on the map. The engineering survey will be performed by a licensed professional under the supervision of the field team leader.

5.8.4.2 Sampling

All surface sampling points will be field screened for radioactivity using FIDLER, HE using the spot test, and barium by XRF or LIBS, to identify gross concentrations of contaminants and provide the basis to select samples for further laboratory analysis.

For purposes of future baseline risk assessment calculations two SWMU groups are defined: 1) one group consists of the two SWMUs associated with the barium nitrate pile, SWMU 16-010(a) and SWMU 16-016(c) and its drainage; 2) the other group consists of the six SWMUs associated with HE disposal at the basket wash facility, SWMUs 16-010(h), 16-010(i), 16-010(k), 16-010(l), 16-010(m), and 16-010(n) and their primary drainages.

SWMU 16-010(a). At the former flash pad, field screening will be initiated on a stratified random sampling grid within the 215 ft x 180 ft area. Stratified random sampling is described in Subsection 4.5.2. Intervals between nodes of the grid will be approximately 20 ft (see Fig. 5-36). Phase I surface samples selected for laboratory analysis will be biased for the three maximum barium values resulting from field screening. Up to ten additional samples will be taken where staining is visible or where positive HE or above-background radiation concentrations are indicated by the field screening. At locations selected for laboratory analysis, 0 to 6 in. of soil will be collected.

SWMU 16-016(c). As explained in Subsection 5.8.1.1 the storage of barium nitrate was very likely within SWMU 16-010(a) rather than northeast of

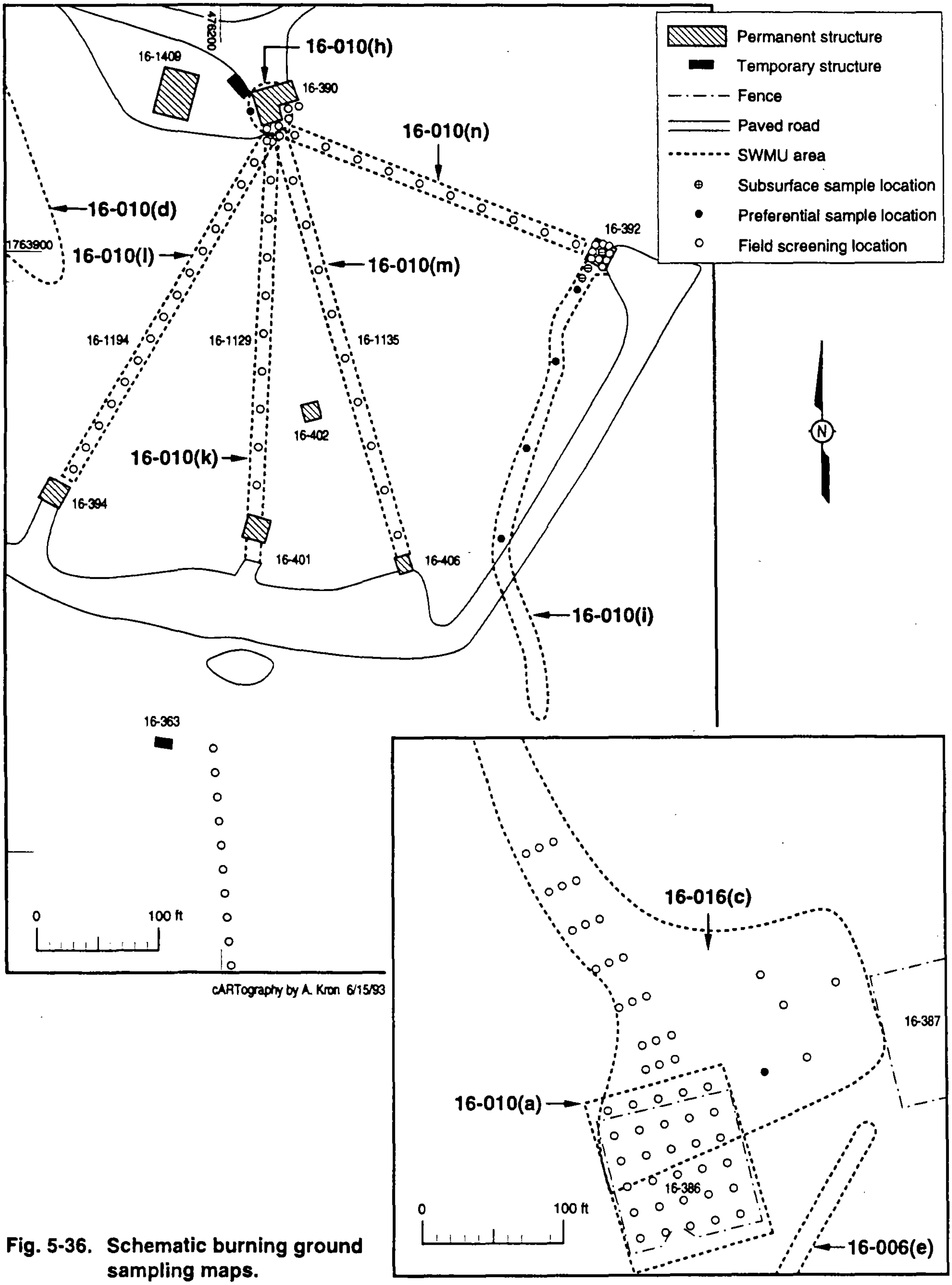


Fig. 5-36. Schematic burning ground sampling maps.

TA-16-386. However, in order to verify that no contamination exists above SALs at this location, four surface soil samples will be screened at this location. The general screening locations are shown on Fig. 5-36.

A stain-biased soil sample will be taken approximately 25 ft due east of the northeast corner post of the fence at SWMU 16-010(a). A blackened stain was observed at this location during field observations. Phase I samples selected for laboratory analysis in this area will be biased for the two maximum values resulting from field screening as well as the stain-biased sample.

The drainage from these units will be field screened with three points, spaced at 10 ft. intervals and centered on the drainage, on a transect located every 30 ft extending 210 ft from the fence at SWMU 16-010(a). Five samples from the drainage will be sent for full laboratory analysis based on the highest field screening values for barium. Up to ten additional surface samples will be taken where staining is visible or where positive HE or above-background radiation concentrations are indicated by the field screening.

SWMU 16-010(h). At the former basket wash facility, five evenly-spaced (approximately 6 ft) points will be field screened on the south side of the building. Two Phase I laboratory surface samples will be collected, biased to the highest barium values. Any samples that yield positive HE on screening tests will also be sent for laboratory analysis. In addition, one sample will be collected from the soil adjacent to the sloping cement pad from which contamination may have washed.

SWMU 16-010(i). On the surface of the sand in the filter bed, ten randomly chosen samples will be field screened. Phase I laboratory surface samples will be biased for two above-background radiation field-screened values. In the absence of anomalous radiation values, the two samples will be field-randomized. Since water entered at the center of the filter bed from the trough, a sample will be taken at the center of the filter bed.

At the three selected locations, core sample will be taken to a depth of 3 ft or bedrock. Field screening of the core will dictate the interval of the core to be analyzed.

As Engineering drawing ENG-C 1106 shows, this unit discharged to a drainage pipe, buried approximately 14 in. below the surface. A sample will be taken directly below the end of the drainage pipe, now exposed, one sample 12 in. upgradient, and one sample 12 in. downgradient. The upgradient and downgradient subsurface samples will be taken 14 to 16 in. below the surface.

Additional surface soil samples will be taken in the drainage leading away from this unit. Four samples will be taken, the first sample 2 ft from the unit where any effluent might have first encountered soil. Three more samples will be taken every 50 ft. At all of these locations, 0 to 6 in. of soil will be collected. See Fig. 5-36 for sample locations.

SWMU 16-010(l). Field inspection of the ground below this trough indicates numerous stain-biased sample locations. From south to north, staining is observed at the 3rd, 7th, 10th, 14th, and 18th anchors. The anchors are approximately 10 ft apart. The trough is compromised at the 13th and 23rd anchors. At these locations and at every joint in the trough from the 23rd anchor to 10 ft from the basket wash facility, soil beneath the trough will be field screened. Full laboratory analysis will be performed on up to ten samples with positive HE field screening values. If three or fewer samples have positive HE values, then up to three samples will be biased for maximum values for barium from field screening. At all of these locations, 0 to 6 in. of soil will be collected.

SWMUs 16-010(k) and 16-010(m). Field inspection shows no stain-biased sample locations at these units. At these two troughs, field screening will commence on the soil directly below the troughs. Ten roughly evenly-spaced samples will be field screened, starting 20 ft from the basket wash facility and terminating at the filter beds (see Fig. 5-36). Full laboratory analysis will be performed on up to 10 samples that yield positive HE values. If fewer than three samples have positive HE, then select the remaining samples (up to three) based on maximum screened locations for barium. At all of these locations, 0 to 6 in. of soil will be collected.

SWMU 16-010(n). A field inspection of this area shows no points for stain-biased sampling, ten roughly evenly-spaced surface soil samples will be field screened. These field-screened samples will commence 20 ft from the basket wash facility and terminate adjacent to the filter bed. Full laboratory analysis will be performed on up to ten samples that yield positive HE values. If fewer than three samples have positive HE, then select the remaining samples (up to three) based on maximum screened locations for barium. At these locations, soil will be collected from 0 to 6 in.

South drainage. The south drainage for much of the burning ground will be field screened at ten randomly selected sediment catchments between the outfall from the former Hypalon pond and the downstream end of the sedimentation area, including locations at 130 ft and 165 ft from the road (see Fig. 5-36). Five sediment traps will be selected based on the highest barium field screening values. Any samples with positive HE field screening readings will also be sampled for laboratory analysis. A likely sample location is at the bottom of the canyon where the drainage flattens and runoff velocity is greatly decreased. At all of these locations, 0 to 6 in. of soil will be collected.

Subsurface samples. Seven subsurface sampling points will be augered (6 to 18 in. or bedrock), collocated with the 27 (or more) surface samples described for SWMUs 16-010(h,i,k,l,m,n). These will be biased to surface points with positive HE screening results. If fewer than seven points yield positive HE screening data, then choose the augered points randomly. If more than seven points yield positive HE screening results, choose those farthest downslope from the basket wash facility.

5.8.4.3 Laboratory Analysis

Full laboratory analyses of samples will be at Level III by the following methods: radionuclides (LANL or DOE method), SVOCs such as HE burn products (SW-846 Method 8270), metals (SW-846 Method 6010), and HE (SW-846 Method 8330). Particular contaminants of concern for this aggregate are barium and HE, including RDX, HMX, TNT, and HE by-products (DNT, DNB, etc.).

5.8.4.4 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the latest revision of the IWP (LANL 1992, 0768). Sampling parameters are summarized in Table 5-46, including appropriate QA/QC field duplicates.

5.9 Cañon de Valle

5.9.1 Background

Although most of the canyons at Los Alamos National Laboratory will be included in the RFI for OU 1049, Canyons, the ER program office has agreed that Cañon de Valle adjacent to OU 1082 should be investigated as part of the RFI for OU 1082. This decision was made because all of the contamination in this section of the canyon is likely to have been derived from TA-16 programmatic activities, and because the principal PCOCs in Cañon de Valle, HE and barium, are the principal PCOCs at OU 1082. Review of the OU 1157 work plan suggests that minimal contamination of Cañon de Valle is likely to be due to operations at TA-8 or TA-9. No effluents streams, such as outfalls, drain from the OU 1157 SWMUs into Cañon de Valle. The only TA-8 or TA-9 activities that could conceivably have impacted the Cañon are firing activities at WW II firing sites. The PCOC list that will be investigated in Cañon de Valle includes all likely potential contaminants from those activities. Thus, potential corrective measures for Cañon de Valle are logically considered in conjunction with those for TA-16.

5.9.1.1 Description and History

Cañon de Valle is the principal drainage for the PRSs located in the northern portions of OU 1082 (Fig. 5-37). These include: SWMU 16-020, the photoprocessing facility (Subsection 5.6); SWMU 16-019, MDA R (Subsection 5.10); SWMU 16-003(k) and SWMU 16-021(c), the HE sumps and outfall at TA-16-260 (Subsection 5.3); SWMU 16-018, MDA P (Subsection 6.1.4.1.1); and SWMUs 16-016(c) and 16-010(a), the barium nitrate pile (Subsection 5.8). This list of SWMUs encompasses most of those that are contaminated with PCOCs above SALs at OU 1082. Other SWMUs to be addressed in two subsequent OU 1082 work plans also may impact this section of Cañon de Valle.

Cañon de Valle heads in the Jemez Mountains northwest of OU 1082. It transects the northeast corner of the operable unit, and forms the northern boundary of the eastern portions of the OU. The canyon has moderately steep walls (see Fig. 5-37) and descends from an elevation of 7 600 ft in the west of the OU to 7 100 ft at the eastern terminus of the OU. Stream flow in the canyon is intermittent; perennial water flow occurs in portions of the

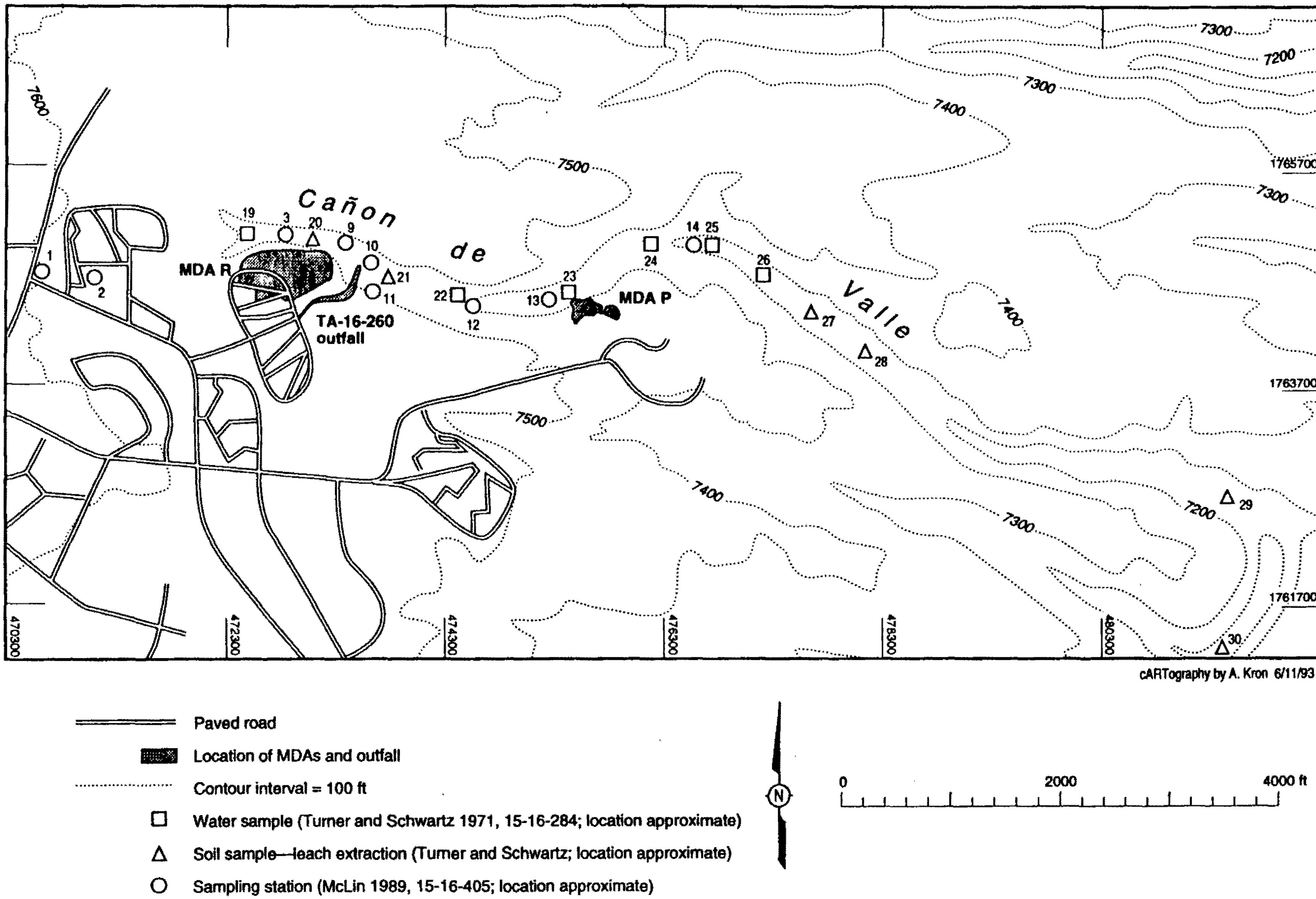


Fig. 5-37. Map of Cañon de Valle showing sampling locations from previous studies (Turner and Schwartz 1971, 15-16-284; McLin 1989, 15-16-405).

canyon north of the operational area of TA-16 due to the influx of process water from TA-16-260. Sediment traps are widely distributed in the canyon bottom.

5.9.1.2 Conceptual Exposure Model - Cañon de Valle

The conceptual exposure model is presented in Fig. 4-10. Site-specific information on potential release sources, chemicals of concern, migration pathways, and potential receptors is presented below.

5.9.1.2.1 Nature and Extent of Contamination

Cañon de Valle soils and water have been analyzed several times during the past 20 years, primarily in conjunction with the studies of sump effluent described in Subsections 5.2 and 5.3. PCOCs in Cañon de Valle are listed in Table 5-47.

Turner and Schwartz (1971, 15-16-284) analyzed twelve soil and water samples collected in Cañon de Valle for HE and barium (Fig. 5-37). These analyses are summarized in Table 5-48. Barium in water ranged up to 30 ppm, and soluble barium in soil ranged up to 9 ppm. HE exhibited a maximum concentration of 4.5 ppm in water and 1.6 ppm in soil.

McLin (1989, 15-16-405) sampled Cañon de Valle during his study of contaminants in and around MDA P. He analyzed water and soil samples at ten locations within the canyon using the EP toxicity procedure. The maximum barium in water was 35.8 mg/L in a "channel below the old pond" (Fig. 5-37) and the maximum soluble barium in soils was 5.6 mg/L in the canyon adjacent to MDA R (see Table 5-49).

In 1992, two soils were sampled in Cañon de Valle, one upstream and one downstream from MDA P. HE was present at moderate levels (< .2 wt % of HMX, RDX, and TNT) (Table 5-50). Barium concentrations were higher than background levels (0.11 wt % in both samples) (Barr 1992, 15-16-371).

Based on the existing data, Cañon de Valle is contaminated with barium and HE at levels above SALs. It is above HE SALs for TNT (40 ppm), and RDX (64 ppm) in soils. Waters were also contaminated above SALs (1 ppm barium, 0.0175 TNT, and 0.00032 RDX).

TABLE 5-47

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, CAÑON DE VALLE

				HE				RAD	METALS				ORGANICS			
PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	UNDETONATED HE	HE DEGRADATION PRODUCTS	HE DETONATOIION PRODUCTS	HE BURN PRODUCTS	URANIUM	METALS SUITE	BARIUM	LEAD	BERYLLIUM	VOLATILES	SEMIVOLATILES	CYANIDE	NITRATE
None	Cañon de Valle	Sediment deposition	N	x	x	x	x	x	x	x	x	x	x	x	x	x
None	Cañon de Valle	Surface runoff	N	x	x	x	x	x	x	x	x	x	x	x	x	x

TABLE 5-48

DATA FROM STUDY OF TURNER AND SCHWARTZ (1971, 15-16-284)

SAMPLE	BARIUM	TNT	HMX/RDX
19 - water	30	3	1.5
20 - soil	9	1	0.6
21 - soil	3	<1	None
22 - water	1	None	None
23 - water	27	None	None
24 - water	15	None	None
25 - water	8	None	None
26 - water	11	None	None
27 - soil	<10	None	None
28 - soil	<10	None	None
29 - soil	Positive	None	None
30 - soil	Positive	None	None

Soils represent 4-hour Soxhlet extractions. For sample locations see Fig. 5-37. All values in ppm. SALs for soil: TNT = 40, RDX = 64, HMX = 4 000, barium = 5 600. SALs for water: RDX = 0.00032 ppm, HMX = 1.8 ppm, TNT = 0.0175 ppm, barium = 1 ppm.

TABLE 5-49

DATA FROM STUDY OF MCLIN (1989, 15-16-405)

SAMPLE	BARIUM [2]	NITRATE [2]	BARIUM [1,3]	NITRATE [3]
1	Dry	Dry	<5.0	<0.2
2	35.8	<0.2	<5.0	<0.3
3	9.9	0.8	5.6	<0.2
9	10.0	0.8	<5.0	<0.2
10	12.4	0.7	<5.0	<0.2
11	9.1	0.8	<5.0	<0.2
12	8.7	0.6	<5.0	<0.2
13	9.5	0.6	<5.0	<0.2
14	9.5	NA	<5.0	<0.2

All concentrations in mg/L. SALs same as Table 5-48 except EP toxicity MCL = 100 ppm barium.

1 EP toxicity test procedure.
2 Water samples.
3 Soil samples. Sample locations shown on Fig. 5-37.

TABLE 5-50

DATA FROM STUDY OF BARR AND KING (1992, 15-16-371 and 15-16-380)

SOIL SAMPLE	BARIUM	TNT	RDX	HMX
Above burning ground	0.14	<0.01	0.11	0.11
Below burning ground	0.14	0.01	0.05	0.08

All values in weight per cent. SALs same as Table 5-48.

5.9.1.2.2 Potential Pathways and Exposure Routes

Chemicals released from PRSs located in the northern region of OU 1082 could have been transported by storm water runoff down drainage channels discharging into Cañon de Valle. Therefore, PCOCs may be located in surface water, sediments, and surface soils in the stream channel. Volatile organic compounds are expected to volatilize into the atmosphere close to the source; therefore, they are unlikely to be present in the stream channel.

Because of institutional controls, there is no public access to this area. In the future, this area may be used for recreational purposes (e.g., camping). Chapter 4 contains a detailed discussion of the migration pathways, potential human receptors, and exposure routes.

5.9.2 Remediation Decisions and Investigation Objectives

Problem Statement (DQO Step 1)

Cañon de Valle receives effluent from three of the SWMU aggregates at TA-16 that are most likely to present a risk to humans; these are: MDA R, the drainage outfall from machining building TA-16-260, and MDA P. Surface samples taken from Cañon de Valle show elevated levels of HE and barium.

The problems for Cañon de Valle are: 1) to determine the extent of contamination in Cañon de Valle in order to perform a baseline risk assessment, and 2) to evaluate whether subsurface soils in the canyon are contaminated. A baseline risk assessment for Cañon de Valle requires information on both average concentration of PCOCs and spatial distribution of such contaminants to help design a Phase II study.

Decision Process (DQO Step 2)

Initial goals for the Phase I studies are: 1) verification/elimination of specific PCOCs for these areas, and 2) providing sufficient Phase I data so that Phase II studies can be implemented in an efficient and cost-effective manner.

Cañon de Valle – surface. If screening assessment confirms contaminant levels different from background and above SALs at Cañon de Valle, the results of Phase I study will be used to perform a baseline risk assessment to determine whether a VCA should be performed, such as installation of a barrier to prevent off-site migration of COCs.

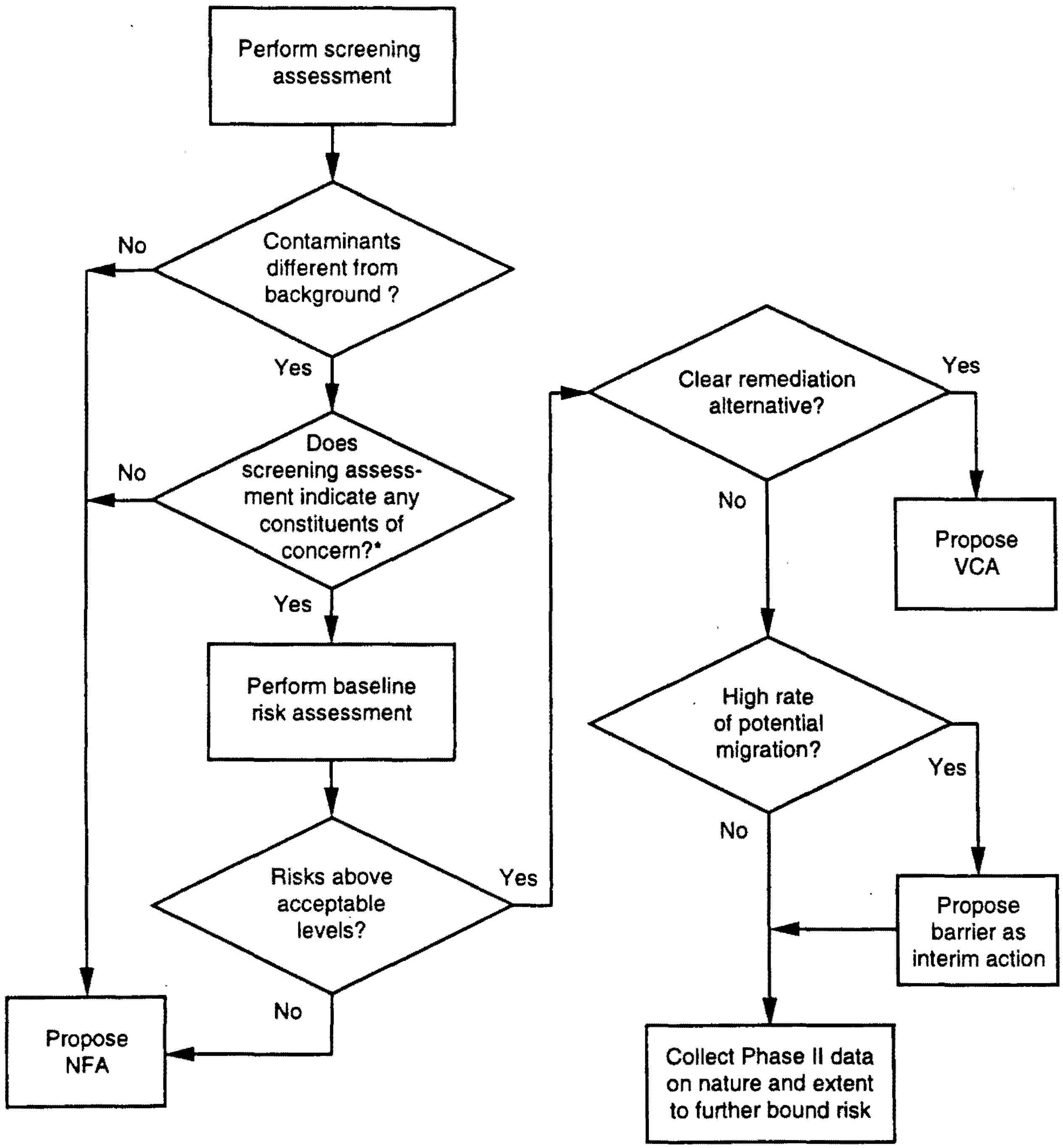
Cañon de Valle – subsurface. No data exist that indicate contamination of the subsurface in Cañon de Valle. Thus, the goal of Phase I for the subsurface is to evaluate whether PCOCs are different from background and exceed SALs or whether multiple contaminants may pose a health risk. If PCOCs are not different, NFA the subsurface. If PCOCs without background exceed SALs, then incorporate the subsurface data into the baseline risk assessment and institute a Phase II study to further define nature and extent of subsurface contamination. A subsidiary question in the subsurface at Cañon de Valle is the possible existence of an alluvial aquifer. If soil moisture measurements indicate a continuous alluvial aquifer in the canyon, then incorporate this information into risk assessment models. EPA guidance suggests use of residential scenario in regions in which alluvial aquifers can be pumped with sufficient yield to serve as a water supply.

Possible remediation alternatives for Cañon de Valle include some combination of: 1) full removal of contaminated soils with long-term disposal in a permitted landfill; and 2) implementation of barriers to inhibit off-site migration. The decision flow logic for Cañon de Valle is shown in Fig. 5-38.

5.9.3 Data Needs and Data Quality Objectives

Decision Inputs and Investigation Boundary (DQO Steps 3 and 4)

Assumptions made for the canyon include: 1) that PCOCs are concentrated in the central channel of the canyon; and 2) that there is a barium and HE contamination problem in the canyon, but the risk to human health under realistic exposure scenarios is unknown.



* PCOCs > SALs or possible multiple contaminant problem

Fig. 5-38. Decision flow for Cañon de Valle.

Questions to be addressed during Phase I are: 1) Are HE, HE by-products, barium, or other metals present at levels that would present a risk to humans, in Cañon de Valle?; 2) What is the nature and extent of migration of contaminants in Cañon de Valle?; and, 3) Is an alluvial aquifer present within Cañon de Valle? Data needed to address these questions are: 1) concentrations of PCOCs in surface and subsurface soils and water; and 2) soil moisture measurements on subsurface soils, particularly directly above the soil/tuff interface.

The domain of interest is the surface and subsurface soils and water in Cañon de Valle in those areas most likely to be impacted by TA-16 operations. Cañon de Valle will be sampled from the effluent point of the MDA R drainages down the canyon for approximately 6 000 ft. This distance allows evaluation of contaminant contribution from three principal SWMUs that may impact Cañon de Valle: MDA R, the TA-16-260 outfall, and MDA P, but avoids contaminant contributions from TA-14, which is located downstream from the TA-16 operation area on the north of Cañon de Valle. If data from this section of Cañon de Valle suggest that TA-16 contamination is being transported down Cañon de Valle beyond the furthest downstream point investigated, then additional data from further down Cañon de Valle will be collected in Phase II. In addition, other portions of Cañon de Valle will be investigated by the Canyons OU.

Decision Logic (DQO Step 5)

Cañon de Valle – surface. Based on the results of the Phase I study of Cañon de Valle, perform a preliminary baseline risk assessment. Use the results of this baseline risk assessment to decide between the following options: 1) propose Phase II study to obtain additional information on the nature and extent of contamination and transport of contaminants if the baseline risk assessment suggests significant levels of risk (between 10^{-4} and 10^{-6}), but additional data may further bound the risk; 2) proceed to VCA if significant (between 10^{-4} and 10^{-6}) risk is demonstrated, and a clear remediation alternative exists for the canyon; 3) propose NFA if the risk is minimal (< 10^{-4} to 10^{-6}). If Phase I data suggest that the rate of potential contaminant migration in Cañon de Valle is high, installation of a barrier to prevent off-site migration may be recommended as an interim action.

Cañon de Valle – subsurface. Soil concentrations for subsurface samples will be used to compare to background and SALs for metals (particularly barium), HE, and other PCOCs. If the concentrations of PCOCs are at or below background and SALs, then propose NFA for the subsurface. If more than one PCOC is above background but below SALs, then perform multiple contaminant screening to evaluate whether any PCOCs are of concern in combination with other constituents. In either case, PCOC and soil moisture data will be incorporated into the proposed baseline risk assessment for the surface soils.

The decisions described in the previous two sections for Cañon de Valle will be based on sample means of soil and water samples from sediment traps in Cañon de Valle.

Design Criteria (DQO Step 6)

The purpose of surface sampling Cañon de Valle is to obtain information about contaminant extent, migration, and transport, so the samples will be located to provide approximately uniform coverage of the region of interest. Geomorphologic mapping will provide information on the heterogeneity of sediments and rock outcrop in the canyon bottom. In Cañon de Valle, 30 sediment traps and associated water will be selected so that a sample is taken approximately every 200 ft. These samples of sediment traps will be selected to provide adequate coverage of the diversity of sediments in the canyon, based on the geomorphologic mapping. Professional judgment suggests that 30 samples will be adequate for an initial baseline risk assessment.

Because the primary goal for subsurface sampling in Cañon de Valle is a reconnaissance survey, the subsurface samples will be biased (IWP, Appendix H). Ten laboratory samples will be selected out of up to 60 field-screened subsurface samples. With 10 samples, the probability of detecting contamination is 0.87 if 20% or more of the site is contaminated (see Subsection 4.5, Chapter 4). The use of field screening makes the reconnaissance sampling probability statement very conservative. The deepest subsurface sample from each of the 30 sampling locations will be sampled for soil moisture. In order to determine whether an alluvial aquifer is present, it is necessary to have comprehensive, unbiased data.

The Cañon de Valle sampling will assume that the potential contaminants are relatively homogeneously distributed on a sediment-trap scale.

5.9.4 Sampling and Analysis Plans

Phase I sampling is designed to provide sufficient data to perform a baseline risk assessment for Cañon de Valle.

SOPs used in this sampling plan are listed in Table 5-51. Sample numbers and necessary analyses are shown in Table 5-52. Field-screening methods are described in Subsection 4.7. SOPs for these procedures are currently in preparation.

TABLE 5-51

STANDARD OPERATING PROCEDURES FOR FIELD ACTIVITIES

LANL-ER-SOP	TITLE	NOTES
01.02, R0	Sample Containers and Preservation	Applied to all laboratory samples
01.04, R1	Sample Control and Field Documentation	Applied to all laboratory samples
06.10, R0	Hand Auger and Thin-Wall Tube Sampler	
06.13, R0	Surface Water Sampling	All water samples
11.01, R0	Measurement of Bulk Dowsing, Dry Dowing, Water Content, and Porosity of Soil	Subsurface Samples

5.9.4.1 Engineering Surveys

The engineering surveys will include a geomorphological study of Cañon de Valle. This survey will document the locations and morphologies of sediment traps, the locations and volumes of water flow, and the locations of tributaries to the canyon. Subsequent to the geomorphic survey, an engineering survey will be done to locate, stake, and document the sampling points for sediment and water analysis. All sample locations will be registered on a base map, scale 1:7 200. If, during the course of sampling, any sample points must be relocated, the new position will be resurveyed and the revised locations will be indicated on the base map.

TABLE 5-52

SUMMARY OF SITE SURVEYS, SAMPLING AND ANALYSIS FOR CAÑON DE VALLE

		Laboratory Samples							Field Screening							Field Lab.						Laboratory Analyses											
			Structure		Surface		Subsurface								A					B				C				D	E	F	G	H	
PRS	PRS TYPE	Sampled Media		Field dup		Field dup		Field dup	Gross Alpha	Gross Gamma/Beta	Organic Vapor	HE Spot Test	Geophysics Surface	Barium - LIBS	Geological Characterization	Gross Alpha	Gross Gamma/Beta	Tritium	Volatile Organics	XRF	Soil Moisture	Alpha spectroscopy	Gamma spectroscopy	Nitrate	Total Uranium	Isotopic Plutonium	Isotopic Uranium	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCBs (SW 8080)	High Explosives (SW 8330)	Cyanide
None	Cañon de Valle	Sediment			30	2	10	1				30#		30#	30						30		40	30	40			10	40	40		40	40
None	Cañon de Valle	Water*			30	2																	30*	30*	30*			30*	30*	30*		30*	30*

* Samples taken if water present at sediment sampling points

\# = The actual number of subsurface samples will depend on the depth to bedrock.

A, B = not applicable; D, H = full suite, subsurface and water samples; D volatiles in subsurface and water only. E = full suite (PAH); F = 1082 suite.

The engineering survey will be performed by a licensed professional under the supervision of the field team leader.

5.9.4.2 Sampling

Thirty sediment traps suitable for sampling will be located and flagged in Cañon de Valle at approximately 200 ft intervals for 6 000 ft downstream in Cañon de Valle from MDA R (Fig. 5-39).

Cañon de Valle will be sampled at locations surveyed in as described above. Thirty sediment samples will be taken at approximately 200 ft intervals eastward along the channel within Cañon de Valle. Water samples will be taken at those locations containing standing or flowing water. At each location, a hand-augered sample will be taken to bedrock. Each core will be divided into 6 in. segments. The upper 0 to 6 in. of each will be sent for laboratory analysis. The lower 0 to 6 in. will be analyzed for soil moisture content. All subsurface segments will be field screened for HE and barium. The following hierarchical biasing scheme will be used to select subsurface laboratory samples: 1) up to ten samples that yield positive HE spot tests, and 2) additional samples to a total of ten with the highest barium field screening results. If more than ten samples yield positive HE spot tests, then select at most one subsurface sample in an individual core and choose those samples collected farthest downstream in the canyon.

5.9.4.3 Laboratory Analysis

Full laboratory analyses of samples will be at Level III by the following methods: for radionuclides (LANL or DOE method), metals (SW-846 Method 6010), semivolatiles (SW-846 Method 8270), and HE and its by-products (SW-846 Method 8330). Potential contaminants of particular concern in Cañon de Valle are HE (HMX, RDX, TNT), barium, silver, and HE degradation products and impurities.

5.9.4.4 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the latest revision of the IWP (LANL 1992, 0768). Sampling parameters for Cañon de Valle including appropriate QA/QC field duplicates are provided in Table 5-52.

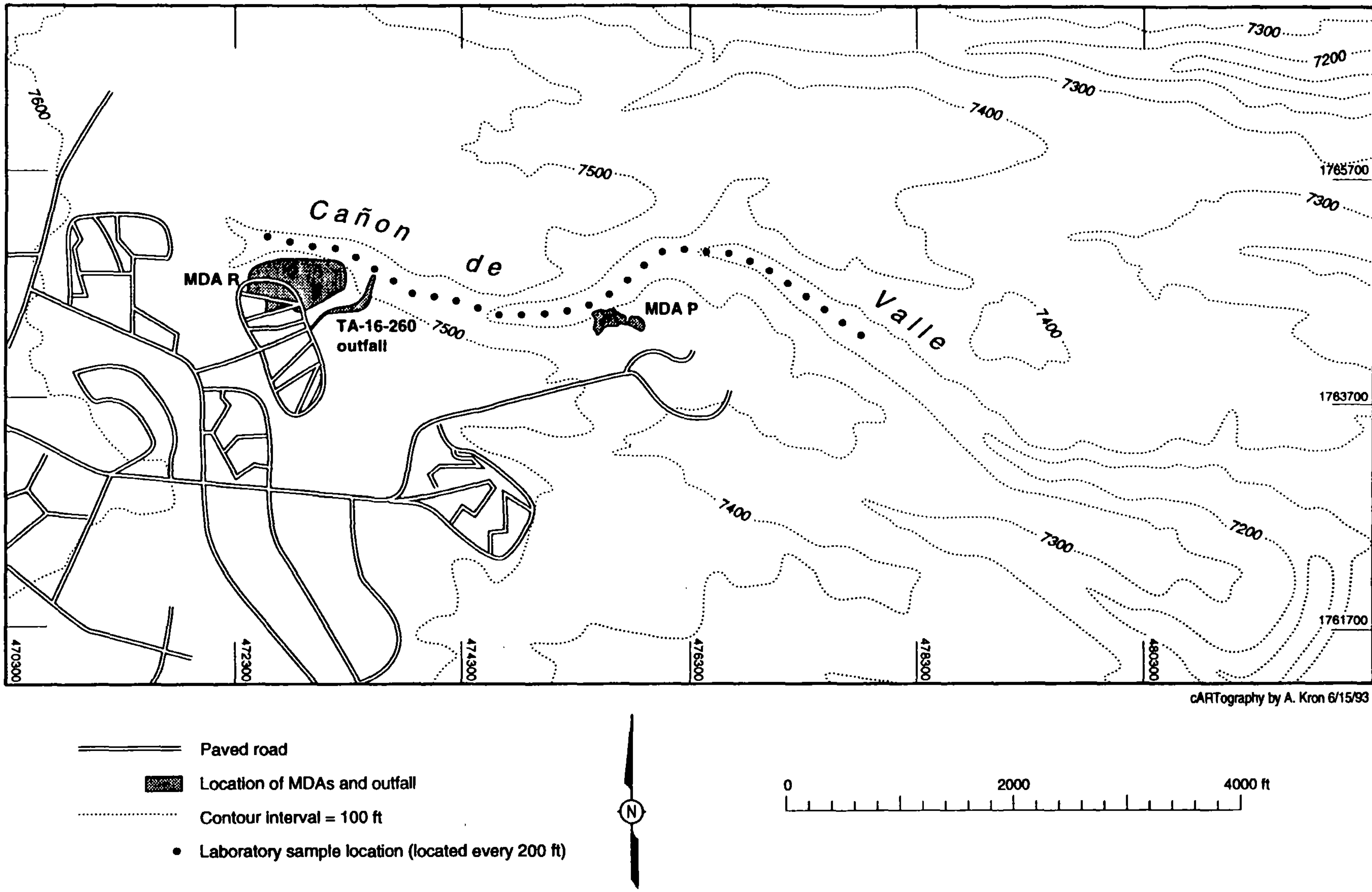


Fig. 5-39. Laboratory sampling locations in Cañon de Valle.

5.10 MDA R, SWMU 16-019

5.10.1 Background

5.10.1.1 Description and History

SWMU 16-019 is a material disposal area that consists of the WW II S-Site burning ground and its waste disposal site. It is located north of TA-16-260 and south of Cañon de Valle (see Fig. 5-6). The total area of MDA R was estimated to be 2.27 acres in 1965 (Russo 1965, 15-16-376), although examination of a 1948 aerial photograph suggests that the cleared area associated with the WW II area was slightly larger. MDA R lies on level terrain with a moderate slope to the north, dropping off 80 ft into Cañon de Valle. An oblique-angle photograph taken on October 13, 1949, shows three distinct bermed U-shaped pits each containing a blackened area. Each pit was approximately 75 x 75 ft. A road encircled the pits and the area was fenced (Photograph 12230). A photograph obtained from the Los Alamos County Historical Archives, circa 1948, shows darkened staining from the westernmost pit downslope into the canyon (Photograph 15-16-377). A WW II-era site worker recalls that HE was burned in an open field prior to construction of the bermed pits (Hickmott and Martin 1993, 15-16-448). Presently, the area is covered with grasses and pine trees have been re-established.

MDA R was constructed in the mid-1940s and was used as a burning ground for waste explosives prior to the construction of the present burn site in 1951. HE burning was initially in an open field (Hickmott and Martin 1993, 15-16-448); later, three bermed pits were constructed (Abernathy et al. 1945, 15-16-420). A 1948 memo mentions an explosion and fire at the burning ground and describes how HE scrap was collected, broken up, and burned (Converse 1948, 15-16-143). The site was abandoned sometime in the early 1950s, probably in 1951. During construction of the 260-Line, the berms and surface soil at MDA R were graded northward into Cañon de Valle (LANL 1990, 0145). Both the SWMU Report and the Environmental Restoration Release Site Data Base inaccurately state that there is no evidence that the site was ever used for the disposal of debris. A field examination of MDA R by OU 1082 team members on August 14, 1992, revealed much debris that had been pushed northward over the edge of what was the MDA R burning ground toward the canyon floor. Oil cans, glass vials, metal structures, and coaxial cables were observed below MDA R on the face of the canyon. The debris is being held back by a natural barrier of wood and trees that resulted from clearing the area for TA-16-260. There is no information available concerning decommissioning or decontamination activities.

5.10.1.2 Conceptual Exposure Model - MDA R

The conceptual exposure model is presented in Fig. 4-4. Site-specific information on potential release sources, chemicals of concern, migration pathways, and potential receptors is presented below.

5.10.1.2.1 Nature and Extent of Contamination

There is no existing analytical data for MDA R. By analogy with the modern burning ground and its waste disposal area, MDA P, the likely COCs within this SWMU include HE, HE by-product residual from burning, semivolatiles, fuel oil, uranium, asbestos, and metals, particularly barium. Contamination is likely to be present on both the surface and near surface because of the bulldozing of the site during the early 1950s. PCOCs for MDA R are found in Table 5-53.

5.10.1.2.2 Potential Pathways and Exposure Routes

MDA R consists of potentially-contaminated subsurface/surface soils and debris that have been pushed into the canyon. The dominant pathway for off-site migration is by surface water transport down the drainages to Cañon de Valle. Contaminants may accumulate in sedimentation areas in drainages. Subsurface contamination that may be present could be brought to the surface via excavation or erosion.

Current human receptors are limited to on-site workers. Chapter 4 contains a detailed discussion of the migration pathways, conversion mechanisms, human receptors, and exposure routes.

TABLE 5-53

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, MDA R

PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	HE				RAD	METALS		
				UNDETONATED HE	HE DETONATION PRODUCTS	HE DEGRADATION PRODUCTS	HE BURN PRODUCTS	URANIUM	METALS SUITE	BARIUM	ASBESTOS
16-019	MDA R	Disposal area	N	x	x	x	x	x	x	x	x

5.10.2 Remediation Decisions and Investigation Objectives

Problem Statement (DQO Step 1)

SWMU 16-019. MDA R was used as a burning ground for waste explosives and it was also used for the disposal of other debris. Based on information about the present burning ground, PCOCs include HE, HE by-products, barium, and uranium. Similarly, based on our knowledge of contamination at the modern burning ground and its waste disposal area, MDA P, the likelihood of contamination at the SWMU is high. Both surface and subsurface contamination are possible as a result of bulldozing at the site.

The problem during Phase I will be to determine whether PCOCs are present at levels that are different from background and above SALs at MDA R or in its drainages, which lead into Cañon de Valle. An additional Phase I goal is to remove the debris that is scattered on the north side of the SWMU.

Decision Process (DQO Step 2)

A Phase I study will be conducted to determine whether contamination is present in MDA R.

For MDA R, initial goals for the Phase I studies are: 1) verification/elimination of specific PCOCs for these areas; and 2) providing sufficient Phase I data so that Phase II studies can be implemented in an efficient and cost-effective manner.

The results of Phase I study of MDA R and its drainages will be used to determine which of the following actions should be recommended for the MDA R site itself:

1. Phase II study (if contaminants are different from background and exceed SALs). Phase II would include a baseline risk assessment.

2. NFA (if contaminants are not different from background or do not exceed SALs).

Possible remediation alternatives for MDA R are analogous to those proposed for MDA P and include some combination of: 1) capping in-place with long-term monitoring; 2) full removal of contaminated soils with long-term disposal in a permitted landfill.

Subsequent to completion of remediation, MDA R will be resampled to verify cleanup. Decision logic is shown in Fig. 5-40.

5.10.3 Data Needs and Data Quality Objectives

Decision Inputs and Investigation Boundary (DQO Steps 3 and 4)

SWMU 16-019. Assumptions made include: 1) that the drainages serve as the primary mechanism for egress of PCOCs from MDA R, and may concentrate contaminants in their sediment traps; and 2) that the subsidiary COCs (HE by-products, metals other than barium) do not have radically different deposition and transport mechanisms than HE, uranium, and barium. So, field screening for these three contaminants will allow us to determine the presence of other PCOCs. Although the second assumption is clearly not true in detail, existing data and modeling suggest that the semivolatile HE by-products (e.g., DNT) are not strongly fractionated from TNT in many reference landscapes (Layton et al. 1987, 15-16-447). In addition, those PCOCs that are field screened are by far the most likely to present a health risk at this site.

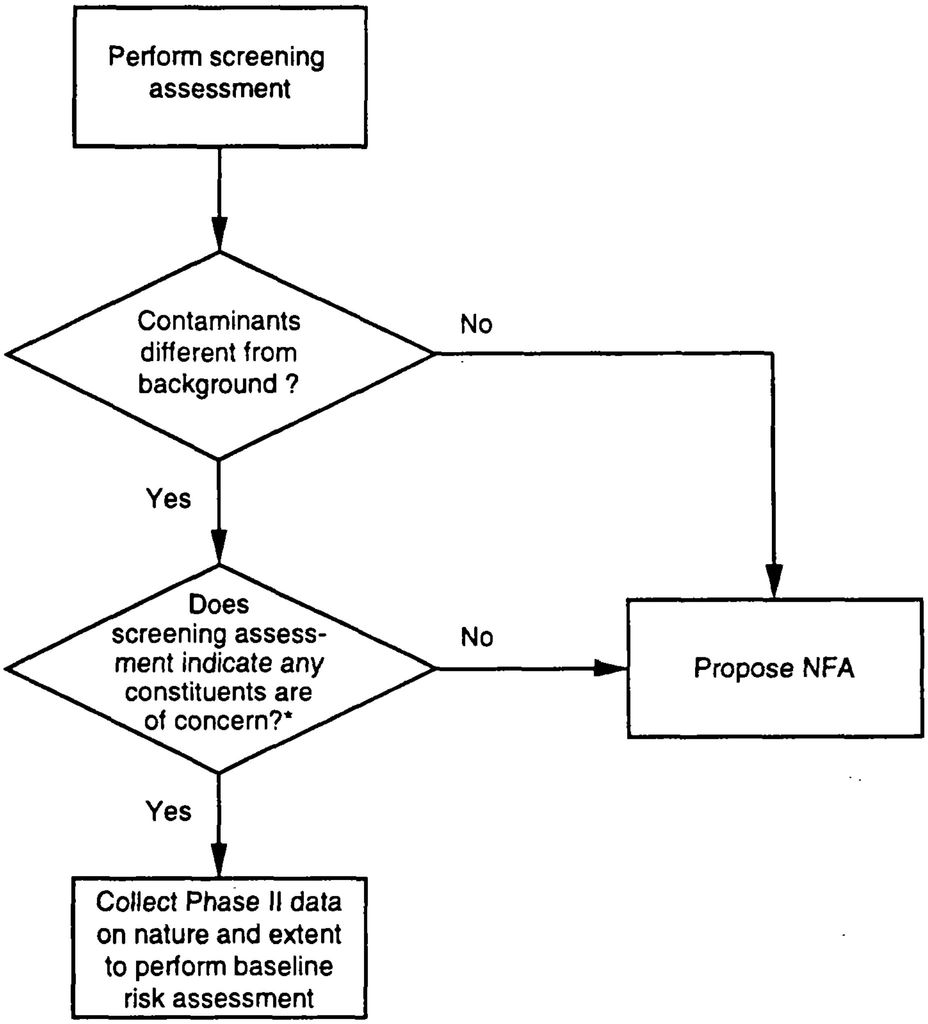
The decision process will be applied to the surface and subsurface soils of MDA R. Subsurface soils of MDA R will be considered to bedrock during Phase I.

In Phase I the following questions will be addressed.

1. Do levels of HE, HE by-products, barium, or other PCOCs exceed SALs in the surface soils or drainages of MDA R?

2. Do levels of HE, HE by-products, barium, or other PCOCs exceed SALs in the subsurface soils of MDA R?

Debris on the north side of the landfill will be removed. This debris will need to be field-screened for radiation and HE as part of a proper disposal process.



* PCOCs > SALs or possible multiple contaminant problem

Fig. 5-40. Decision flow for MDA R.

The data needed to answer these two questions are the concentrations of HE, HE by-products, barium, and other PCOCs in the surface and subsurface soils of MDA R, and the surface soils of the MDA R drainages.

Decision Logic (DQO Step 5)

SWMU 16-019. If contaminant levels are different from background and above SALs in the surface or subsurface soils of MDA R, implement a Phase II study to determine nature and extent of contamination. Otherwise, NFA will be recommended for MDA R.

If contaminants exceed SALs in the drainages of MDA R into Cañon de Valle, propose Phase II study to determine nature and extent of contamination in the drainages and transport of contaminants into Cañon de Valle.

The reconnaissance decisions to determine presence or absence of contaminants at MDA R and in its drainages will be based on sample maxima.

Design Criteria (DQO Step 6)

SWMU 16-019. The principal design criteria for MDA R is to locate a potentially small (< 100 ft), probably buried waste disposal site within a large area. A reconnaissance sampling approach incorporating judgmental location of samples will be used for MDA R (IWP, Appendix H). In each case, laboratory samples will be analyzed for HE, HE by-products, radionuclides, barium, and other metals.

Some assumptions made in designing this sampling plan for MDA R include: 1) that bulldozing of the site in the early 1950s would probably have buried the potentially-contaminated areas by as much as 2 to 3 ft; 2) that although much of the waste may be buried, it is likely that mixing of the bulldozed material would be such that surface manifestation of the buried waste will remain near the buried waste; 3) that the waste disposal site for HE disposal was located on or near the canyon rim in the area north of the three bermed enclosures; 4) that during decommissioning of the burning pits, they were covered with fill, rather than being excavated and removed; and, 5) that PCOCs would be concentrated in the sediment traps draining the MDA.

For the surface soils of MDA R, field screening techniques will be used to bias for locations with high values of HE, radiation, and barium as will other field indications such as staining or unusual lack of vegetation. The field screening measurements will be taken on a 75 ft grid over the entire area of MDA R, as defined by examination of aerial photographs. The grid spacing is based on the fact that the burn pits in the historical aerial photographs are approximately 75 x 75 ft and the likely size of the MDA R waste disposal pit was probably 50 to 150 ft in length, by analogy with MDA P. However, the grid spacing will be halved, to 37.5 ft, over a 500 x 300 ft area directly over the burn pits themselves, because PCOCs in each pit are likely to be heterogeneously distributed. On the basis of field screening, 15 3-ft core samples will be selected for laboratory analysis. The following hierarchical biasing scheme will be used: 1) any sample yielding positive HE; 2) any sample yielding above-background radiation; and, 3) any sample with barium higher than two times background.

Applying the reconnaissance sampling approach to the laboratory samples, a sample population of 15 will detect contamination with a probability of .78 if 10% of the near surface is contaminated or with a probability of .96 if 20% of the site is contaminated.

For the drainage channels from MDA R into Cañon de Valle, field screening techniques will be used to select samples from 5 sediment traps from two drainages. In the absence of field indications, sediment traps will be selected at approximately evenly-spaced intervals to provide uniform coverage of the region of interest. Considering each drainage individually, a sample population of 5 will detect contamination with a probability of .66 if 20% of each drainage is contaminated or with a probability of .9 if 40% of the site is contaminated.

Subsurface sampling of MDA R will be conducted by drilling eight boreholes to bedrock in areas judged likely to contain contaminants if subsurface contamination is present. The locations of the three bermed burn pits may have had fill bulldozed over them; thus, they are likely locations for subsurface contamination. They can be located accurately by study of 1948 aerial photographs. Based on those aerial photographs, three boreholes will be drilled at the likely location of those pits. Five boreholes will be located at

75 ft intervals on the canyon rim north of the location of the burn pits because examination of 1948 aerial photographs shows a road terminating at the canyon rim north of these pits. It is likely that this road was used to haul burn debris to the canyon for canyon-side disposal; a similar relation between the present burning ground and its disposal area, MDA P, existed from the early 1950s through 1984. The location of these drill cores may be biased by field screening evidence of contamination. A sample population of 8 will detect contamination with a probability of .81 if 20% of the subsurface is contaminated or with a probability of .87 if 25% of the site is contaminated.

5.10.4 Sampling and Analysis Plans

Phase I sampling is intended to determine if releases are associated with these units. The Phase II sampling plan, if necessary, will further define the nature, extent, and rate of migration of any release identified in Phase I.

SOPs used in this sampling plan are listed in Table 5-54. Sample numbers and necessary analyses are shown in Table 5-55. Field-screening methods are described in Subsection 4.7. SOPs for these procedures are currently in preparation.

TABLE 5-54

STANDARD OPERATING PROCEDURES FOR FIELD ACTIVITIES

LANL-ER-SOP	TITLE	NOTES
01.02, R0	Sample Containers and Preservation	Applied to all laboratory samples
01.04, R1	Sample Control and Field Documentation	Applied to all laboratory samples
04.01, R0	Drilling Methods and Drill Site Management	Cores to bedrock
06.10, R0	Hand Auger and Thin-Wall Tube Sampler	Subsurface soil samples
06.11, R0	Stainless Steel Surface Soil Sampler	All 0 to 6 in. surface samples
12.01, R0	Field Logging, Handling, and Documentation of Borehole Materials	All cored samples

TABLE 5-55

SUMMARY OF SITE SURVEYS, SAMPLING, AND ANALYSIS FOR MDA R

			Laboratory Samples						Field Screening							Field Lab.						Laboratory Analyses											
PRS	PRS TYPE	Sampled Media	Structure	Field dup	Surface	Field dup	Subsurface	Field dup	Gross Alpha	Gross Gamma/Beta	Organic Vapor	HE Spot Test	Geophysics Surface	Barium - LIBS	A Geological Characterization	Gross Alpha	Gross Gamma/Beta	Tritium	Volatile Organics	B XRF	Soil Moisture	Alpha spectroscopy	Gamma spectroscopy	C Beta spectroscopy	Total Uranium	Isotopic Plutonium	Isotopic Uranium	D VOA (SW 8240)	E Semivolatiles (SW 8270)	F Metals (SW 6010)	G Asbestos	H High Explosives (SW 8330)	Cyanide
16-019	MDA R	Soil			25	2				135		135		135											25				25	25	25	25	
16-019	MDA R	Tuff/soil					8	1		8#		8#		8#											8				8	8	8	8	

= The actual number of samples will depend on the results of the field screening and the depth of the cores.
A, B, C, D = not applicable; E = full suite (PAH); F = 1082 suite; H = full suite.

5.10.4.1 Engineering Surveys

SWMU 16-019. In the field, the engineering survey will locate, stake, and document the SWMU boundaries, the sampling points for radiation screening, HE screening, surface and subsurface sampling, and all surface engineering and geomorphic features. All sample locations will be registered on a base map, scale 1:7 200. If, during the course of sampling, any sample points must be relocated, the new position will be resurveyed and the revised locations will be indicated on the map. The engineering survey will be performed by a licensed professional under the supervision of the field team leader.

Prior to these land surveys a removal of debris scattered on the north side of the landfill will be performed. All debris will be field-screened for radiation and HE, flashed at the TA-16 burning ground, and removed to an appropriate permitted landfill.

The boundaries of SWMU 16-019 will be located and flagged. SWMU 16-019 will be delineated based on detailed comparisons between 1948 aerial photographs and 1:7 200 orthophotographs, as well as a detailed geomorphic study of the disturbed fill material on the north side of the SWMU. The likely locations of the bermed areas will be staked, based on detailed examination of historic aerial photographs. The two principal drainages will be mapped from their confluence with Cañon de Valle southward to their terminus or to the road, whichever occurs first. Ten approximately evenly-spaced sediment traps in each of the two channels will be located and flagged for field screening, and subsequent sampling. Identified locations should be sufficiently variable in sediment type to provide a representative subset of sediments.

A 75 ft sampling grid for HE screening, barium screening, and radiation screening are required over this SWMU. The approximate coordinates of this grid will be:

CORNER	EAST	NORTH
SW	472400	1764600
NW	472400	1765100
NE	473400	1765100
SE	473400	1764600

In a 500 x 300 ft area over the three burning pits, the grid spacing will be halved to 37.5 ft (see Fig. 5-41).

5.10.4.2 Sampling

Low-energy gamma radiation measurements, HE field swipe tests, and barium field screening will be reported at the grid nodes and in the drainage channels surveyed as described above (Baytos 1991, 15-16-339). Measurements will be examined for anomalies that could be used to guide the laboratory sampling described in the following subsections.

If the radiation, barium, and HE surveys of SWMU 16-019 yield negative results, then 15 field-randomized 3-ft core samples will be taken within the SWMU boundaries at grid node points. However, if any of the survey points yield above background concentrations for radiation, barium, or HE, then laboratory samples will be collected and analyzed at those points. At these sampling locations, 0 to 3 ft of soil will be collected. These 3 ft samples will be divided into 6 in. intervals and field screened for HE, radiation, and barium. One 6 in. sample for laboratory analysis will be taken from each core using the following hierarchical biasing scheme: 1) a sample with a positive HE reading; 2) a sample with an above-background radiation reading; and, 3) the segment with the highest barium field screening reading.

Two drainages crossing MDA R will be sampled 5 times, biased by the HE screening and radiation screening described. In the absence of positive results for the radiation and HE field screening, five sediment traps at roughly evenly-spaced intervals will be taken from the southward terminus of the surveyed zone to the confluence of Cañon de Valle. At these locations, 0 to 6 in. of soil will be collected.

Eight drill cores extending to bedrock will be sampled within the boundaries of SWMU 16-019. Three of these will be located within the surveyed boundaries of each of the three U-shaped berms. The other five will be located along the north rim of Cañon de Valle, evenly spaced over a distance of 375 ft and centered on the surveyed locations of the berms, unless surface screening suggests the drill holes should be located elsewhere (Fig. 5-41). Each core will be divided into 6 in. segments. These segments

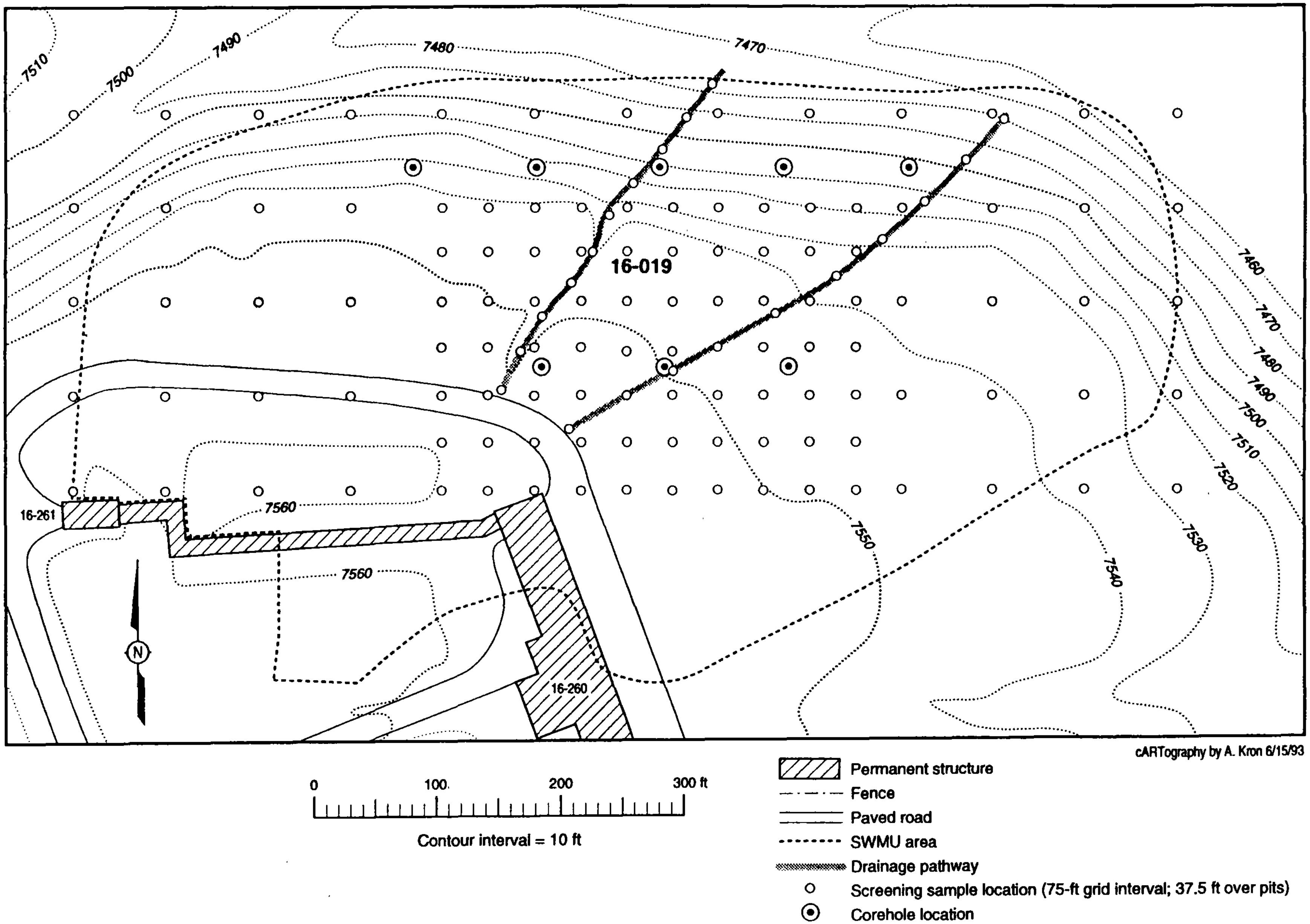


Fig. 5-41. Schematic MDA R sampling grid.

will be field screened for HE, radiation, and barium. One sample for laboratory analysis will be taken from each core using the following hierarchical biasing scheme: 1) a sample with a positive HE reading; 2) a sample with an above-background radiation reading; 3) the segment with the highest barium field screening reading.

5.10.4.3 Laboratory Analysis

Full laboratory analyses of samples will be at Level III by the following methods: for radionuclides (LANL or DOE method), metals (SW-846 Method 6010), semivolatile organics (SW-846 Method 8270), and HE and its by-products (SW-846 Method 8330). Based on knowledge of contaminants at the modern burning ground, potential contaminants of particular concern are barium, uranium, HE (HMX, RDX, and TNT), and HE by-products such as DNT, TNB, and DNB.

5.10.4.4 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the latest revision of the IWP (LANL 1992, 0768). Sampling parameters for MDA R, including appropriate QA/QC field duplicates are provided in Table 5-55.

5.11 Surface Waste Disposal Areas, SWMUs 16-009 and 16-016(a,b)

5.11.1 Background

SWMUs 16-009, 16-016(a), and 16-016(b) are included in an aggregate because all of them were used as surface waste disposal areas. In addition, all of them have poorly-characterized histories of waste disposal. Our knowledge of waste disposal practices and SWMU histories are primarily derived from studies of aerial photographs.

5.11.1.1 Description and History

SWMU 16-009. SWMU 16-009 was a burn treatment area. It was located in a level field near the western end of S-Site north of the administration area (Fig. 5-1). It was located roughly 200 ft northwest of TA-16-54, the WW II barium nitrate grinding facility. The burning area was completed in August 1945 as a trash-burning site (Abernathy et al. 1945, 15-16-420). It was not located in the old HE exclusion area, and during the time of its operation a dedicated HE burning area existed at the MDA R burning ground. Aerial photographs indicate that the burn area was a bermed enclosure about 100 ft square. The berm was about 6 ft high; it surrounded the area on three sides. On the east side was an opening large enough to allow trucks access to the enclosed area. The burn area was in use from the late 1940s into the 1960s. The site was decommissioned and the berm leveled. Aerial photos indicate that no further use was made of the site; it is presently an open field of grasses and weeds.

SWMU 16-016(a). SWMU 16-016(a) was a landfill located in the WW II S-Site complex. It is located in a partially forested, level area northeast of bunker TA-16-76 (Fig. 5-42).

It was designated as a SWMU because it was reported in 1965 that an unspecified amount of metal had been buried in the area during WW II (LASL 1965, 15-16-125). A magnetometer survey was conducted over the area, metallic debris was located, and this material was removed to the Area P landfill (Williams 1965, 15-16-126). Examination of aerial photographs from 1948, 1958, and June 1965 do not reveal any obvious surface disturbances in the purported landfill area. Location of the landfill was

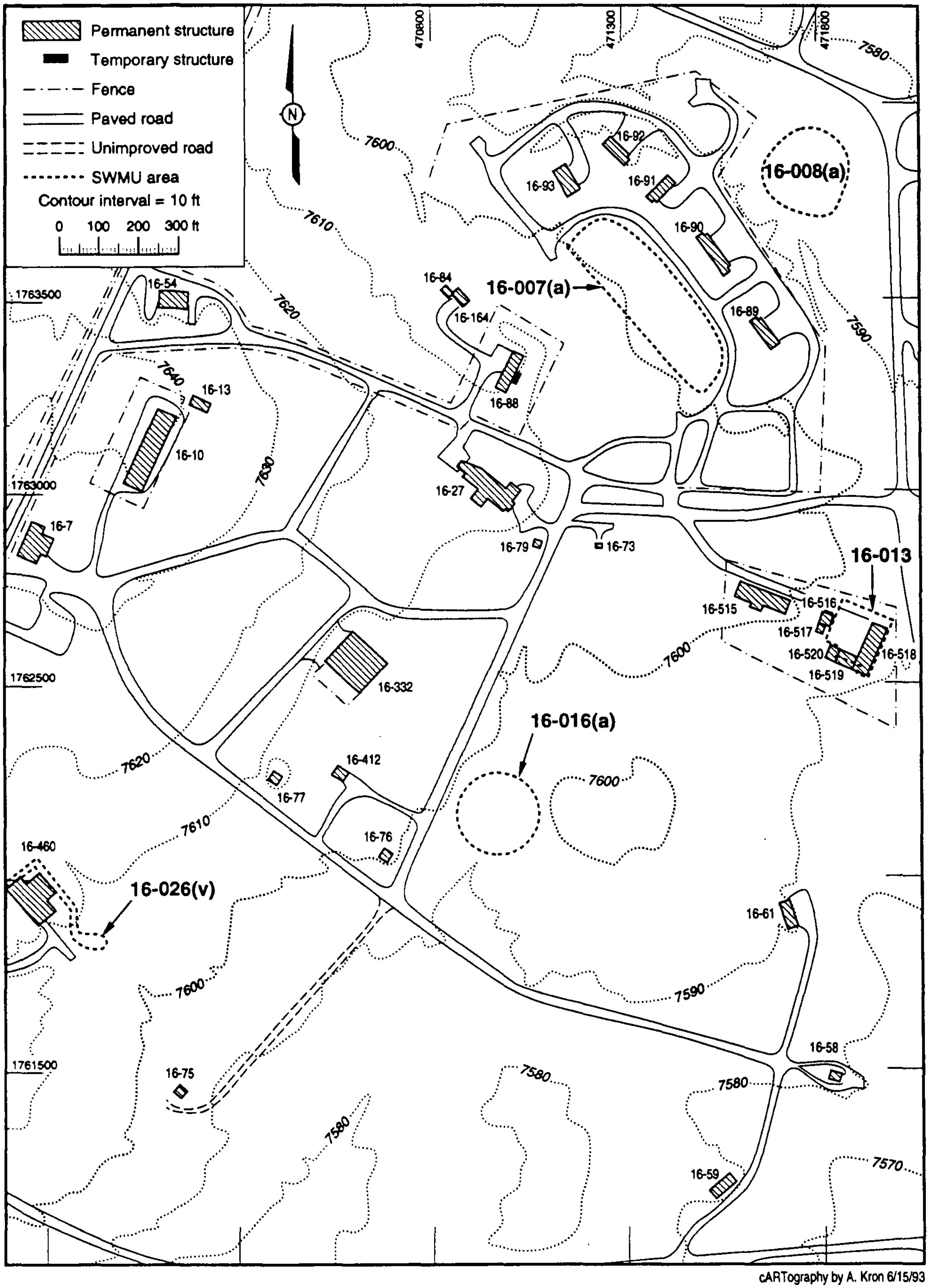


Fig. 5-42. World War II exclusion area.

specified as S43 W51 in LASL coordinates in a 1965 memo (Williams 1965, 15-16-126).

SWMU 16-016(b). SWMU 16-016(b) is a landfill consisting of broken concrete, mounds of soil, and other debris located approximately 500 ft north of TA-16-540 (Fig. 5-1). The area is a level open field with scrub growth of small trees and bushes. The 1987 CEARP field survey revealed traces of HE contamination in the landfill (DOE 1987, 0264). Examination of aerial photographs suggests that the rubble was deposited in the landfill between 1948 and 1958.

5.11.1.2 Conceptual Exposure Model - Surface Disposal

The conceptual exposure model is presented in Fig. 4-8. Site-specific information on potential release sources, chemicals of concern, migration pathways, and potential receptors is presented below.

5.11.1.2.1 Nature and Extent of Contamination

No quantitative data exists for any of the three SWMUs composing this aggregate. PCOCs for the SWMUs are listed in Table 5-56.

SWMU 16-009. SWMU 16-009 served as a waste burning area during the early days of S-Site operations. It probably was not used for burning HE, but may have been used for burning barium nitrate-contaminated material from TA-16-54. Thus, possible COCs in this locality are barium, uranium, other metals, and perhaps semivolatile organics.

SWMU 16-016(a). Likely contaminants in SWMU 16-016(a) are metals and perhaps HE and HE by-products.

SWMU 16-016(b). Likely contaminants include HE, HE by-products, and perhaps metals.

5.11.1.2.2 Potential Pathways and Exposure Routes

This aggregate consists of a burn treatment/disposal area and two landfills; therefore, potential contamination may be present in surface and subsurface soils as a result of suspected solid and liquid surface disposal, burning, spills, leaks, and waste burial. No large drainages discharge from these SWMUs, so off-site transport by surface water runoff is unlikely. Wind

TABLE 5-56

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, SURFACE WASTE DISPOSAL AREAS AGGREGATE

				HE				RAD	METALS		org
PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	UNDETONATED HE	HE DETONATION PRODUCTS	HE DEGRADATION PRODUCTS	HE BURN PRODUCTS	URANIUM	METALS SUITE	BARIUM	SEMIVOLATILES
16-009	Burn treatment area	Burning debris	N					x	x	x	x
16-016(a)	Landfill	Metal disposal	N	x		x		x	x	x	
16-016(b)	Landfill	Debris disposal	N	x		x		x	x	x	

dispersion is not a significant migration pathway because each area has been revegetated with grasses and weeds. No current exposure to potential subsurface contamination exists. In the future, subsurface contamination could be brought to the surface via excavation or erosion.

Current human receptors are limited to on-site workers. The dominant health and safety risk for current on-site workers is contact with HE. Chapter 4 contains a detailed discussion of the migration pathways, conversion mechanisms, human receptors, and exposure routes.

5.11.2 Remediation Decisions and Investigation Objectives

Problem Statement (DQO Step 1)

SWMUs 16-009, 16-016(a), and 16-016(b) have been identified as PRSs. The problem for Phase I of the RFI work plan for the surface waste disposal area aggregate is to determine whether any of the SWMUs are contaminated at levels which are different from background and higher than SALs using a reconnaissance sampling approach. Based on our search of historical records the likelihood of contamination at these sites is deemed to be small.

Decision Process (DQO Step 2)

A Phase I investigation will be implemented to confirm the absence or presence of suspected contaminants of concern at levels that are different from background and above SALs. If screening assessment indicates contamination in Phase I, then a Phase II study of extent of contamination will be undertaken. If screening assessment does not indicate contamination for a particular SWMU, then NFA will be recommended for that SWMU. Confirmation/elimination of particular PCOCs is a secondary goal of Phase I. Following any Phase II studies of extent of contamination, the surface disposal areas will be cleaned to risk-based levels if remediation is indicated. The likely remediation alternative is disposal of contaminated material in a permitted landfill. Following any cleanup, the SWMUs will be resampled to verify that remediation was successful. Decision logic for this aggregate is shown in Fig. 5-43.

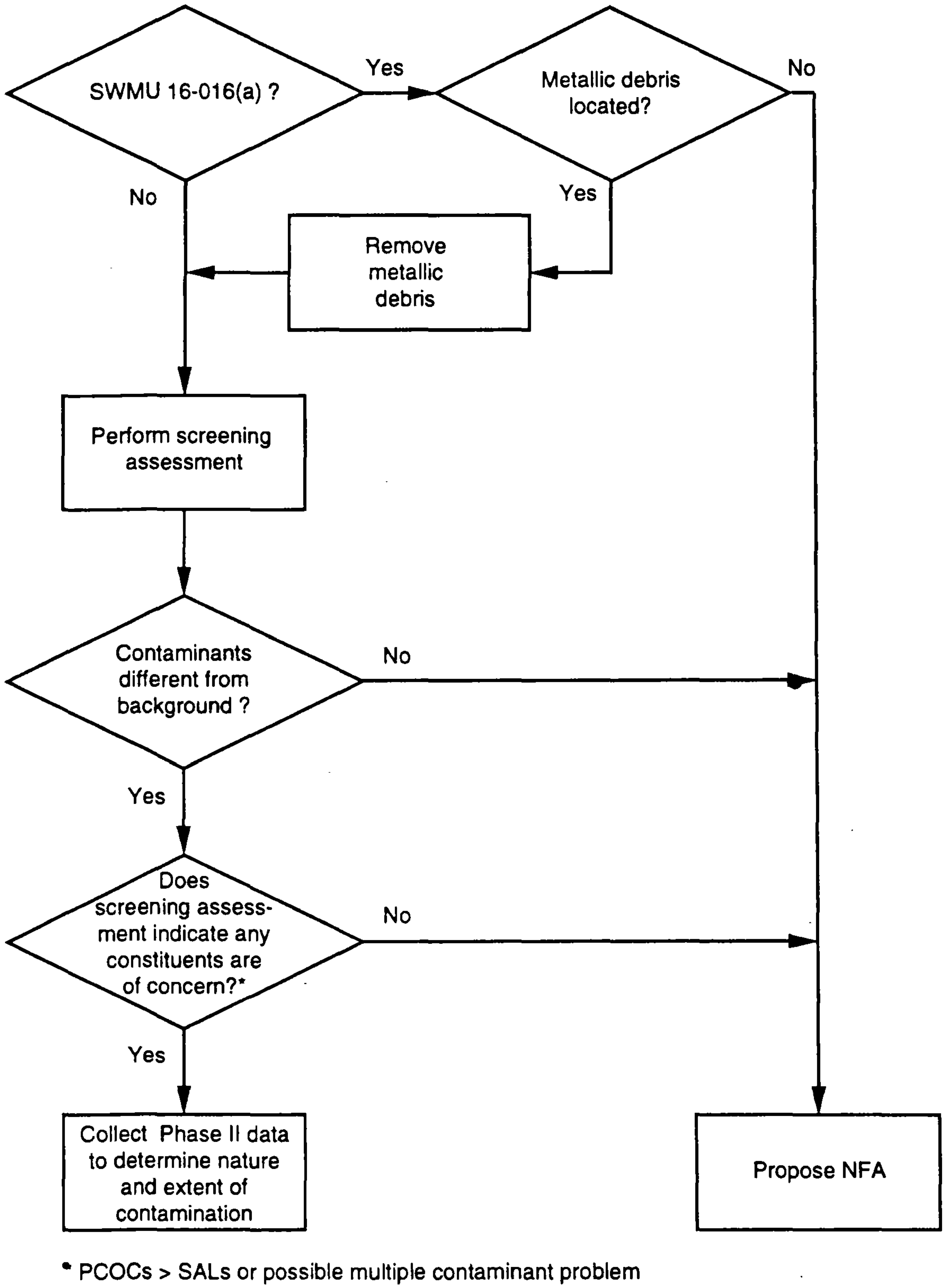


Fig. 5-43. Decision flow for surface waste disposal areas.

5.11.3 Data Needs and Data Quality Objectives

Decision Inputs and Investigation Boundaries (DQO Steps 3 and 4)

In Phase I, the following questions need to be addressed.

1. For SWMU 16-009, are subsurface soils contaminated with metals, organics, or radionuclides different from background and above SALs?

2. For SWMU 16-016(a), can any metallic debris be located? If so, are the adjacent subsurface soils contaminated with metals, HE, and HE by-products different from background and above SALs?

3. For SWMU 16-016(b), are surface soils contaminated with HE, HE by-products, and metals at levels which are different from background and above SALs?

The data needed to address the first question are the levels of metals, organics, and uranium in the subsurface soils of SWMU 16-009. For the second question, the presence of metallic debris can be detected using electromagnetic and magnetic measurements. If such debris is located, contamination from metals, HE, or HE by-products may be determined from subsurface soil concentrations of these contaminants. The data needed to address the third question are the levels of HE, HE residuals, and metals in the surface soils of SWMU 16-016(b).

For each of these SWMUs the investigative boundaries will be defined by the SWMU boundaries. An assumption is that PCOCs will be concentrated near their original source.

Decision Logic (DQO Step 5)

For SWMUs 16-009 and 16-016(b), screening assessment will begin with a comparison of the sample data to the relevant background distributions. If the sample data are found to be different from background, the sample maxima will be compared to SALs. If any of the suspected contaminants at a particular SWMU are different from background and exceed SALs, a Phase II study will be recommended to determine the nature and extent of contamination. If none of the suspected contaminants at a particular SWMU differ from background and exceed SALs, then NFA will be recommended. For SWMU 16-016(a), if metallic debris is located, the debris will be removed and disposed of in an approved landfill after flashing at the TA-16 burning ground. In addition, one sample from the adjacent subsurface soil will be collected for laboratory analysis of metals, HE, and HE residues. If contaminant levels are found to be different from background and above SALs, a Phase II study will be conducted to characterize the nature and extent of contamination in the subsurface soils. If no debris is located, or contaminant levels do not exceed SALs, NFA will be recommended.

Design Criteria (DQO Step 6)

For SWMUs 16-009 and 16-016(b), a reconnaissance sampling approach will be used (IWP, Appendix H). Field screening results will be used to bias the samples toward areas where screened contaminant levels are highest in order to maximize the chance of detecting contamination if it is present. At each of these SWMUs, field screening for the primary PCOC will be conducted at 20 field randomized locations. A total of three laboratory samples will be taken at each of these SWMUs. SWMU 16-009 will be sampled to a depth of 3 ft; whereas SWMU 16-016(b) will be sampled to a depth of 6 in. Using the reconnaissance approach, a sample of size 3 will detect contamination with a probability of .55 if 25% of the site is contaminated or, with a probability of .85 if 50% of the site is contaminated. These probabilities are actually very conservative because of the biasing by the field screening.

For SWMU 16-016(a), EM and magnetic surveys will be conducted on a grid to identify metallic debris. If a concentration of debris is located, a single subsurface sample will be selected adjacent to the debris. If no debris is located, the previous removal operations will be assumed to have eliminated any potential health risk. The single sample is based on the low anticipated risk at this site and the selection of a judgmental location representative of the worst-case potential contamination from the debris.

The following assumptions have been made: 1) that bulldozing the berm around SWMU 16-009 may have buried contaminants to a depth of up to 3 ft;

and 2) that contamination at SWMU 16-016(b) is concentrated on or near the surface.

5.11.4 Sampling and Analysis Plans

Phase I sampling is intended to determine if potential contamination is associated with these units. The Phase II sampling plans, if necessary, will define the complete nature, extent, and rate of migration of any release identified in Phase I.

SOPs used in the sampling plan are listed in Table 5-57. Sample numbers and necessary analyses are shown in Table 5-58. Field screening methods are described in Subsection 4.7; SOPs for these procedures are in preparation.

TABLE 5-57

STANDARD OPERATING PROCEDURES FOR FIELD ACTIVITIES

LANL-ER-SOP	TITLE	NOTES
01.02, R0	Sample Containers and Preservation	Applied to all laboratory samples
01.04, R1	Sample Control and Field Documentation	Applied to all laboratory samples
06.10, R0	Hand Auger and Thin-Wall Tube Sampler	VOC-bearing subsurface soil samples
06.11, R0	Stainless Steel Surface Soil Sampler	All 0 to 6 in. surface samples

5.11.4.1 Engineering Surveys

Engineering surveys are needed to locate these SWMUs accurately in the field, and to establish sampling points for electromagnetic and magnetic surveys, radiation screening, HE field screening, surface sampling, and subsurface sampling.

SWMUs 16-009, 16-016(a), and 16-016(b) will be located and flagged, if possible. The boundaries of SWMU 16-009 will be derived from detailed comparisons between 1948 aerial photographs and 1:7 200 orthophotographs. SWMU 16-016(a) will be surveyed in at LASL coordinates S43 W51 for a distance of 100 ft in each direction from that point. The

TABLE 5-58 SUMMARY OF SITE SURVEYS, SAMPLING AND ANALYSIS FOR LANDFILL, SURFACE DISPOSAL, BURN PIT		Laboratory Samples							Field Screening							Field Lab.						Laboratory Analyses											
															A					B				C				D	E	F	G	H	
PRS	PRS TYPE	Sampled Media	Structure	Structure Field dup	Surface	Surface Field dup	Subsurface	Subsurface Field dup	Gross Alpha	Gross Gamma/Beta	Organic Vapor	HE Spot Test	Geophysics Surface	Barium - LIBS	Geological Characterization	Gross Alpha	Gross Gamma/Beta	Tritium	Volatile Organics	XRF	Soil Moisture	Alpha spectroscopy	Gamma spectroscopy	Beta spectroscopy	Total Uranium	Isotopic Plutonium	Isotopic Uranium	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCBs (SW 8080)	High Explosives (SW 8330)	Cyanide
16-009	Burn pit	Soil			3	1				20				20									3		3				3	3			
16-016(a)	Landfill	Soil					1						x												1					1		1	
16-016(b)	Landfill	Soil			3							20													3					3		3	

A, B, C, D, G = not applicable; E = full suite (PAH); F = 1082 suite; H = full suite boundaries of the mounded soil and debris will be surveyed for SWMU 16-016(b).

5.11.4.2 Geophysical Survey

An EM and magnetics grid will be located over the approximate location of SWMU 16-016(a). The approximate corners of this grid are:

CORNER	EAST	NORTH
SW	470900	1762100
NW	470900	1762100
NE	471100	1762300
SE	471100	1762300

Electromagnetic and magnetic measurements will be made within the surveyed area (Fig. 5-44). SOPs for geophysical investigations are currently in preparation. These will be examined for anomalies that might indicate the presence of buried metal.

5.11.4.3 Sampling

SWMU 16-009, administration area burning ground. Low-energy gamma radiation measurements for the detection of uranium and other radionuclides and barium field screening will be performed on twenty field-randomized points within the boundaries of SWMU 16-009 (Fig. 5-45). Anomalous radiation or barium screening measurements will be used to guide subsequent sampling for laboratory analysis

Three laboratory samples will be taken within the boundaries of this SWMU. At sampling locations, 0 to 3 ft. of soil will be collected. Their locations will be based on the radiation field screening tests, if any above-background readings occur. In the absence of anomalous radiation survey analyses or barium field screening measurements, field randomization methods will be used within the boundary of the SWMU. These samples will be homogenized and submitted for laboratory analysis.

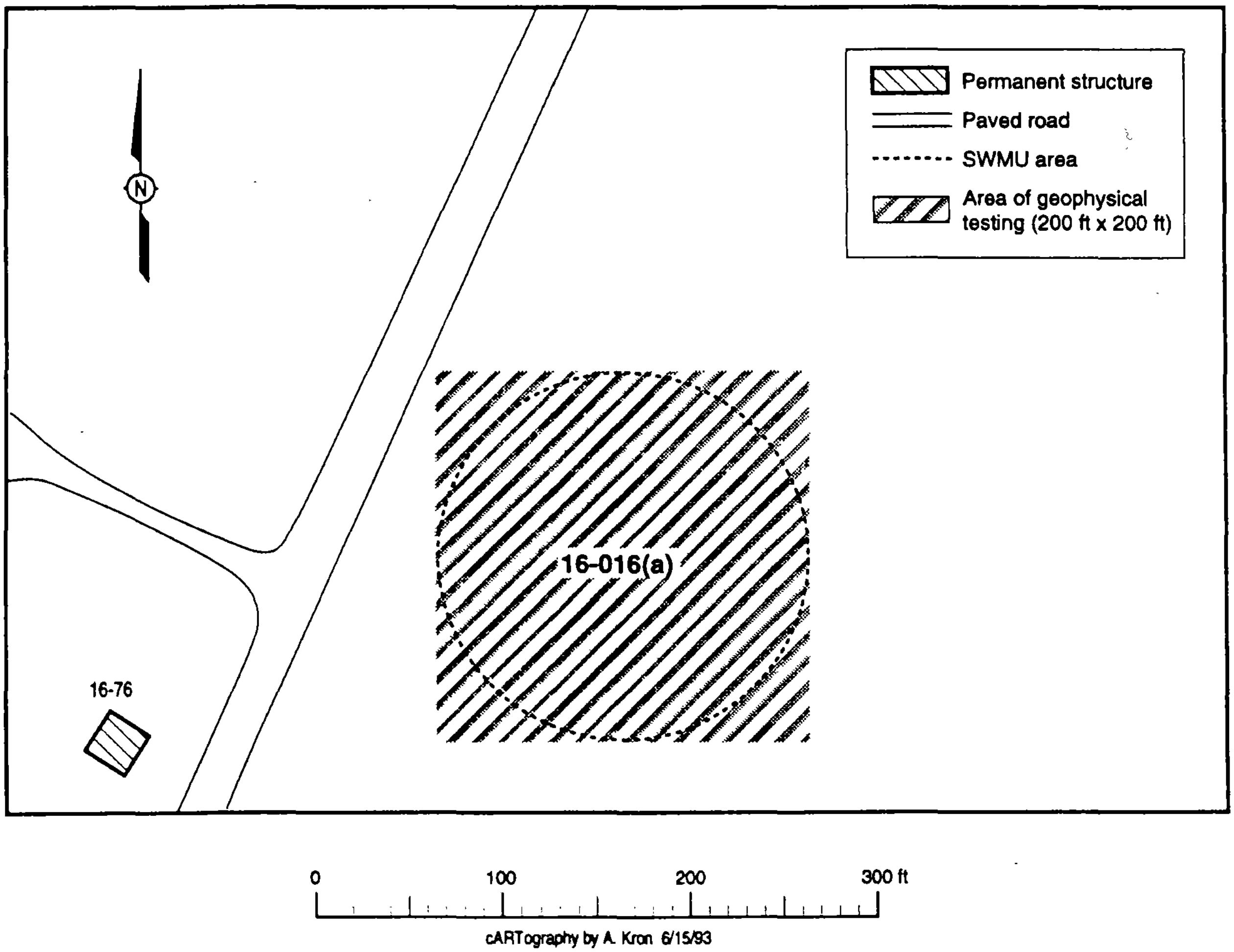


Fig. 5-44. Schematic location of geophysics and testing for SWMU 16-016(a).

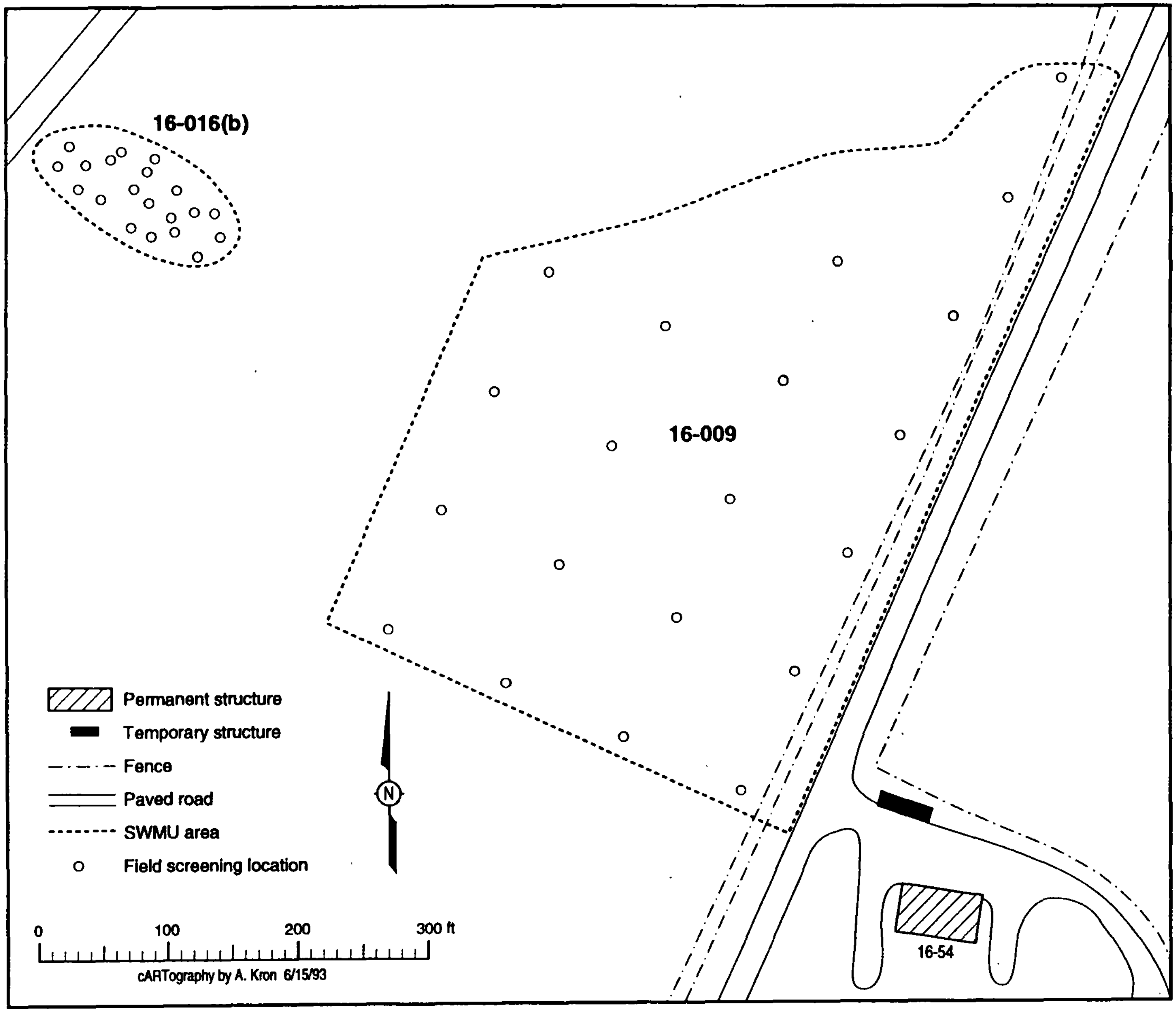


Fig. 5-45. Schematic sample locations for SWMUs 16-016(b) and 16-009.

16-016(a), former metal burial area. Laboratory sampling of this SWMU will only occur if a concentration of metallic debris that appears to be the former waste disposal site is discovered during the geophysical survey. If a concentration of debris is located, then a single auger hole (4 ft or to bedrock) will be sited adjacent to the debris and a single 6 in. laboratory sample will be taken from the level of the debris. Debris will be disposed of in a permitted landfill.

16-016(b), Surface Disposal Area. Twenty field-randomized HE swipes will be taken in and around the debris within SWMU 16-016(b) (Fig. 5-45). Positive HE readings will be used to guide subsequent sampling for laboratory analysis.

Three surface samples will be taken within the boundaries of SWMU 16-016(b). At these locations, 0 to 6 in. of soil will be collected. Their location will be based on the HE field screening tests, if any positive readings occur. In the absence of positive HE field analyses, field randomization methods will be used within the boundary of the SWMU.

5.11.4.4 Laboratory Analyses

Full laboratory analyses of samples will be at Level III by the following methods: for radionuclides (LANL or DOE method), SVOCs (SW-846 Method 8270), metals (SW-846 Method 6010), and HE and its by-products (SW-846 Method 8330). Specific contaminants of concern at these SWMUs include barium, HE (RDX, HMX, TNT), and HE by-products.

5.11.4.5 Sample Quality Assurance

Sampling parameters for all three SWMUs are listed in Table 5-58 including relevant field duplicates.

5.12 TA-16 Waste Water Ponds Aggregate, SWMU 16-007(a) and SWMU 16-008(a)

5.12.1 Background

The two SWMUs in this aggregate contain a total of five ponds. One SWMU with four ponds has been excavated, filled with clean soil, and is now covered in natural grasses. The fifth pond is intact but inactive. The SWMUs are aggregated on the basis of geographical proximity, similarity of operations in buildings associated with the ponds, nature of use as evaporative ponds, similarities of suspected contaminants, and proposed sampling techniques. The SWMUs are listed in Table 5-59 and shown in Fig. 5-46.

5.12.1.1 Description and History

SWMU 16-007(a). SWMU 16-007(a) consists of four backfilled ponds about 100 ft southwest of TA-16-90. The ponds were approximately 100 ft square each, flat-bottomed, and aligned in a row from northwest to southeast. The ponds were located on a level mesa within a depression 8 to 10 ft deep; berms 4 to 6 ft high separated the ponds. Aerial photographs from the 1940s show the ponds containing liquid. The site of the former ponds is now level with the mesa and covered with grasses.

These four backfilled ponds were located northeast of former buildings TA-16-30, -31, -32, -33, and -34. Buildings TA-16-31, -32, and -33 were explosives machining buildings; TA-16-30 and -34 were magazines. The drains from the machining buildings discharged to the ponds. The buildings were decommissioned and destroyed by burning in January/February 1960. The ponds were excavated as part of the S-Site demolition and restoration activities in 1967 (Thrap 1970, 15-16-001). In a personal interview with L. Hilton in April 1993, Mr. Hilton indicated that the cleanup of these ponds may not have been very thorough (Hickmott 1993, 15-16-477). The ponds are believed to have received HE-contaminated liquid containing barium and organics. Natural uranium was used in association with some explosive charges (Courtright 1969, 15-16-318) and may have been discharged to the ponds. The aerial photographs show that a release would have to go over the berms surrounding the ponds; there is no documentation that such a release occurred.

TABLE 5-59

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, POND AGGREGATE

				HE				RAD	METALS		ORGANIC	
PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	UNDETONATED HE	HE DETONATION PRODUCTS	HE DEGRADATION PRODUCTS	HE BURN PRODUCTS	URANIUM	BARIUM	BERYLLIUM	SEMIVOLATILES	VOLATILES
16-007(a)	Four ponds that received liquid waste from former Buildings TA-16-30, -31, -32, -33, and -34	High explosives machining/high explosives storage	N	x		x		x	x	x	x	x
16-008(a)	Pond that received liquid waste from the HE sumps at process buildings TA-16-89, -90, and -91	High explosives machining	N	x		x	x	x	x	x	x	x

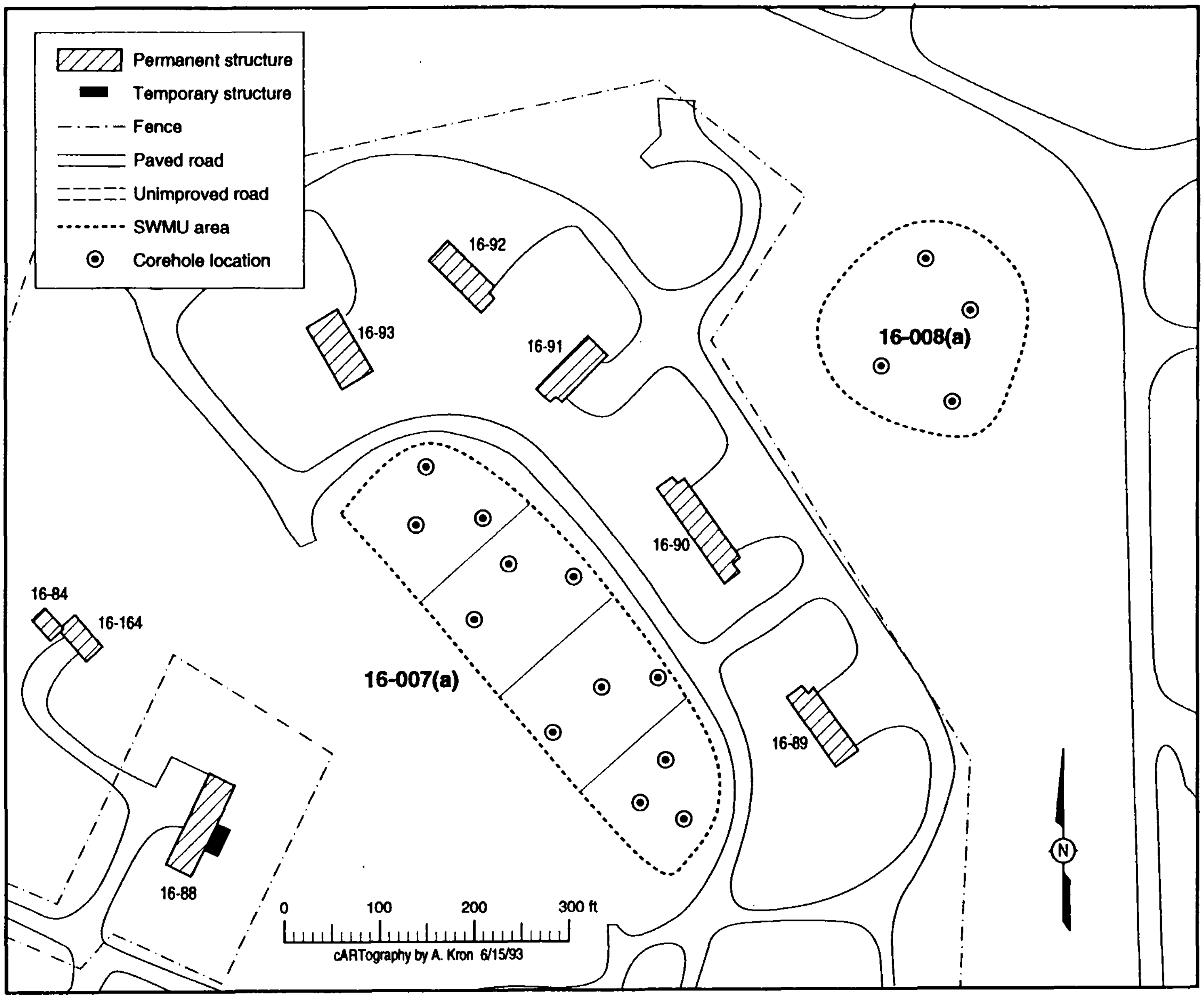


Fig. 5-46. Schematic sampling plan for ponds.

SWMU 16-008(a). SWMU 16-008(a) is an inactive, unlined pond about 200 ft in diameter. It can contain runoff; documents suggest that it occasionally dries up during the summer. It is located on a level mesa surrounded by trees. Drawing ENG-C 5647 shows that an HE burning area once existed at this location.

An oblique aerial photograph taken during the construction phase suggests that this pond may have been 10 to 15 ft deep.

Thrap (1970, 15-16-001) indicates that this pond received liquid waste from the HE sumps at process buildings TA-16-89, -90, and -91. These buildings were constructed in 1949 as a stopgap machining line prior to the completion of the 260-Line. TA-16-92 and TA-16-93 of this complex housed machining and electroplating facilities but did not empty into this pond (LANL 1990, 0145). The pond may have received HE, barium, uranium, and organic cleaning agents and machining oils. No documentation has been found that indicates that the pond has been cleaned.

5.12.1.2 Conceptual Exposure Model

The conceptual model for this aggregate is assumed to be a worker surface soil exposure and is detailed in Chapter 4, Fig. 4-9. Subsection 5.12.1.2.1 presents the potential sources of contamination and PCOCs. PRS-specific information on migration pathways and potential receptors are discussed in Subsection 5.12.1.2.2.

5.12.1.2.1 Nature and Extent of Contamination

Table 5-59 summarizes the PCOCs for this aggregate. At SWMU 16-007(a), three grab subsurface soil samples were collected from each of the four ponds as part of Environmental Problem #24, Request LA821 (DOE 1989, 15-16-345). Samples were taken from the bottom 12 to 15 in. of core samples that ranged in depth from 4.5 ft to 5 ft (bedrock interface). Samples were analyzed for radionuclides, metals, volatile organic compounds, and HE. Table 5-60 lists constituents detected, concentration range in parts per million, local background range, and SALs. No HE was detected. Several of the analytical results were qualified for various reasons, such as "...in general, the chromatography was very poor" (DOE 1989, 15-16-345).

TABLE 5-60

CONTAMINATION DETECTED AT SWMU 16-007(a)
ENVIRONMENTAL PROBLEM #24 (DOE 1989, 15-16-345)

POND NUMBER	PCOC	CONCENTRATION RANGE	LOCAL BACKGROUND [a]	SOIL SCREENING ACTION LEVEL [a]
1,2,3,4	Barium	160-230 ppm	120-810 ppm	5 600 ppm
1,2,3,4	Beryllium	1-2 ppm	0.42-4.4 ppm	0.16 ppm
1,2,3,4	Chromium	11-31 ppm	1.17-136 ppm	400 ppm
1,2	Nickel	14, 19 ppm	2-19 ppm	1 600 ppm
3,4	Cadmium	3 ppm	0.03-1.7 ppm	80 ppm
2	Lead	19 ppm	8-98 ppm	500 ppm
1,2	Acetone	.081-.310 ppm	0 ppm	8 000 ppm
4	TCE	.002-.005 ppm	0	3.2 ppm
4	Benzene	.004 ppm	0	0.67 ppm
4	Toluene	.005 ppm	0	890 ppm
4	Chlorobenzene	.004 ppm	0	67 ppm
4	Cesium-137	0.250 pCi/g	0.01-0.82 pCi/g	4.0 pCi/g
1	Uranium-235	.065,.072 pCi/g		$1.8x10^1$ pC/g

a See Table 4-1.

Environmental Problem #24 also reports analyses within SWMU 16-008(a) (DOE 1989, 15-16-345). Five grab samples of sediment (LA819) and three grab samples of water (LA820) were collected in the inactive pond. One sample was located at the mouth of two drainage ditches draining into the pond, one at the mouth of a second drainage, and three were collected on a traverse across the pond. The water samples were collected on three different days at the influent end of the pond.

Samples were analyzed for radionuclides, metals, volatile organic compounds, and HE. Table 5-61 lists PCOCs detected, concentration range in parts per million, local background range, and SALs. No HE were detected.

In 1986, the pond [SWMU 16-008(a)] was also sampled at four places with coring tools to a depth of 6 in. Samples were analyzed for HE (plus decomposition products) and barium nitrate. Baytos (1986, 15-16-289) reports that no barium nitrate was found in any sample. HE fractions and

TABLE 5-61

CONTAMINATION DETECTED AT SWMU 16-008(a)

NUMBER OF SAMPLES	PCOC(s)	CONCENTRATION RANGE	LOCAL BACKGROUND [c]	SCREENING ACTION LEVEL [c]
5 soil	Barium	430-2300 ppm	120-810 ppm	5 600 ppm
4 soil	Beryllium	1 ppm	0.42-4.4 ppm	0.16 ppm
5 soil	Chromium total	9-25 ppm	1.17-136 ppm	400 ppm
1 soil	Nickel	133 ppm	2-19 ppm	1 600 ppm
4 soil	Cadmium	3-5 ppm	0.03-1.7 ppm	80 ppm
3 soil	Acetone	.017-.040 ppm	0 ppm	8 000 ppm
3 water	Barium	5-6 ppm	a	1 ppm
1 water	Silver	.034 ppm	a	0.05 ppm
1 water	Chromium total	.0.016 ppm	a	0.05 ppm
3 soil	Cesium-137	0.28-0.68 pCi/g	0.1-1.4 pCi/g	4.0 pCi/g [b]

a No information
b Derived 1993 based on 10 mrem/yr limit
c See Table 4-1.

decomposition products were .02 wt% or less. Baytos comments, "In summary—no explosives were found at the places sampled according to our estimate of the worst case conditions (area in the pond where HE would accumulate)."

Although existing data show PCOC concentrations in the water and the surface and near surface soils including values above SALs, there is no data to evaluate the potential for subsurface contamination below the pond floor for SWMU 16-007(a) and below 12 in. for SWMU 16-008(a).

5.12.1.2.2 Potential Pathways and Exposure Routes

The ponds consist of potential subsurface contamination where constituents could have been released to the environment via leaching into surrounding soils. Once contaminants have been released to surrounding subsurface soils they could migrate via liquid infiltration further into the subsurface soils.

Currently, subsurface contamination does not pose a health risk to the public. In the future, on-site exposures could occur if the subsurface soil is exposed to the surface either through excavation or erosion. Chapter 4 contains a detailed discussion of the migratory pathways, human receptors, and exposure routes that may be associated with PRSs within this OU.

5.12.2 Remediation Decisions and Investigation Objectives

Problem Statement (DQO Step 1)

There are no data available on the extent of contamination beneath the bedrock interface of the backfilled ponds or beneath the first foot of sediment in the inactive pond. Existing data may not reflect deeper subsurface conditions since the current fill layer for the backfilled pond and the top foot of sediment for the inactive pond may not be the result of past machining operations and may cover soils, sediments, or bedrock contaminated from past activities. Therefore, the objective of this preliminary investigation is to determine if potential contaminant concentrations are above SALs in the subsurface at or above the bedrock interface of the backfilled ponds. In the inactive pond the area of interest is in the sediments above and adjacent to the floor of the pond.

Decision Process (DQO Step 2)

If concentrations of contaminants in subsurface soils, sediments, or bedrock are above SALs, then a site-specific baseline risk assessment will be performed to determine if a CMS or VCA is required. This may require collecting additional data (Phase II investigation). If contaminant concentrations are below SALs, then these ponds will be proposed for NFA.

5.12.3 Data Needs and Data Quality Objectives

Decision Inputs and Investigation Boundary (DQO Steps 3 and 4)

Decision inputs consist of potential contaminant concentrations (Table 5-59) in the subsurface sediments and bedrock within the boundaries of the ponds. The subsurface core samples for SWMU 16-007(a) will include all soils and sediments to include a minimum of 2.5 ft of bedrock below the floor or fill boundary. Two 5 ft cores, or a total depth of 10 ft, are anticipated to collect 2.5 ft of bedrock or fill boundary. Based on previous studies in which metal contamination has been found within bedrock, it is expected that the highest concentrations of PCOCs in tuff will occur within 2.5 ft of the soil/ bedrock interface (Nyhan et al. 1984, 0166; McLin 1989, 15-16-405).

PCOC concentrations for the core will be reported. The subsurface core samples for SWMU 16-008(a) will include all soils and sediments and a minimum of 2.5 ft of bedrock below the floor or fill boundary at the bottom of the pond. PCOC concentrations for the core will be reported. Two 5 ft cores, or a total depth of 10 ft, are anticipated to collect 2.5 ft of bedrock or fill boundary.

All ponds were designed to provide a large surface for water evaporation and inflow of pond liquids into the soil. Historical aerial photographs of the site suggest that ponds did not accumulate waste preferentially in any area, as the entire pond bottom in dry periods was white with waste deposits. This would suggest that pond wastes may be uniform across the pond floor.

Decision Logic (DQO Step 5)

The core sample concentrations for the PCOC will be compared to specific PCOC concentrations. If the PCOC value observed is greater than the SAL, then a baseline risk assessment will evaluate if a Phase II will be undertaken. If the PCOC value observed is less than its SAL, then NFA will be proposed.

Design Criteria (DQO Step 6)

The proposed pond core samples will provide estimates of the pond PCOC concentrations. Three to four boreholes shall be placed in each pond from the surface to roughly 10 ft depth. Each borehole will result in two 5 ft cores for sampling. Each core shall be field screened for radiological constituents and spot tested for HE to focus the core portion submitted to the off-site laboratory for PCOC confirmation, completeness, and concentration. In the absence of field indicators for PCOCs, a laboratory sample will be randomly selected from each pond. These data shall be used to test the hypothesis that PCOC concentrations are greater than the SALs.

Water is infrequently observed in the ponds from rainfall and surface drainage. This water is ephemeral in nature and does not represent any usable water source. Thus, no water sampling is proposed in the ponds.

5.12.4 Sampling and Analysis Plan

SOPs that control field activities in this sampling plan are listed in Table 5-62. Sample numbers and required analysis are shown on Table 5-63.

TABLE 5-62

STANDARD OPERATING PROCEDURES FOR FIELD ACTIVITIES

LANL-ER-SOP	TITLE	NOTES
01.02, R0	Sample Containers and Preservation	Applied to all laboratory analytical samples
01.04, R0	Sample Control and Field Documentation	Applied to all laboratory analytical samples
04.01, R0	Drilling Methods and Drill Site Management	Applied to core drilling
06.10, R0	Hand Auger and Thin-Wall Tube Sampler	Applied to augered soil samples
12.01	Field Logging, Handling, and Documentation of Borehole Materials	All core samples, soil and lithologic logging

5.12.4.1 Engineering Surveys

SWMUs 16-007(a) and 16-008(a) will be field surveyed, which will consist of site engineering (geodetic) mapping. Site mapping is required to accurately record the location of the SWMUs. In the field, the engineering survey will locate, stake, and document the location of the SWMUs. Sample locations will be registered on a base map, scale 1:7 200. If during the course of sampling any sample points must be relocated, the new position will be surveyed and the revised locations will be indicated on the map. The engineering survey will be performed by a licensed professional under the supervision of the field team leader.

5.12.4.2 Sampling

SWMU 16-007(a). Three core holes will be drilled into each pond at randomly-selected locations (Fig. 5-46). Cores will be collected in 5 ft runs from the surface to a minimum of 2.5 ft into bedrock or fill; two 5-ft cores are anticipated. Cores will be screened by PID to determine the presence of volatile PCOCs. If positive, then that 6 in. interval of the core will be collected for VOCs in the laboratory. Homogenized samples from

TABLE 5-63

SUMMARY OF SITE SURVEYS, SAMPLING AND ANALYSIS FOR WASTE WATER PONDS AGGREGATE

			Laboratory Samples						Field Screening							Field Lab.						Laboratory Analyses											
			Structure		Surface		Subsurface								A					B				C				D	E	F	G	H	
PRS	PRS TYPE	Sampled Media		Field dup		Field dup		Field dup	Gross Alpha	Gross Gamma/Beta	Organic Vapor	HE Spot Test	Geophysics Surface	Barium - LIBS	Geological Characterization	Gross Alpha	Gross Gamma/Beta	Tritium	Volatile Organics	XRF	Soil Moisture	Alpha spectroscopy	Gamma spectroscopy	Beta spectroscopy	Total Uranium	Isotopic Plutonium	Isotopic Uranium	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	PCBs (SW 8080)	High Explosives (SW 8330)	Cyanide
16-007(a)	Waste pond	Sediment/ tuff					4*	1	12#	12#	12#	12#			12#	12#	12#		12#	12#			4*		4*			4*	4*	4*		4*	
16-008(a)	Waste pond	Sediment/ tuff					1*		4#	4#	4#	4#			4#	4#	4#		4#	4#			1*		1*			1*	1*	1*		1*	

A = stratigraphic logging, B = barium; C, G = not applicable; D, E, H = full suite, F = 1082 suite.
* A minimum of 4/1 samples will be sent for lab analyses; additional samples will result from positive field screening or pond depths greater that 5 ft.
# = Actual number of samples screened will depend on the depths of the ponds.

consolidated rock core will be produced by chipping each core. These chips will be mechanically combined to generate a single homogenized sample that represents each of the 5 ft intervals. Each core will be field screened for PCOCs such as undetonated HE, HE by-products, beryllium, and radiation. Field screening methods are described in Subsection 4.7. Any samples that show positive screening for PCOCs will be submitted for laboratory analysis. If no samples have a positive screening for PCOCs, then in each pond one core will be selected randomly and the analytical sample as described above will be sent for laboratory analyses of PCOCs (see Table 5-63).

SWMU 16-008(a). One hole will be augered to determine the depth of the floor of the pond and layering of sediments (Fig. 5-46). This core will determine the sampling depth, which will include the bottom 1 ft of sediment, the subsurface soil beneath the floor of the pond (if soil exists), and the first 2.5 ft of bedrock. Two 5 ft cores are anticipated. Three core holes will be drilled with a hollow-stem auger drill rig and continuous core system. Cores will be screened by PID to determine the presence of volatile PCOCs. If positive, then that 6 in. interval of the core will be collected for VOCs in the laboratory. Homogenized samples from consolidated rock core will be produced by chipping each core. These chips will be mechanically combined to generate a single homogenized sample that represents each of the 5 ft intervals. Each sample will be will be field screened for PCOCs including undetonated HE, and radiation. Any samples that show positive screening for PCOCs will be submitted for laboratory analysis. If no samples have a positive screening for PCOCs, then one core will be selected randomly and the analytical sample as described above will be sent for laboratory analyses of PCOCs (Table 5-63).

5.12.4.3 Laboratory Analysis

Laboratory analyses of samples will be at Level III for radionuclides (LANL or DOE method), metals (SW-846 Method 6010), VOCs (SW-846 Method 8240), SVOCs (SW-846 Method 8270), and HE and its by-products (SW-846 Method 8330). The principal radionuclides of concern are uranium isotopes, the principal HE of concern are TNT and RDX. The principal by-products of concern are DNT, TNB, and DNB. The principal VOCs are hydrocarbon solvents, and the metals of concern are barium and beryllium.

5.12.4.4 Sample Quality Assurance

SOPs that control field activities in this sampling plan are listed in Table 5-62. Field quality assurance samples will be collected according to the guidance provided in the latest revision of the IWP (LANL 1992, 0768). Any QA/QC duplicate samples to be collected during the course of the field investigation are outlined in Table 5-63.

5.13 TA-13 (P-Site), SWMUs 13-001, 13-002, 13-004, 16-035, 16-036

5.13.1 Background

This aggregate consists of SWMUs associated with firing activities at TA-13. The SWMUs are broken out as a SWMU aggregate for geographic reasons; it is a small, self-contained site for which drainage and grid samples covering many SWMUs may be appropriate. In addition, because all of the SWMUs are associated with WW II firing site activities, most of the samples will be analyzed for the same suite of contaminants. SWMUs in this aggregate and their PCOCs are listed in Table 5-64.

5.13.1.1 Description and History

TA-13 is located at the eastern end of the current TA-16 explosives manufacturing area (Fig. 5-9). The operational site lies on level ground from which the vegetation has been cleared; the landfill and firing site SWMUs lie on sloping topography that is overgrown with scrub trees and bushes.

TA-13 has been used for a wide variety of Laboratory activities dating back to World War II. It was constructed in 1944 to support the HE project of the Manhattan Project (Kistiakowsky 1944, 15-13-004).

TA-13 was designed principally as a site for counter x-ray diagnostics of HE lens configurations. Activities supporting this x-ray diagnostic effort included operation of counter x-ray equipment, HE assembly, and research in the magnetic method program.

Buildings constructed at TA-13 in 1944 included: an office and shop building (TA-13-1), a firing site control laboratory (TA-13-2), two battleship bunkers (TA 13-3 and TA-13-4), an experimental chamber (TA-13-6), a magazine (TA-13-7), and two storage buildings (TA-13-5, TA-13-8). The battleship bunkers contained the x-ray and magnetic equipment and were capped with steel nose cones to protect this equipment from explosive detonations that occurred between the bunkers.

HE shots were fired at TA-13 at a rapid pace during 1944 and 1945, with firings every 10 minutes during the first two months of 1945. A 203-lb shot fired in September 1944 damaged the steel plates in front of TA-13-3 and TA-13-4 (Parratt 1945, 15-13-007). Assemblies contained HE lenses

TABLE 5-64

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, P-SITE AGGREGATE

				HE				RAD	METALS				
PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	UNDETONATED HE	HE DETONATION PRODUCTS	HE DEGRADATION PRODUCTS	HE BURN PRODUCTS	URANIUM	METALS SUITE	BARIUM	BERYLLIUM	LEAD	ASBESTOS
13-001	Firing site	HE detonations	N	x	x	x	x	x	x	x	x	x	x
13-002	Landfills	Debris disposal	N	x	x	x	x	x	x	x	x	x	x
13-004	Burn site	Burning	N	x	x	x	x	x	x	x	x	x	x
13-035	Soil contamination	HE detonations	N	x	x	x	x	x	x	x	x	x	x
16-036	Soil contamination	HE detonations	N	x	x	x	x	x	x	x	x	x	x

(primarily baratol and Comp-B), uranium, and other metals. The counter x-ray program was suspended in March 1945.

TA-13 was converted to initiator testing in mid-1945. Initiator assemblies consisted of HE, beryllium, polonium, and other metals. A bulldozer was used to clean up the radioactive residues of these initiator tests; shot debris was bulldozed to the south and east of the firing point, SWMU 13-002.

Polonium is an active alpha emitter that severely contaminated buildings, structures, and canyons at TA-13. High alpha counts [up to 20 000 counts per second (cps)] were reported at the easternmost battleship bunker (Buckland 1946, 15-13-006), in another unidentified bunker (Buckland no date, 15-16-181), and in the canyon (Westcott 1948, 15-13-010). The alpha-contaminated buildings were decontaminated in 1946 and 1947 and certified to be free of alpha contamination in 1948 (Westcott 1948, 15-13-010; Buckland 1948, 15-13-011). Polonium has a short half-life (138 days) so any polonium contamination at the site would have decayed away long ago.

An M Division memo suggests that in 1948 the site was to be upgraded for renewed HE firing (Westcott 1948, 15-13-010). An explosive demonstration was held at TA-13 for the education of employees at S-Site in 1950 (Shipman 1951, 15-16-200). This demonstration was fired at the TA-13 burning pit, SWMU 13-004.

The buildings in the western half of TA-13 (TA-13-1, TA-13-5, TA-13-6, TA-13-7, and TA-13-8) were demolished in the early 1950s to make way for the construction of TA-16-340 and its associated structures. TA-13 was incorporated into TA-16 (S-Site) in 1957. TA-13-2, TA-13-3, and TA-13-4 were renumbered TA-16-476, TA-16-477, and TA-16-478 respectively. TA-16-478 (the northern battleship bunker) is used for experimental and high-speed machining tests for the weapons groups at S-Site. Materials machined in TA-16-478 include HE, uranium, and other materials. The trench drain from TA-16-478 is a SWMU [16-003(p)] that will be covered in a future addendum to this work plan.

The following SWMUs resulted from operations at TA-13 described above.

SWMU 13-001 is the firing site located between the two battleship bunkers (TA-13-3 and TA-13-4) and soil contaminated by the firing activities to a radius of 300 ft. The area contains a large amount of debris and shrapnel, which includes firing cables, lead balls, and chunks of steel and copper.

SWMU 13-002 is a landfill to the south and east of the firing point. It is delineated on Fig. 5-9 based on a 1948 aerial photograph. It extends roughly 500 ft south of the firing point. The SWMU area includes a large amount of debris and shrapnel scattered around the two battleship bunkers.

SWMU 13-004 is one or more burning pits at TA-13. These pits were not located on LASL Engineering diagrams or on 1948 aerial photographs. It is likely they were sited in the western half of TA-13 and have been disturbed and covered by construction activities at S-Site.

SWMU 16-035 is soil contamination associated with control bunker TA-13-2.

SWMU 16-036 is soil contamination located beneath battleship bunkers TA-13-3 and TA-13-4.

5.13.1.2 Conceptual Exposure Model

The conceptual exposure model is presented in Fig. 4-6. Site-specific information on potential release sources, chemicals of concern, migration pathways, and potential receptors is presented below.

5.13.1.2.1 Nature and Extent of Contamination

The PCOCs at the TA-13 SWMUs include all contaminants likely to be associated with HE lens and initiator testing. These include: 1) metals that would have been components of the explosive assemblies, particularly lead and beryllium; 2) HE residues including barium and environmental breakdown products; and, 3) radionuclides, particularly natural and depleted uranium (Table 5-64).

It is possible, but extremely unlikely, that radionuclides at the site could include neutron activation products of the initiator experiments or residual 210-lead and polonium. If the chemical separation of 210-lead and polonium was inefficient, then small amounts of residual activity could remain.

No quantitative data relevant to the SWMUs discussed in this subsection are available.

5.13.1.2.2 Potential Pathways and Exposure Routes

At TA-13, potentially-contaminated material consists of surface soils, subsurface soils, and sediments in drainages as a result of detonations, surface disposal, and bulldozed shot debris. Once these contaminants have been released into the environment, the major migration pathway is via surface water runoff carrying contaminants to surface soil beyond the original release site or sediments in either the north or southeastern channels. Subsurface soils can be brought to the surface either by excavation or erosion.

Current human receptors are limited to on-site workers. Chapter 4 contains a detailed discussion of the migration pathways, conversion mechanisms, human receptors, and exposure routes.

5.13.2 Remediation Decisions and Investigation Objectives

Problem Statement (DQO Step 1)

Firing activities at TA-13 (P-Site) may have produced surface and subsurface soil contamination, particularly barium, lead, beryllium, and uranium contamination. In the absence of existing quantitative data, the PCOCs identified in Subsection 5.13.1.2.1 are based on knowledge of processes performed at TA-13. Sampling is necessary to determine whether contaminants are present in surface and subsurface soils and whether concentrations warrant Phase II study and possible remediation, or whether NFA can be recommended based on Phase I sampling. Based on our knowledge of the explosive testing process at this site, we anticipate that PCOCs are likely to be present. In the event that PCOCs are found which require additional investigation at SWMU 13-001 and SWMU 13-002, information on spatial variability will be required in order to perform a baseline risk assessment and/or to design Phase II data collection.

The purpose of Phase I of the RFI work plan for TA-13 is to evaluate whether the firing activities during WW II have yielded environmental contamination which warrants additional investigation. If contaminant levels are found to be different from background and above SALs during Phase I, then a Phase II study of the extent of contamination at the site will be undertaken (unless a preliminary baseline risk assessment indicates this is unnecessary).

Otherwise, cleanup of this site will involve picking up the debris scattered around the firing site area.

Decision Process (DQO Step 2)

The data from the Phase I study will be used to determine if any of the PCOCs are different from background and above SALs. If so, a Phase II study to collect additional data on the nature and extent of contamination will be proposed. Thus, because historical data suggest that contamination associated with these SWMUs is likely, a subsidiary goal of Phase I is to facilitate design of a cost-effective Phase II study. If all PCOCs are below SALs, then NFA will be proposed. An additional goal is to confirm or deny whether specific PCOCs are present in and around the firing area. In the case of SWMU 13-001 and SWMU 13-002, if screening assessment indicates possible contamination and that the contaminants are relatively homogeneous, a baseline risk assessment will be performed to determine which of the following should be recommended: 1) VCA; 2) Phase II study to collect additional data on the nature and extent of contamination; or, 3) NFA.

Following potential Phase II studies of extent of contamination, risk analysis will be used to determine whether remediation is required. If so, TA-13 will be cleaned up to risk-based levels. Possible remediation alternatives for metal or radionuclide-contaminated materials include: 1) removal of contaminated materials to a hazardous or mixed-waste landfill; 2) on-site chemical treatment of soils to remove hazardous contaminants; 3) *in-situ* soil stabilization of contaminants to levels dictated by a site-specific risk assessment. Following any of these treatment options, contaminated areas of the site will be resampled to verify cleanup to risk-based levels.

Figure 5-47 illustrates the decision process.

5.13.3 Data Needs and Data Quality Objectives

Decision Inputs (DQO Step 3)

For TA-13, the goal of Phase I of the RFI is to determine what contaminants, if any, are present at the firing site, landfill, burning pits, and the soils around the control bunker and the battleship bunkers. The source data

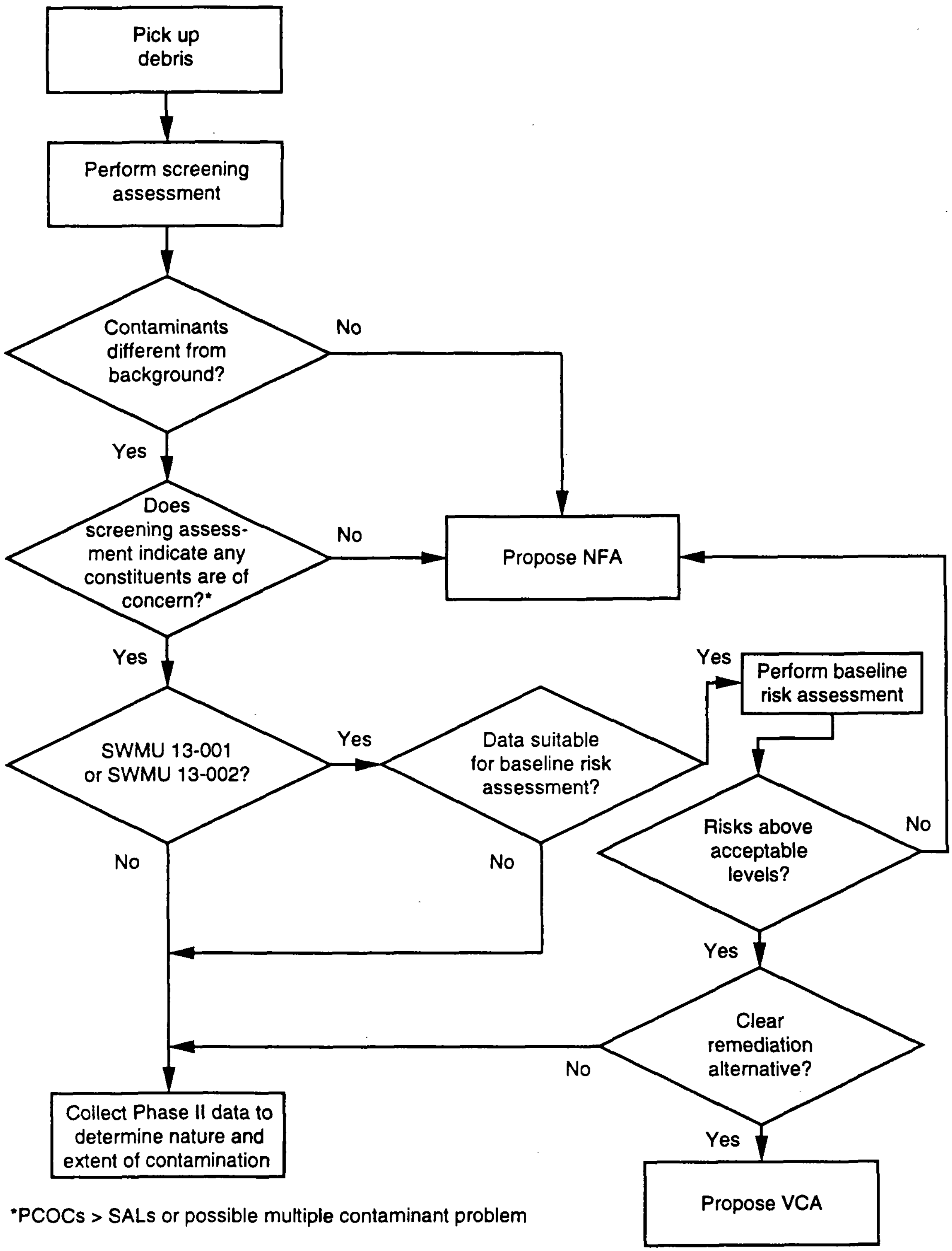


Fig. 5-47. Decision flow for TA-13 (P-Site).

required to make a decision regarding possible contamination at TA-13 are the concentrations of contaminants in the soils and subsurface soils of the firing site, landfill area, burning pits and the soils around the control bunker and battleship bunkers. The data for SWMU 13-001 and SWMU 13-002 will be collected in a manner that provides coverage of the site and information about the spatial variability of the concentrations of PCOCs. Shrapnel and debris present at the site needs to be flagged and marked for pickup. Prior to pickup, the shrapnel will need to be field checked for radioactivity.

Investigation Boundary (DQO Step 4)

The decision process will be applied to the soils and subsurface soils of SWMU 13-001 (firing site), SWMU 13-002 (landfill), and SWMU 13-004 (burning pit, if located), and the soils within SWMU 16-035 (control bunker) and SWMU 16-036 (battleship bunkers). The SWMU boundaries will serve as spatial boundaries; however, sampling in the channels will extend beyond the SWMU boundaries.

A point source is assumed at the firing site for dispersion of contaminants by detonation; however, such contaminant dispersal would be deflected by the mass of the battleship bunkers. The transport of contaminants by bulldozing at the landfill site is expected to result in non-uniform distribution of contaminants. Metallic contaminants are expected to be concentrated in clay-rich sediments in the runoff channels.

Decision Logic (DQO Step 5)

Based on the results of Phase I study proceed as follows. Perform screening assessment to determine whether contaminant levels are different from background and, if so, whether SALs are exceeded, based on the sample maxima. Based on screening assessment, if possible contamination is not indicated, propose NFA. For SWMU 13-001 and SWMU 13-002, if contamination is indicated and the contaminants are relatively homogeneous, perform a baseline risk assessment to determine whether to propose NFA or whether to initiate a Phase II study to determine the nature and extent of contamination. If heterogeneous contamination is indicated, proceed to Phase II study to further determine nature and extent of contamination. Additional analysis may be performed to examine transport in the channels and extent for the firing site and landfill areas if contaminant levels are found which differ from background and exceed SALs.

Design Criteria (DQO Step 6)

SWMU 13-001 and SWMU 13-002 sampling grid. In the absence of existing data, professional judgment was used to design a reconnaissance stratified sampling grid which will provide information for performing a baseline risk assessment or designing a Phase II study. The 100 ft grid is designed to provide adequate coverage of the large area potentially affected by firing site activities with additional sampling strata focused on the three remaining structures using the reconnaissance sampling approach. The nomogram approach is described in Subsection 4.5.1.1, Chapter 4 of this work plan, and in Appendix H of the IWP. The twenty-six surface sampling points provide a 0.93 chance of detecting surface contamination if 10% of the site is contaminated. Ten biased subsurface trench samples will be selected to provide approximately uniform coverage of the subsurface in the bulldozed area. Ten samples provide a 0.87 chance of finding contamination if 20% of the subsurface is affected. The surface samples will be collected on a randomized grid, and will not be biased by field screening, as is proposed in many other sampling plans for this RFI, because it is not known which of many potential contaminants is likely to drive the decisions for this site, and because we need information on spatial variation of contaminants for baseline risk assessment. Because the primary pathways for human uptake of metals are inhalation and ingestion of fine-grained particulates, and large chunks of metallic contamination may be present, the samples will be sieved.

SWMUs 13-004, 16-035, and 16-036. These three SWMUs will be sampled using a reconnaissance approach (Chapter 4). A sample size of four will provide a probability of 0.66 of detecting contamination if 25% of the site is contaminated or a probability of 0.87 if 40% of the site is contaminated. If SWMU 13-004 cannot be located, it is assumed that the site-wide drainage sampling will provide an adequate understanding of any risk associated with this site. Because the primary pathways for human uptake of metals are inhalation and ingestion and large chunks of metallic contamination may be present, the samples will be sieved.

5.13.4 Sampling and Analysis Plans

Phase I sampling is intended to determine if PCOCs are associated with these units. The Phase II sampling plan, if necessary, will define the complete nature, extent, and rate of migration of any release identified in Phase I.

SOPs used in this sampling plan are delineated in Table 5-65. Sample numbers and necessary analyses are shown on Table 5-66. Field screening methods are described in Subsection 4.7; SOPs for these procedures are currently in preparation.

TABLE 5-65

STANDARD OPERATING PROCEDURES FOR FIELD ACTIVITIES

LANL-ER-SOP	TITLE	NOTES
01.02, R0	Sample Containers and Preservation	Applied to all laboratory samples
01.04, R1	Sample Control and Field Documentation	Applied to all laboratory samples
06.10, R0	Hand Auger and Thin-Wall Tube Sampler	Subsurface soil samples
06.11, R0	Stainless Steel Surface Soil Sampler	All 0 to 6 in. surface samples

5.13.4.1 Engineering Surveys

Engineering and geomorphic surveys are needed to locate SWMUs, drainages, and sediment traps in the field as well as to establish grids for the electromagnetic and magnetic survey, a radiation survey, surface sampling, and trenching. This land survey will also be used to determine the extent of shrapnel dispersal from the experimental activities at the firing site. Shrapnel will be field-checked for radioactivity, flagged, and noted in field notebooks.

The engineering survey will locate, stake, and document all SWMU boundaries and all surface engineering features. All sample locations will be registered on a base map, scale 1:7 200. If during the course of sampling any sample points must be relocated, the new position will be resurveyed and the revised locations will be indicated on the map. The engineering

TABLE 5-66

SUMMARY OF SITE SURVEYS, SAMPLING AND ANALYSIS FOR P-SITE

PRS	PRS TYPE	Laboratory Samples							Field Screening							Field Lab.						Laboratory Analyses											
		Sampled Media	Structure		Surface		Subsurface		Gross Alpha	Gross Gamma/Beta	Organic Vapor	HE Spot Test	Geophysics Surface	Barium - LIBS	A Geological Characterization	Gross Alpha	Gross Gamma/Beta	Tritium	Volatile Organics	B XRF	Soil Moisture	Alpha spectroscopy	Gamma spectroscopy	C Beta spectroscopy	Total Uranium	Isotopic Plutonium	Isotopic Uranium	D VOA (SW 8240)	E Semivolatiles (SW 8270)	F Metals (SW 6010)	G Asbestos	H High Explosives (SW 8330)	Cyanide
				Field dup		Field dup		Field dup																									
13-001	Firing site	Soil			28#	2	10	1		157			x			38	38								38#				38#	38#	38#	38#	
13-002	Bulldozed firing site*	Soil																															
13-004	Burning pits**	Soil			3					3						3	3								3				3	3	3	3	
16-035	Soil contamination	Soil			4					4						4	4								4				4	4	4	4	
16-036	Soil contamination	Soil			4					4						4	4								4				4	4	4	4	
	North channels	Soil			5	1				5						5	5								5				5	5	5	5	
	Southeast channel	Soil			5					5						5	5								5				5	5	5	5	

* number of samples included in 13-001
** if located
A, B, C, D = not applicable; E, F, G, H full suite.
= Additional samples may be taken based on field screeening.

survey will be performed by a licensed professional under the supervision of the field team leader.

SWMUs 13-001, 13-002, 13-004, 16-035, and 16-036 will be located and flagged, if possible. SWMU 13-004 is likely to have been disturbed during construction of TA-16-340; if it cannot easily be found during site surveying, it will be assumed that any regional channel sediment sampling will reveal any health risks associated with the SWMU.

The major channels emanating from the areas encompassing the firing sites and the landfill will be mapped in detail. Sediment traps suitable for sampling will be located and flagged in the large east-west channel north of TA-16-478 and in the largest channel draining the landfill area (SWMU 13-002). The first sediment sample in the northern channel will be located (as nearly as possible) due north of the northeast point of the sampling grid delineated for radiation sampling. The first sediment sampling site in the southeast channel will be located within 10-ft of the topographic break to the southeast of the firing point (SWMU 13-001). All sediment traps will be located in each of these two drainages, and five in each, located at roughly 100-ft interval, will be flagged as sampling locales. Identified locations should be sufficiently numerous to trace the courses of the channels and to provide a representative subset of sediments between TA-13 and primary drainages.

A 50-ft spaced grid approximately covering the 300 ft radius of SWMU 13-001 will be surveyed to locate points for a radiation survey. Approximate corners of this grid are:

CORNER	EAST	NORTH
SW	474800	1762600
NW	474800	1763200
NE	475350	1763200
SE	475350	1762600

The sampling grid is shown in Fig. 5-48.

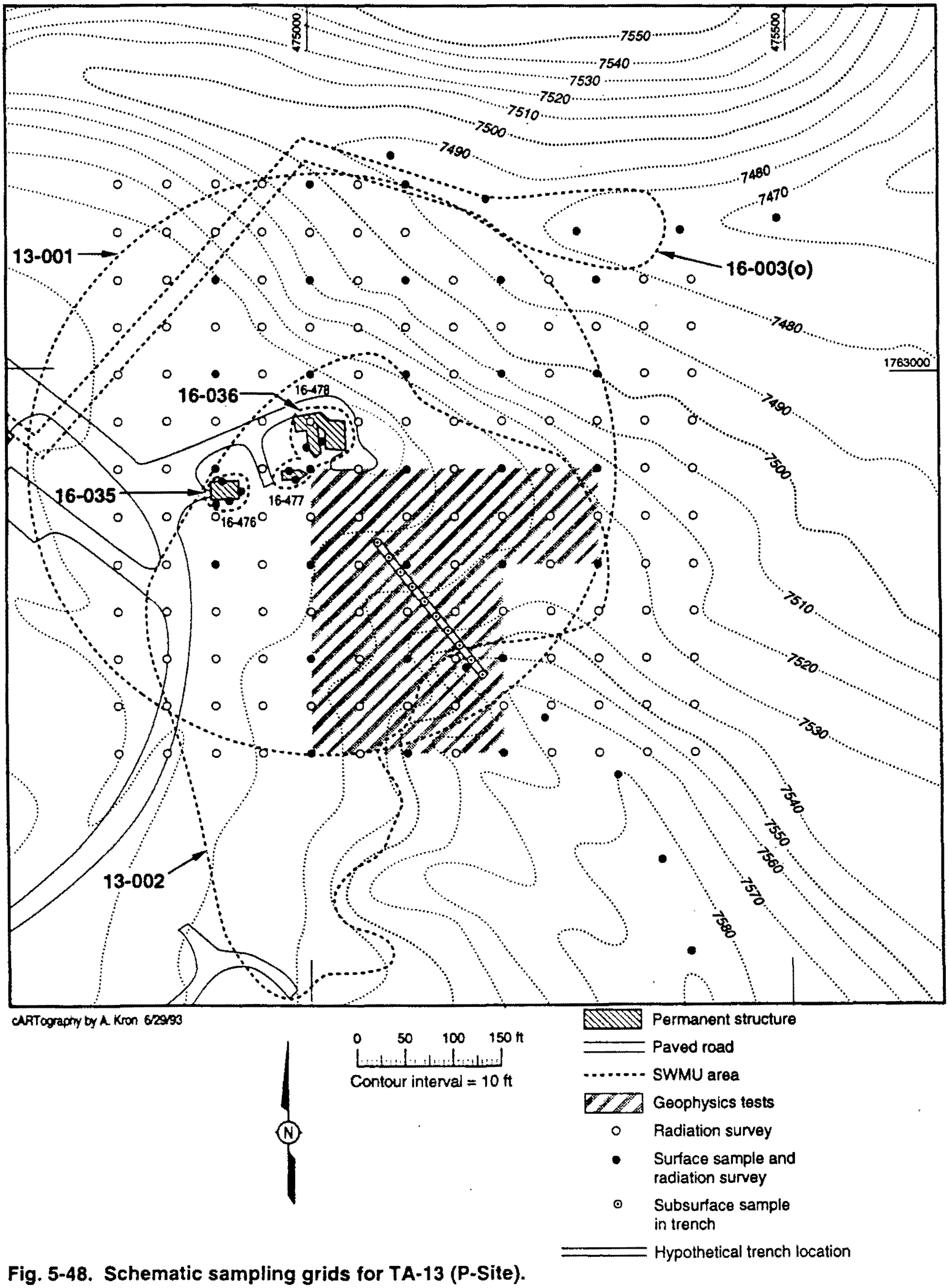


Fig. 5-48. Schematic sampling grids for TA-13 (P-Site).

5.13.4.2 Geophysical Surveys

Electromagnetic and magnetic surveys will be carried out over the landfill (SWMU 13-002) to determine the volume of the landfill, to locate buried metallic debris, and to locate the French drain from TA-16-478. SOPs for geophysical surveys are currently in preparation.

A single non-rectangular-grid geophysical survey at TA-13 will be conducted over the landfill southeast of the firing area. The approximate corners of this grid are:

CORNER	EAST	NORTH
SW	475000	1762600
NW	475000	1762900
NE	475300	1762900
SE	475300	1762600

The grid will not include the points in the southeastern corner of this rectangle (see Fig. 5-48). Sampling points will be delineated using a 5 ft grid spacing.

Electromagnetic and magnetic measurements will be made at each node of the 5-ft grid delineated above. These will be examined for anomalies that might indicate the presence of buried metal.

5.13.4.3 Sampling

Many of the SWMUs considered in this subsection resulted from related contaminant dispersal process, thus an aggregate-wide sampling grid provides coverage of several of these SWMUs. Additional surface samples will be collected within specific areas that may be associated with identified SWMUs.

SWMU 13-001 The firing site centered on the two battleship bunkers

SWMU 13-002 A landfill to the south and east of the firing point

Low-energy gamma radiation measurements for the detection of uranium and other radionuclides will be reported at the nodes of the 50 ft grid described above. The radiation survey will also be extended down the two drainages selected for channel sediment sampling, with readings taken at the flagged sampling localities and other sediment traps. Measurements will be examined for anomalies that would be used to bias the sampling described in the following subsections.

These two SWMUs will be covered by a 100-ft spaced surface sampling sub-grid within the radiation grid. Surface samples will be collected at points overlapping the radiation grid at 100-ft intervals as delineated in Fig. 5-48. Any points that yield above-background radiation screening values will also be sampled for laboratory analysis. At these sampling locations, 0 to 6 in. of soil will be collected. Samples will be sieved (60-mesh) to remove shrapnel-sized metallic chunks. The surface sampling grid will proceed in a south-southeast direction in an irregular pattern designed to cover the boundaries of landfill SWMU 13-002. Coverage provided by this grid is biased to the south and east of the firing point, both because the landfill activities would have dispersed debris in this direction and because the bulk of the battleship bunkers would have prevented dispersal of large amounts of contaminants to the north and west. In order to provide information on spatial variability, the actual samples will be collected at a random distance in a random direction from the actual grid nodes.

Based on the data from the geophysical survey, a 200-ft trench approximately 4-ft deep will be dug in the area of the landfill, SWMU 13-002. It is vitally important that the trench avoid the French drain east of TA-16-478. Following visual inspection in the trench and field screening for radiation, 10 samples will be taken at approximately 20-ft intervals. At these locations, 0 to 6 in. of soil will be collected, either from the bottom or sides of the trench, depending on field indications as described above.

SWMU 13-004, burning pits. If these pits can be located during the field survey, each will be sampled three times within its boundaries. At these locations, 0 to 6 in. of soil will be collected. Samples will be sieved (60-mesh) to remove shrapnel-sized metallic chunks. If they cannot be located, then we will assume that the regional channel sediment sampling will reveal any contaminants that may have been associated with them.

SWMU 16-035, soil associated with control bunker TA-13-2. Four surface samples will be collected adjacent to the control bunker TA-13-2. These samples will be located within 5 ft of the bunker; one each will be taken to the north, east and south of the bunker (Fig. 5-48). At these locations, 0 to 6 in. of soil will be collected. Samples will be sieved (60-mesh) to remove shrapnel-sized metallic chunks.

SWMU 16-036, soil associated with battleship bunkers TA-13-3 and TA-13-4. Four surface samples will be collected adjacent to bunkers TA-13-3 and TA-13-4. Two samples will be taken within 5 ft of each bunker. At these locations, 0 to 6 in. of soil will be collected. Samples will be sieved (60-mesh) to remove shrapnel-sized metallic chunks. If possible, these samples will be located to the east and west of the northern bunker and to the north and south of the southern bunker.

Five sediment (or soil) samples will be taken near the top of the north and southeastern channels continuing at the 100-ft surveyed intervals. At these locations, 0 to 6 in. of soil will be collected.

5.13.4.4 Laboratory Analyses

Full laboratory analyses of samples will be at Level III by the following methods: for radionuclides (LANL or DOE method), metals (SW-846 Method 6010), semivolatiles (SW-846 Method 8270), and HE (SW-846 Method 8330). The principal radionuclide of concern is uranium, the principal HE by-products of concern are DNT, TNB, and DNB; the metals of concern are barium, lead, and beryllium; and the HE of concern are TNT and RDX.

5.13.4.5 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the latest revision of the IWP (LANL 1992, 0768). Field QA/QC duplicates are delineated in Table 5-66.

5.14 TA-11 Firing Site Aggregate, PRSs 11-001(a,b), 11-002, 11-003(b), 11-004(a-f), 11-006(a-d), C-11-001

5.14.1 Background

The TA-11 Firing Site Aggregate (Fig. 5-49) consists of SWMUs and an area of concern (AOC) that are integral components of the active firing site operations at TA-11 (K-Site) [SWMU 11-004(a-f), SWMU 11-006(a-d), and SWMU 11-002] or are physically covered by the active firing site [SWMU 11-001(a-b) and AOC C-11-001]. SWMUs 11-004(a-f) are components of the active drop and skid sensitivity test area, which is known as the drop tower complex. SWMU 11-003(b) is immediately adjacent to the drop tower complex.

Debris and particulates from many years of drop tower experiments and experiments at SWMU 11-001(b) have contributed to potential surface contamination that could extend into the surrounding environment for several hundred feet. Field observations of firing site debris found indications of firing activities within 700 ft of the drop tower. Therefore, the surrounding area, out to a radius of 700 ft from the drop tower, has also been included in PRSs grouped in the firing site aggregate. PRSs grouped in the firing site aggregate contain potential surface and subsurface contamination from past activities and potential surface contamination from current activities (see Table 5-67). The rationale for aggregating these PRSs is that they are active or buried and will not be remediated until the site is decommissioned. Surface soil will be sampled to determine whether potential contaminants have migrated from the source area. If necessary, an interim action to prevent off-site migration resulting from past contamination activities will be implemented to protect human health.

5.14.1.1 Description and History

TA-11 (K-Site) is located approximately 1.5 mi east of the main operational area of TA-16. TA-11 is located on a narrow rise (approximately 200 x 600 ft) that slopes steeply downward to the north and south and more gradually to the east. The area surrounding the operational area is highly vegetated. The site is drained by two main drainages: a drainage approximately 500 ft north and a drainage approximately 100 ft to the south of the structures at the site (Fig. 5-49). The drainages empty into a tributary of Water Canyon. The

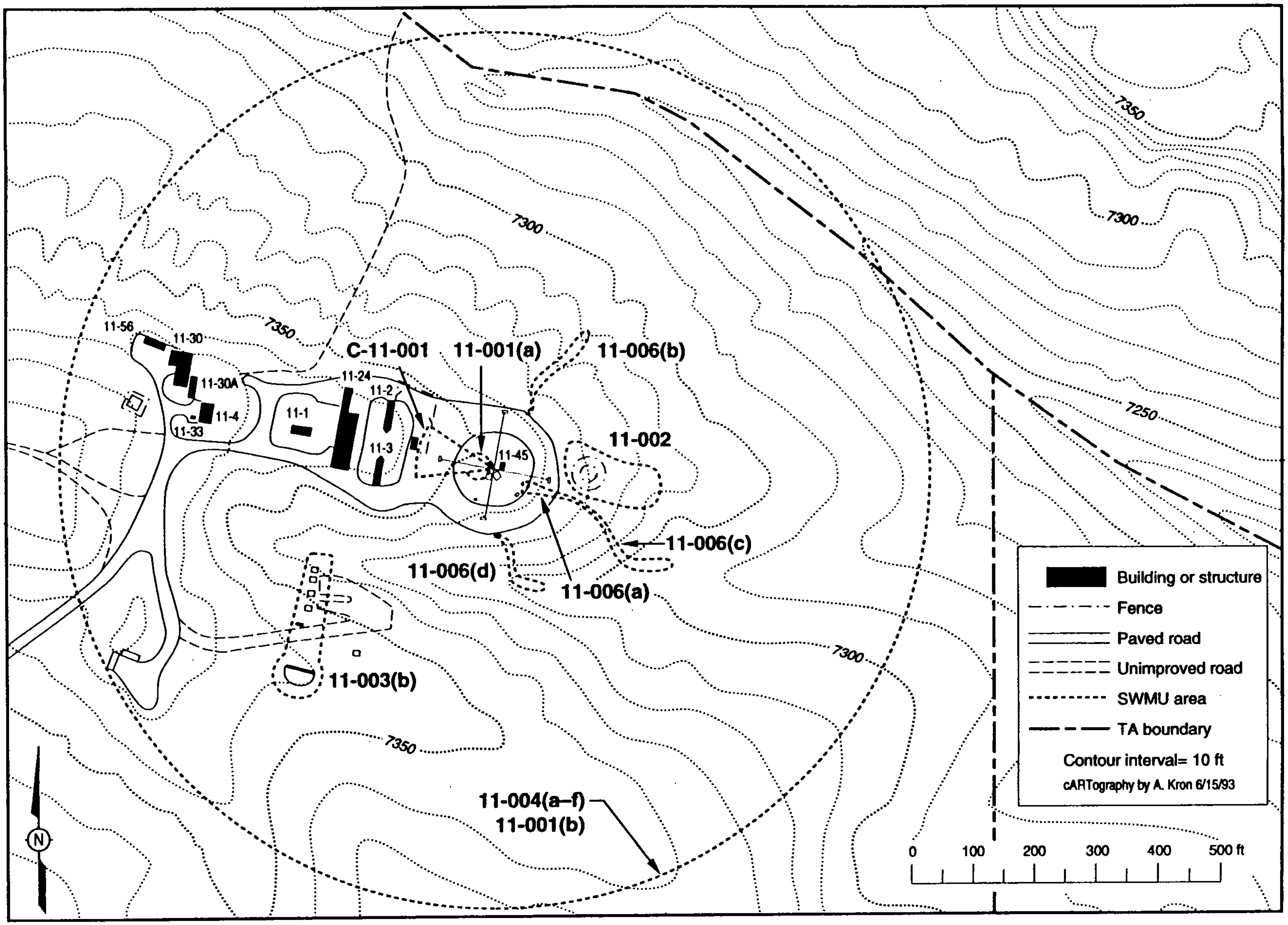


Fig. 5-49. Firing site.

TABLE 5-67

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, TA-11 FIRING SITE AGGREGATE

PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	HE				RAD			METALS			CYANIDE
				UNDETONATED HE	HE DETONATION PRODUCTS	HE DEGRADATION PRODUCTS	HE BURN PRODUCTS	TOTAL URANIUM	URANIUM ISOTOPES	PLUTONIUM ISOTOPES	BARIUM	METALS	ASBESTOS	
11-001(a)	Firing pit (beneath asphalt apron of drop tower)	Fixture testing	N	x	x	x					x			
11-001(b)	Firing pit (beneath 15-ft berm)	Implosion and photofission experiments	N	x	x	x		x	x	x	x	x	x	x
11-002	Open burning area	Burning of HE, propellants, jet fuel	Y	x	x	x	x	x			x	x		
11-003(b)	Mortar impact area	Launch of lead balls	N									x		
11-004(a-f)	Drop tower	High explosive assembly testing	Y	x	x	x		x			x	x	x	x
11-006(a-d)	HE sump and catch basins	High explosive assembly testing	Y	x	x	x		x			x	x	x	x
C-11-001	Area of potential soil contamination (TA-11-5, beneath the asphalt apron of the drop tower)	Photofission experiments and/or photographic laboratory activities	N						x	x				x

tributary to Water Canyon was a perennial stream from treated effluent released from the TA-16 sanitary waste treatment plant, which was inactivated in 1992.

TA-11 was built in the latter part of 1944 (LASL 1944,15-11-001) to house a betatron and a cloud chamber used in studies of implosion symmetry using x-rays and the magnetic method (Neddermeyer 1945, 15-11-005). The x-rays, generated by a betatron, projected the image of an imploding test device onto a cloud chamber (Hawkins 1961, 15-16-299). The image was recorded using flash photography. The betatron and cloud chamber were installed in two, closely-spaced, steel-reinforced, concrete bunkers (TA-11-2 and TA-11-3, see Fig. 5-49). Two SWMUs in the firing site aggregate are associated with these activities, SWMU 11-001(a) and SWMU 11-001(b).

SWMU 11-001(a): TA-11-14. SWMU 11-001(a) was an HE firing pit located approximately 140 ft southeast of TA-11-2. The firing pit consisted of a 12.5 ft x 37 in. x 4.5 ft-deep semicircular concrete wall (TA-11-14) open to the west. The firing pit was used for testing the integrity of aluminum, steel, and copper nose shields that covered the x-ray ports of TA-11-2 and TA-11-3. The firing pit was demolished during the drop tower complex construction in 1956. Prior to demolition, a radiation survey was conducted at TA-11-14 and no significant radioactive contamination was found (Blackwell 1956, 15-11-013). The location of the firing-pit is now covered by the concrete apron of the drop tower. During construction of the drop tower, the concrete remains of the pit were moved and now lie approximately 125 ft southeast of the drop tower.

SWMU 11-001(b). SWMU 11-001(b) includes the firing pit between the betatron in TA-11-2 and the cloud chamber in TA-11-3. From 1944 to 1945, HE tests of up to 200 lb were detonated in contact with uranium and aluminum in this pit. Test assemblies consisted of uncased HE (Griffin 1992, 15-11-048). Therefore, detonations would have resulted in little shrapnel apart from small, pulverized remains of the uranium and aluminum and remnants of the wooden or metal stands used to elevate the test assemblies. The extent of possible contamination associated with these tests includes the area surrounding the drop tower. A walk-through survey of the area by the OU 1082 Project Leader on May 22, 1992, revealed little debris beyond an approximate 700 ft radius from the drop tower. Therefore, the area surrounding the drop tower out to a radius of 700 ft is also included in this SWMU. This boundary is preliminary and will be changed if the RFI indicates a larger or smaller area is appropriate.

Between January 1946, and late 1956, photofission studies of uranium, uranium-235, uranium-238, and plutonium were conducted in a shelter (TA-11-23) in the area between TA-11-2 and TA-11-3 (Hawkins 1961, 15-16-299). The shelter no longer exists and the area (including TA-11-2 and TA-11-3) is currently covered by a 15 ft berm, spray coated with gunite. TA-11-2 and TA-11-3 are currently used as control centers for the drop tower complex. A radiation survey made at TA-11-2 and TA-11-3 just prior to February 1956, (Blackwell 1956, 15-11-013) found no "significant radioactive contamination".

C-11-001: TA-11-5. C-11-001, an AOC, is also associated with the 1946-1956 photofission experiments. C-11-001 is the site of a TA-11-5, a 6 x 32 ft wood frame building constructed after 1945 and removed some time prior to 1956. This building may have housed the laboratory used to prepare samples for the photofission experiments on uranium and plutonium. TA-11-5 might also have been used as a darkroom. This AOC is currently covered by the asphalt apron of the drop tower.

SWMU 11-003(b), a mortar impact area, is the target area associated with the decommissioned air-gun facility, TA-11-24.

The air-gun facility was completed in 1956. The gun itself had a 24-in. bore and an overall length of 96 ft. The purpose of the gun was twofold: to launch experimental packages into the targets located to the south of building TA-11-24 or, in what was known as the closed barrel mode, to first accelerate packages down the barrel and then decelerate them against the compressed cushion of air at the closed end of the tube.

The targets, located 150 to 250 ft south of TA-11-24, were 12 ft x 12 ft x 12-in.-thick poured concrete slabs set in line with the bore of the gun. Various weapons packages, designed to withstand extremes of acceleration and deceleration, were tested by firing them into the targets. Some devices contained HE and depleted uranium. Interviews with site personnel who were employed at TA-11 during the active life of the air-gun facility indicate that there was no launch of the devices containing HE and depleted uranium in which the outer payload envelope was compromised (Martin 1992, 15-11-069). A review by OU 1082 personnel of several volumes of post-shot target/projectile photographs currently stored at TA-11 also revealed no evidence of a breach of any outer payload envelope.

On a single occasion in 1972, a steel target was erected approximately 250 ft from the gun muzzle for an impact test of an inert mock-up of a radioactive thermal generator power supply. The device was a 12-in.-diameter, hollow-steel sphere filled with steel or lead ball bearings suspended in a graphite matrix. The sphere fractured upon impact (Griffin 1992, 15-11-070).

SWMUs 11-004(a-f): TA-11-25, -26, -27, -28, -41, and -42. In 1956, TA-11 was modified to conduct explosives and weapons safety studies (LASL 1945, 15-16-148; Brooks 1956, 15-11-014; Thrap 1964, 15-11-024). Modification involved construction of a 160-ft-high drop tower (TA-11-25) surrounded by a 130-ft-diameter concrete pad (TA-11-26). SWMUs 11-004(a-f) are components (hoists, pads, the tower itself, and the underlying concrete and asphalt aprons) of this drop tower complex located 180 ft east of TA-11-2 and TA-11-3. The components are well maintained. The drop tower was used for conducting drop and skid sensitivity tests and continues as an active test firing facility. Cased warheads and bare explosives charges were dropped from the tower to measure impact sensitivity. The maximum amount of explosive in cased experiment devices was 600 lb (Brooks 1959, 15-11-015). For cased experiments, the HE does not detonate, but fragments of undetonated HE and metal components of the warheads may be scattered by break up upon impact. Potential metals of concern are uranium and beryllium. Bare high explosive skid sensitivity tests, however, routinely detonate. In incomplete detonations high explosive debris may also be distributed beyond the drop tower complex. The arrangement of the pads on the concrete apron is such that debris is thrown primarily to the south and east. Therefore, possible contamination associated with the drop tower complex includes the surrounding area affected by the explosive tests debris.

Interviews with workers at TA-11 and an October 1987, CEARP Phase I Draft report (DOE 1987, 0264) indicate that debris is generally located within a 350 ft radius of the drop tower. Several walk-through surveys of the area by the OU 1082 Project Leader revealed little debris beyond approximately 500 ft from the drop tower.

SWMUs 11-006(a-d): TA-11-39, -50, -51, and -52. Currently the drop tower complex sits on a concrete pad, about 130 ft in diameter with a curb, which is surrounded by a further asphalt apron, also with a curb. After an HE drop from the tower, large pieces of unexploded HE are gathered by hand and the concrete and asphalt aprons surrounding the drop tower are cleaned using high-pressure water hoses. Potential metals of concern for 11-006(a-d) are the same as for 11-004(a-f), i.e., uranium and beryllium. The concrete pad drains to an HE sump, TA-11-39 [SWMU 11-006(a)], located to the east of the drop tower complex. The sump consists of a concrete box, 4.5 x 5.3 x 4.25 ft deep, the upper rim of which is at the level of the concrete pad. (A general description of high explosive sumps is given in Subsection 5.2.1). The sump, in turn, drains across the asphalt into one of three catch basins (TA-11-51). (The sump was installed in 1961; however, the catch basins were not installed until 1970.) The three catch basins are concrete boxes, 6 x 4 x 2 ft deep [SWMUs 11-006(b, c, and d)], with aluminum tops and overflow drains. These are TA-11-50, TA-11-51, and TA-11-52, respectively. The catch basins receive wash down and runoff from the asphalt apron. Their outfalls are NPDES permitted (EPA 05A069, EPA 05A096, EPA 05A097) and are channeled along asphalt-lined drainages into natural drainages flowing east from TA-11 to Water Canyon. After the HE in the sump and catch basins has settled, it is collected for disposal at the TA-16 burning ground.

SWMU 11-002. SWMU 11-002, an active burn area about 30 ft in diameter, is located east of the drop tower at the edge of its asphalt apron. The area slopes to the east and is intersected by a small drainage. It was used as an experimental burning area for components on or in assembled configurations with HE, propellants, and jet fuel. HE and propellant burns were conducted directly on the sand pad. The jet fuel burns took place within an open-topped steel containment tank. These activities occurred from 1948 to October 1992. Non-experimental burns of depleted uranium and HE-contaminated materials have also occurred (LANL 1990, 0145). It remains an active experimental area.

During three 1975 safety tests, several iridium-encased thorium oxide containers were burned on top of as much as 3 000 pounds of Titan III propellant. Combustion products of Titan III propellant consist of carbon dioxide, carbon monoxide, water vapor, hydrogen, nitrogen, hydrogen chloride, and aluminum oxide. The gases dissipated into the air and no residual hydrochloric acid is expected at this site (Martell 1992, 15-11-066) since burning would distribute the combustion products widely and the hydrochloric acid would return to the ground much like acid rain and be neutralized by the local alkaline soil. In all tests, the iridium casings remained intact and no alpha contamination was detected (Gibbons 1974,15-11-028; Gibbons 1975, 15-11-029; Amies 1975, 15-11-030).

5.14.1.2 Conceptual Exposure Model

The on-site conceptual exposure model for the firing site aggregate PRSs is presented in Chapter 4, Fig. 4-6. Subsection 5.14.1.2.1 presents the source and extent of contamination, and PCOCs. PRS-specific information on migration pathways and potential receptors is discussed in Subsection 5.14.1.2.2.

5.14.1.2.1 Nature and Extent of Source

Table 5-67 summarizes the PCOCs for this aggregate. Past and future activities at these sites indicate that a major pathway would be off-site migration of potential contaminants. Subsurface contamination does not present a current source for off-site migration and will be addressed when the site is decommissioned. The most likely transport mechanism is movement of constituents with sediment in the Water Canyon drainages.

PRSs buried under and adjacent to the drop tower complex. The locations of SWMU 11-001(a) and AOC C-11-001 are covered by the concrete and asphalt aprons surrounding the active drop tower. The firing pit associated with SWMU 11-001(b) is covered by the berm over TA-11-2 and TA-11-3. Potential contaminants associated with SWMU 11-001(a) include constituents from explosives testing, such as undetonated HE, HE residuals, and barium (Table 5-67). Potential contaminants associated with AOC C-11-001 include constituents from photofission experiments (uranium-235, uranium-238, plutonium-238, and plutonium-239, -240) and chemicals from photoprocessing activities. Potential contaminants associated with SWMU 11-001(b) include constituents from explosives testing (undetonated HE, HE residuals, beryllium, and uranium) and constituents associated with photofission experiments. SWMU 11-003(b) may contain lead balls of approximately .5-in. diameter.

Drop tower complex. The potential contaminants from SWMUs 11-004(a-f) consists of debris and particulates dispersed within 700 ft of the firing site including undetonated HE, HE residuals from partial detonation and weathering, metals (including beryllium and barium), and uranium (Table 5-67).

SWMUs 11-006(a-d). Potential contamination from SWMUs 11-006(a-d) are the same as those associated with SWMUs 11-004(a-f) (Table 5-67). Potential contaminants could be located under the sump or catch basins, and/or in the drainages associated with the outfalls from the catch basins.

SWMU 11-002. Potential contaminants associated with SWMU 11-002 include HE residuals (e.g., barium and burn by-products), uranium, beryllium, and lead (Table 5-67).

5.14.1.2.2 Potential Pathways and Exposure Routes

PRSs in the firing site aggregate contain potential surface and subsurface contamination. It is not appropriate to characterize the surface PRSs in this aggregate at this time, because active operations are continually changing site conditions. Subsurface PRSs present no current health hazard and characterization of these PRSs would seriously disrupt active operations; therefore, subsurface PRSs will be addressed when the site is decommissioned. However, it is appropriate to ascertain the extent of contaminant migration to determine if off-site migration presents a health risk or safety hazard to public health.

The dominant pathway for off-site migration is by surface water transport in the drainages to Water Canyon. The firing site aggregate is surrounded on all other sides by Laboratory property requiring a security clearance to enter. Current public exposure would only occur at the intersection of Water

Canyon with State Highway 4 near White Rock, approximately 6 miles from the drop tower (Fig. 1-2). It is unlikely that contaminants have migrated this far from the source.

Current on-site health and safety risks for this PRS aggregate are to workers from unexploded HE and radioactivity associated with SWMU 11-002. However, this is an active site and the responsibility for management of these risks lies with the active operation and will not be addressed in this RFI. In the future, the most probable land use scenario for this site is as a recreational area (i.e., hiking and camping). Chapter 4 contains a detailed discussion of the migration pathways, conversion mechanisms, human receptors, and exposure routes.

5.14.2 Remediation Decisions and Investigation Objectives

Problems Statement (DQO Step 1)

The PRSs associated with the firing site aggregate include integral components of, or are buried under or immediately adjacent to integral components of, an active firing site. Continuing work at this site can be expected to affect the active PRSs and drainages included in this aggregate. Any current risks to on-site workers are the responsibility of the active operations and will not be addressed in the RFI. Active drop tower complex SWMUs will not be remediated until the site is decommissioned. Buried PRSs present no current risk to the public or on-site workers and also will not be remediated until decommissioning of the site. Therefore, final investigations and permanent corrective measures for these PRSs, including currently inaccessible PRSs, will be deferred until the site is decommissioned. The main problem is to investigate contaminant migration down the north and south drainages from the drop tower complex to the Water Canyon tributary.

Although the closest point for public exposure is at the intersection of Water Canyon and State Road 4, near White Rock (Fig. 1-2), interim actions to stop or reduce off-site migration, such as the removal of contaminated sediments and/or the placement of barriers, will be based on samples collected in the sediment catchments in the Water Canyon tributary.

Decision Process (DQO Step 2)

To determine if off-site migration presents a potential health problem, potential contaminant levels in sediments in the main tributary to Water Canyon (Fig. 5-50) will first be compared to SALs (see Chapter 4 and IWP Subsections 4.2.2 and Appendix J (LANL 1992, 0768). If the SALs are exceeded, then a baseline risk assessment will be carried out and potential contaminant levels in sediments in the tributary will be used to calculate whether or not acceptable risk levels are exceeded for a site-specific scenario. Evaluation of the health hazard will be based on a recreational use scenario. Although public exposure is not an issue at this location, if levels correspond to unacceptable risk levels for a recreational-use scenario, then an interim action to stop migration will be evaluated.

Evaluation of a safety hazard will be based on the presence of unexploded HE in the tributary to Water Canyon. If fragments of unexploded HE are found in the tributary, or if the concentration of HE in the sediment catchments of the tributary are determined to be above acceptable safety levels, then an interim action will be evaluated. The safety levels for amount and particle size that is acceptable from a safety perspective have not been determined. It is the responsibility of WX Division to set acceptable safety limits for HE fragments.

The decision logic for this aggregate is shown on Fig. 5-51.

5.14.3 Data Needs and Data Quality Objectives

Decision Inputs and Investigation Boundary (DQO Steps 3 and 4)

The potential public health risk is from off-site migration of potential contaminants listed in Table 5-67. As stated previously, the major route for potential off-site migration is the tributary to Water Canyon. Sediment catchments in this tributary provide an estimate of the maximum concentrations of PCOCs downstream of the drop tower.

The decision to propose deferred action for this aggregate will be based on PCOC concentrations (including pieces of HE that present a safety problem) in the sediment catchments. If necessary, these data will be used in the baseline risk assessment.

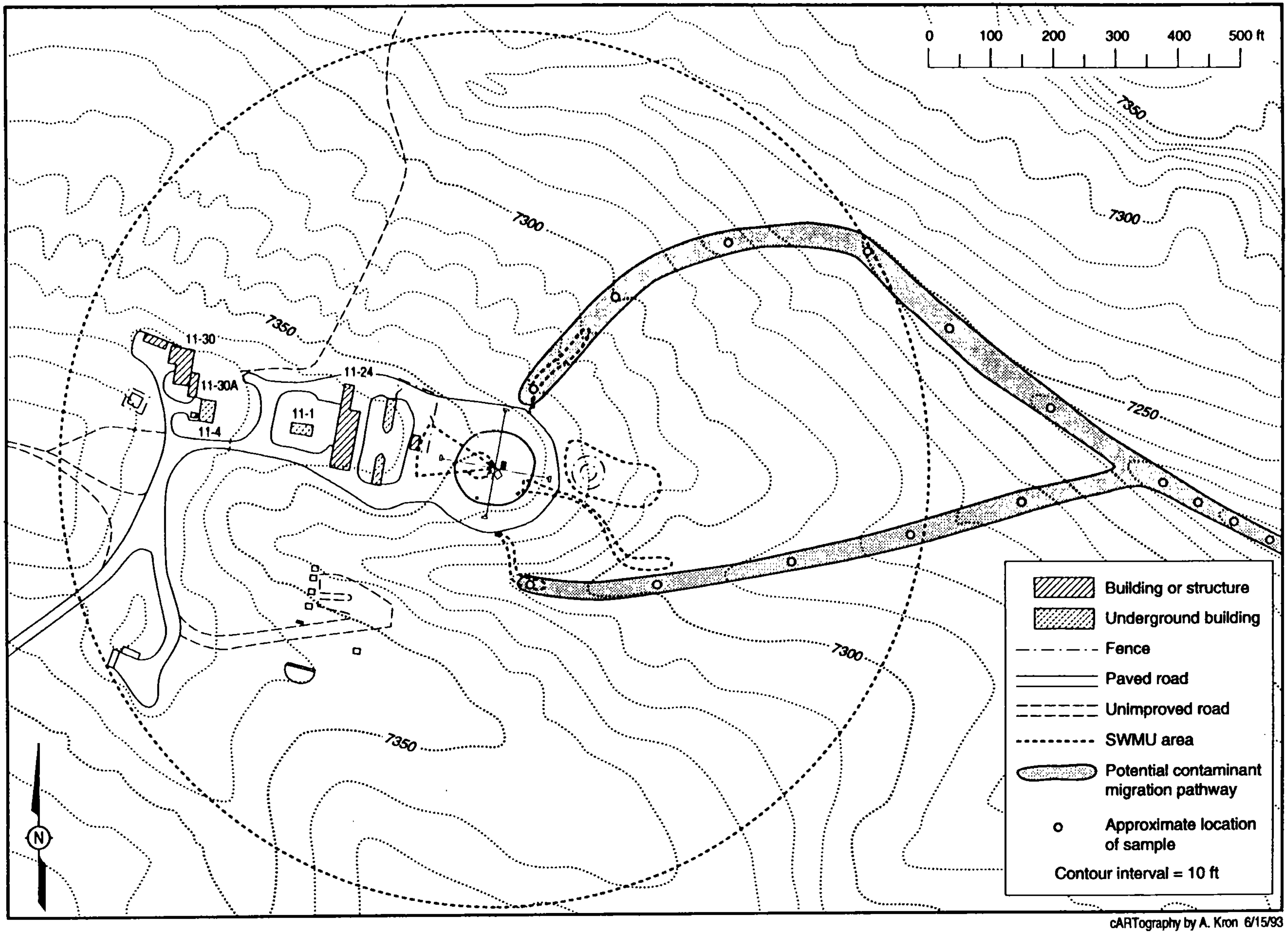
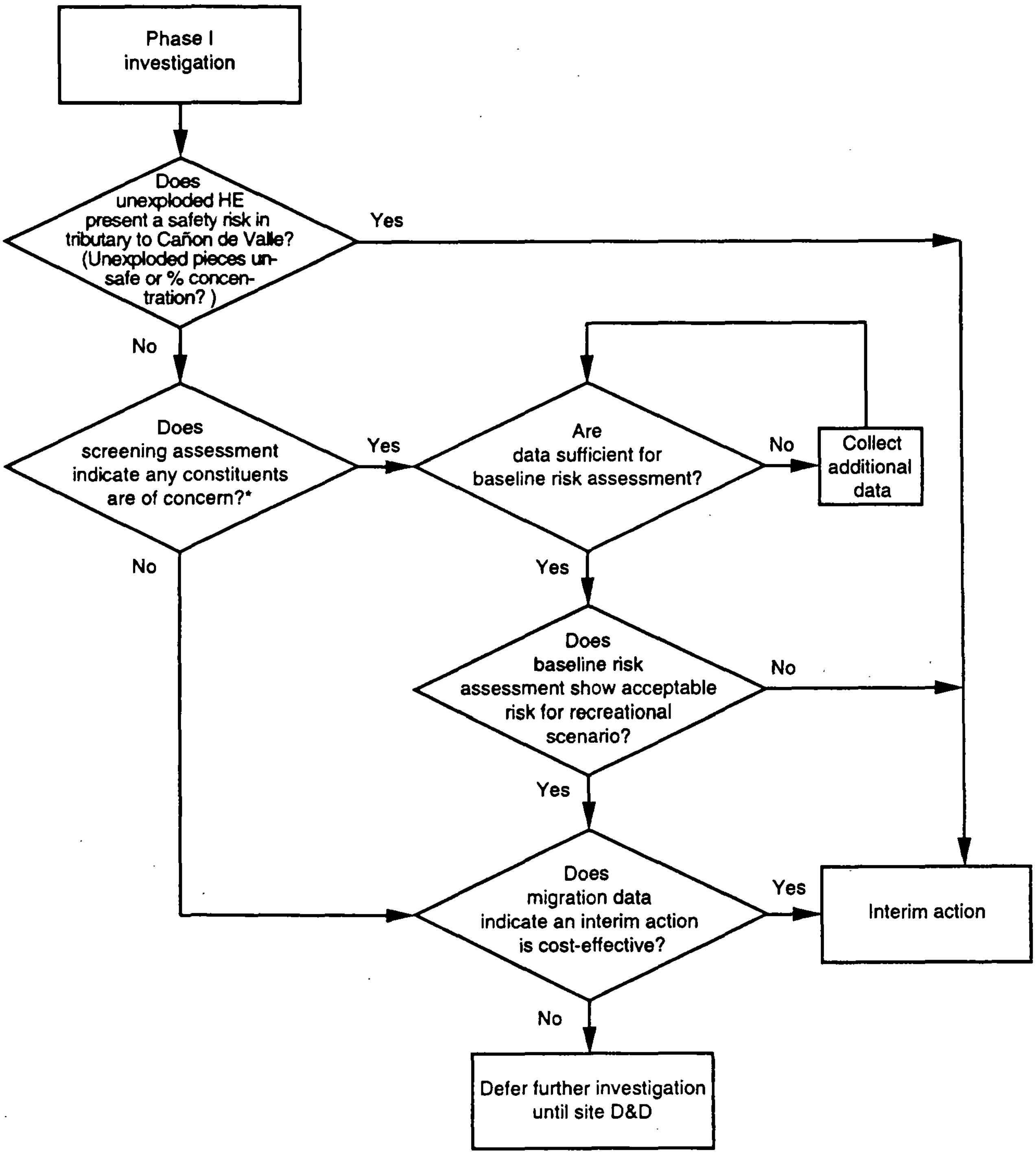


Fig. 5-50. Map showing possible path of potential contaminant transport.



*PCOCs> SALs or possible multiple contaminant problem

Fig. 5-51. Decision flow for PRS Aggregate A.

A secondary goal of the Phase I survey will be to provide data that will help plan the Phase II survey, if it is needed. Data collected on PCOC concentrations in the north and south drainages will help design the Phase II migration rate survey.

The data required for these assessments are measurements of potential contaminant concentrations (Table 5-67) and HE particle size distributions and concentrations in the sediment catchments of the tributary to Water Canyon and in the two main drainages to the tributary.

Decision Logic (DQO Step 5)

If the maximum concentrations of any potential contaminant in the sediment catchments in the tributary to Water Canyon are above the SALs or if a safety hazard exists, then Phase II sampling will be required to determine the maximum extent of migration. After Phase II sampling is complete, an interim action will be taken to mitigate contaminant migration. If the PCOC concentrations are below SALs in the Water Canyon tributary catchments, then deferred action may be proposed.

Design Criteria (DQO Step 6)

Reconnaissance sampling will be used for the sediments catchments in the tributary to Water Canyon. The catchments are expected to have collected PCOCs, and should provide an upper bound to PCOC concentrations.

It is assumed that if potential contaminants have reached the tributary to Water Canyon, they will be detectable in one or more of the four large sediment catchments below the confluence of the south drainage with the tributary (Fig. 5-50). The primary PCOC for this study is HE. All samples in the Water Canyon tributary will be analyzed for HE (both laboratory analytic measurement on the sieved soil sample and a safety screen on the complete field sample) and other PCOCs (Table 5-67).

Sediment catchments every 200 ft in the north and south drainages will be sampled for HE to evaluate the pattern of contaminant migration. These data will help design a Phase II survey, if it is needed. All samples will be screened to see if they meet health and safety requirements. Appropriate transport and laboratory safety procedures will be implemented based on the field screening data.

PCOCs are expected to be homogeneous in the x and y dimensions of the sediment catchments, but there may be some stratification (in the z dimension). For this reason, three full laboratory analyses (one per soil core) are recommended for each of the catchments in the tributary of Water Canyon below the confluence of the south drainage and the tributary. Two full laboratory analyses will be adequate for sediment catchments in the north and south drainages.

5.14.4 Sampling and Analysis Plan

SOPs that control field activities in this sampling plan are listed in Table 5-68. Sample numbers and required analysis are shown on Table 5-69.

TABLE 5-68

STANDARD OPERATING PROCEDURES FOR FIELD ACTIVITIES

LANL-ER-SOP	TITLE	NOTES
01.02, R0	Sample Containers and Preservation	Applies to all laboratory analytical samples
01.04, R1	Sample Control and Field Documentation	Applies to all laboratory analytical samples
06.10, R0	Hand Auger and Thin-Wall Tube Sampler	Applies to augered soil samples
06.11, R0	Stainless Steel Surface Soil Sampler	Applies to the collection of soil/sediment samples
06.09, R0	Spade and Scoop Method for Collection of Soil Samples	Applies to the collection of soil/sediment samples

5.14.4.1 Engineering Surveys

The four major sediment catchments in the tributary to Water Canyon and the sediment catchments in the upstream north and south drainages will be surveyed and flagged. These data will be recorded on a base map, scale 1:7 200. If during the course of sampling any sample points must be relocated, the new position will be surveyed and the revised locations will be indicated on the map. The engineering survey will be performed by a licensed professional under the supervision of the field team leader.

TABLE 5-69

SUMMARY OF SITE SURVEYS, SAMPLING AND ANALYSIS FOR TA-11 FIRING SITE AGGREGATE

			Laboratory Samples								Field Screening							Field Lab.						Laboratory Analyses											
			Structure		Surface		Sub-surface										A					B				C				D	E	F	G	H	
PRS	PRS TYPE	Sampled Media		Field dup		Field dup	No. of cores	No. of samples	Total	Field dup	Gross Alpha	Gross Gamma/Beta	Organic Vapor	HE Spot Test	Geophysics Surface	Barium - LIBS	Geological Characterization	Gross Alpha	Gross Gamma/Beta	Tritium	Volatile Organics	XRF	Soil Moisture	Alpha spectroscopy	Gamma spectroscopy	Beta spectroscopy	Total Uranium	Isotopic Plutonium	Isotopic Uranium	VOA (SW 8240)	Semivolatiles (SW 8270)	Metals (SW 6010)	Asbestos	High Explosives (SW 8330)	Cyanide
TA-11*	Runoff - N drainage	Sediment			6	1								6											2			2	2		2	2	2	6	2
	Runoff - S drainage	Sediment			5									5											2			2	2		2	2	2	5	2
TA-11*	Tributary to Water Canyon	Sediment					12	3	12	1				12											12			12	12		12	12		12	12

A, B, C, D = not applicable; E, H = full suite; F = 1082 suite
*PRSs are not being sampled individually for this Aggregate. Rather, the sampling strategy is to look for potential off-site migration.

5.14.4.2 Sampling

Tributary to Water Canyon. The four major sediment catchments below the confluence of the south drainage and the tributary to Water Canyon will be sampled (Fig. 5-50). A transect across each catchment perpendicular to the tributary will be sampled with the auger and thin-wall sample method. Samples will be collected at three points and analytical samples removed at two or three depths at each point: at the surface, middle, and bottom of the catchment; or, at the surface and bottom. The field team will make the decision as to total sample depth based upon the depth of the catchments. Analytical samples will be a minimum of 0.2 ft in length. The specific lateral spacing of the three sampling holes will be determined by the field team based upon surface morphology.

First, analytical samples will be sifted to identify HE fragments that pose a safety hazard. The fragments diverted by sifting will be weighed in the field as well as the parent sample from which the HE is separated. Then the soil samples from the same depth in each catchment will be composited to generate a total of three analytical samples per catchment. These three samples will be sent for a full suite laboratory analysis.

North and south drainages. Surface soil/sediment samples (0 to 6 in.) will be collected at catchments spaced approximately every 200 ft in the north and south drainages (Fig. 5-50). HE swipe tests will be performed on all samples to determine presence or absence of HE. The first and last (upstream and downstream) sample in each drainage will sent to the laboratory for a full suite laboratory analysis. The intervening samples will be submitted only for HE characterization analyses.

5.14.4.3 Laboratory Analysis

Laboratory analyses of samples will be at Level III for radionuclides (LANL or DOE method), metals (SW-846 Method 6010), SVOCs (SW-846 Method 8270), and HE (SW-846 Method 8330). The principal radionuclides of concern are uranium and plutonium isotopes; the HE by-products of concern are DNT, DNB, and TNB; the principal organics are cyanide; and, the metals of concern are barium, beryllium, silver, and lead.

5.14.4.4 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the latest revision of the IWP (LANL 1992, 0768). Any QA/QC duplicate samples planned to be collected during the course of the field investigation are outlined in Table 5-69.

5.15 TA-11 Outfalls Aggregate, SWMU 11-005(c), SWMUs 11-011(a-c)

5.15.1 Background

The SWMUs in the outfalls aggregate have a mixture of potential surface and subsurface contamination from past activities (Table 5-70 and Fig. 5-52). All but SWMU 11-005(c) are active outfalls. All outfalls had low flow. These SWMUs have no quantitative historical data on the concentration of potential contaminants. A single Phase I sampling approach will be taken to evaluate potential contamination that resulted from past activities.

5.15.1.1 Description and History

SWMU 11-005(c). SWMU 11-005(c) is an outfall north of TA-11-2 from a drain line (now plugged) that served TA-11-2. TA-11-2 housed the betatron which was removed prior to construction of the drop tower complex in 1956. The drain line was installed in 1944, when the building was constructed and served a sink, hot water heater, and a floor drain. Activities at TA-11-2 are described in Subsection 5.14.1.1. PCOCs are uranium and plutonium isotopes associated with the photofission experiments. Cleaning solvents may have been used in association with this activity. Photographic processing may been associated with the WW II betatron activities. The discharge from the outfall is to a slightly sloped area consisting of fill from an adjacent road bed.

The area is currently heavily vegetated, which would restrict the movement of potential contaminants.

SWMU 11-011(a): NPDES 03A130. SWMU 11-011(a) is an active outfall associated with TA-11-30A, which contains support equipment for the vibration test facility in TA-11-30. The electrical equipment in TA-11-30A is cooled by water circulating through a cooling tower. Blowdown from the cooling tower is not treated prior to release through the outfall. TA-11-30A floor drains are also connected to this outfall. The outfall consists of a 2-in. pipe (surrounded by a 2-in. layer of insulation) located approximately 6 ft east of the NE corner of TA-11-30.

The outfall discharges to a short (approximately 20 ft drainage channel). The soil is loosely compacted and porous.

TABLE 5-70

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, TA-11 OUTFALLS AGGREGATE

PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	RAD: URANIUM ISOTOPES	RAD: PLUTONIUM ISOTOPES	METALS: METALS SUITE	ORGANICS: VOLATILE	ORGANICS: SEMIVOLATILE	ORGANICS: CYANIDE
11-005(c)	Drain line outfall formerly serving Building TA-11-2	Betatron and photofission experiments	N	x	x	x	x		x
11-0011(a)	NPDES Outfall 03A130 serving Building TA-11-30A	Blowdown from cooling tower	Y			x		x	
11-0011(b)	Outfall serving Building TA-11-30	Electrodynamic vibration facility	Y				x	x	
11-0011(d)	Outfall serving Building TA-11-24	Air gun facility, office area, light machine shop	Y			x	x	x	

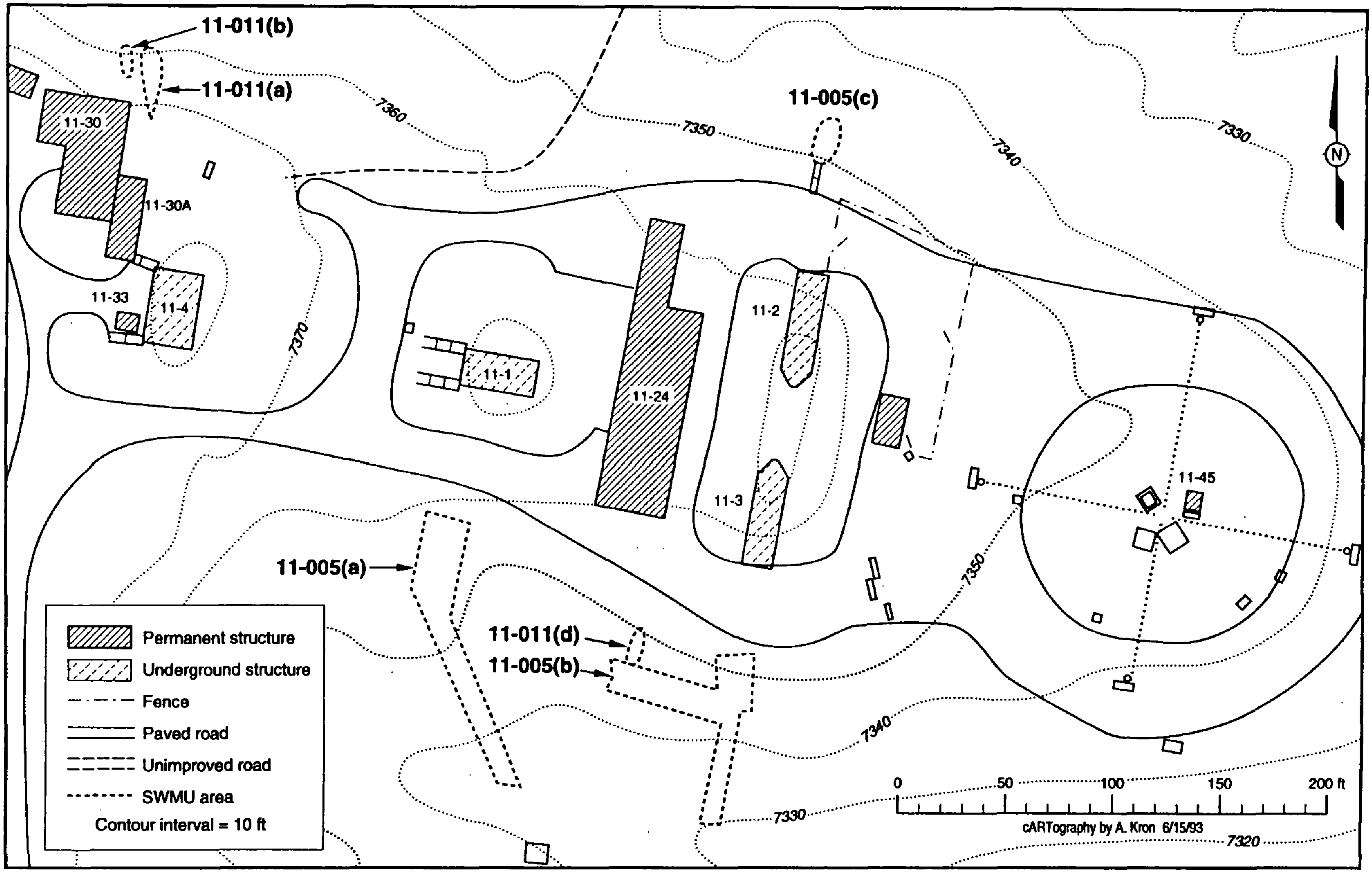


Fig. 5-52. Septic systems and outfalls at TA-11.

SWMU 11-011(b). SWMU 11-0011(b) is an active outfall that serves the floor drains of TA-11-30. A sink drain formerly connected to this outfall has been removed. TA-11-30 houses an electrodynamic vibration facility. SWMU 11-0011(b) lies on a slope approximately 15 ft due north of TA-11-30. The outfall consists of a 3-in. pipe that extends approximately 10 in. beyond the side of the hill.

The outfall discharges to a short (approximately 5 ft drainage channel). The soil is loosely compacted and porous and the area is heavily vegetated.

SWMU 11-011(d). SWMU 11-0011(d) is an active outfall associated with TA-11-24, which contained the air gun facility. The outfall consists of a 4-in. steel pipe located on the south side of TA-11-24. The air gun was used to conduct acceleration and impact tests on full-scale warhead mock-ups. TA-11-24 is currently used as offices and a light machine shop.

The discharge from the outfall is to a sloped area of unconsolidated porous soil. Thus, the concentration of potential contaminants from this outfall would be highest directly below the discharge area.

5.15.1.2 Conceptual Exposure Model

The conceptual model for the outfalls aggregate is presented in Chapter 4, Fig. 4-3. Subsection 5.15.1.2.1 presents the PCOCs for each SWMU and the potential release sources. PRS-specific information on migration pathways and potential receptors is discussed in Subsection 5.15.1.2.2.

5.15.1.2.1 Nature and Extent of Contaminants

Table 5-70 summarizes the PCOCs for this aggregate. There are no existing quantitative environmental chemistry data, but the historical data were adequate to narrow the list of potential contaminants for some SWMUs (Table 5-70).

SWMU 11-005(c). Potential contaminants are volatile organics (cleaning solvents) from routine building operations, uranium and plutonium isotopes and metals from photofission experiments. PCOCs include silver and cyanide that may have been used in photographic processing during WW II-era activities.

SWMU 11-011(a). Potential contaminants are semivolatile organics and chromates, which may have been used in the water treatment process.

SWMU 11-011(b). Potential contaminants are volatile and semivolatile organics from the routine operations of the electrodynamic facility.

SWMU 11-011(d). Potential contaminants are organic cleaning agents, cutting oils, and metals used in the machine shop.

5.15.1.2.2 Potential Pathways and Exposure Routes

Although on-site exposure to workers is the responsibility of the active operation, exposure from potential contamination at outfalls resulting exclusively from past activities will be evaluated (Table 5-70).

The outfalls discharge to sloped areas of unconsolidated porous soil. Thus, potential contaminants are expected to migrate vertically rather than laterally. Therefore, off-site migration by surface water transport in the drainages to Cañon de Valle is unlikely.

Future exposure scenarios include on-site workers, campers, and construction workers. A more detailed description of the migratory pathways, conversion mechanisms, potential human receptors, and exposure routes are presented in Chapter 4.

5.15.2 Remediation Decisions and Investigation Objectives

Problem Statement (DQO Step 1)

The objective of the Phase I sampling is to determine if concentrations of potential contaminants from past operations at the outfalls are above SALs for potential contaminants resulting from past activities (Table 5-70). Current Laboratory waste management practices preclude further PCOCs from being discharged at these locations.

Decision Process (DQO Step 2)

If Phase I sampling shows that all PCOCs are below SALs, then NFA will be proposed. If Phase I sampling of any outfall shows contaminant levels above SALs, then a baseline risk assessment for current and future use of the site will be performed.

5.15.3 Data Needs and Data Quality Objectives

Decision Inputs and Investigation Boundary (DQO Steps 3 and 4)

Outfalls on moderate slopes: SWMU 11-005(c) and SWMU 11-011(d). Data needs for these SWMUs consist of concentrations of potential contaminants in the surface and subsurface soils in the discharge area beneath the outfall. The area below these outfalls is a moderately sloping hillside.

Outfalls on steep slopes: SWMU 11-011(a) and SWMU 11-011(b). Data needs for these SWMUs consist of concentrations of potential contaminants in the surface and subsurface soils in the discharge areas beneath the outfalls and in the first sediment trap downstream of the discharge areas. The area below these outfalls is roughly twice as steep as the preceding SWMUs.

Decision Logic (DQO Step 5)

If the maxima of the potential contaminants in any sample are above SALs, then a baseline risk assessment will be conducted. The baseline risk assessment will help decide on whether to propose NFA, do a VCA, or collect more data in a Phase II.

Design Criteria (DQO Step 6)

Reconnaissance sampling will be used at all outfalls. The rationale for biasing sample collection is based on the flow rates of PCOCs at the outfalls, the lack of drivers to redistribute PCOCs, and the tendency for PCOCs to migrate from the outfall source (steepness of the slope, consolidation of the fill below the outfall). Field screening will also be used to help select the location of soil cores.

Because of the low potential contaminant flow rate at each of these outfalls, it is expected that a single core sample should be adequate to sample the outfalls that empty onto a moderate slope. Two soil cores will be required for the outfalls on the steep slope, since it is more likely that contaminants have migrated further from the outfall. Significant flushing of potentially-contaminated soil below the outfall is not likely in either case, since flow from the outfall pipes was low and none of the pipes is in a drainage which has perennial or intermittent flow (e.g., storm water runoff). Based on the low flow from these outfalls, PCOCs are expected to be most concentrated in the surface soil (0 to 6 in.) just below the outfall, but soil cores will be taken to a depth of 18 in. to test this assumption. Three samples per core will be submitted for full laboratory analysis, which yields three values per PCOC for the outfalls on moderate slopes, and six values for outfalls on steep slopes.

It is expected that the data will form an adequate basis for NFA. A baseline risk assessment will be possible if the outfall data is combined with other soil samples collected in the adjoining SWMUs (Fig. 5-52).

5.15.4 Sampling and Analysis Plan

SOPs that control field activities in this sampling plan are listed in Table 5-71. Sample numbers and required analysis are shown on Table 5-72.

TABLE 5-71

STANDARD OPERATING PROCEDURES FOR FIELD ACTIVITIES

LANL-ER-SOP	TITLE	NOTES
01.02, R0	Sample Containers and Preservation	Applied to all laboratory analytical samples
01.04, R1	Sample Control and Field Documentation	Applied to all laboratory analytical samples
06.10, R0	Hand Auger and Thin-Wall Tube Sampler	Applied to augered soil samples

5.15.4.1 Engineering Surveys

The SWMUs in the TA-11 outfalls aggregate will be field surveyed, which will consist of site engineering (geodetic) mapping and geomorphologic mapping. Site mapping is required to accurately record the location of the SWMUs. In the field, the engineering survey will locate, stake, and document the location of the SWMUs. Sample locations will be registered on a base map, scale 1:7 200. If during the course of sampling any sample points must be relocated, the new position will be surveyed and the revised locations will be indicated on the map. The engineering survey will be performed by a licensed professional under the supervision of the field team leader.

TABLE 5-72

SUMMARY OF SITE SURVEYS, SAMPLING, AND ANALYSIS FOR TA-11 OUTFALLS AGGREGATE

PRS	PRS TYPE	Laboratory Samples: Sampled Media	Structure	Structure: Field dup	Surface	Surface: Field dup	Sub-surface: No. of cores	Sub-surface: No. of samples per core	Sub-surface: Total	Sub-surface: Field dup	Field Screening: Gross Alpha	Field Screening: Gross Gamma/Beta	Field Screening: Organic Vapor	Field Screening: HE Spot Test	Field Screening: Geophysics Surface	Field Screening: Barium - LIBS	Field Screening: Geological Characterization (A)	Field Lab.: Gross Alpha	Field Lab.: Gross Gamma/Beta	Field Lab.: Tritium	Field Lab.: Volatile Organics	Field Lab.: XRF (B)	Field Lab.: Soil Moisture	Laboratory Analyses: Alpha spectroscopy	Laboratory Analyses: Gamma spectroscopy	Laboratory Analyses: Beta spectroscopy (C)	Laboratory Analyses: Total Uranium	Laboratory Analyses: Isotopic Plutonium	Laboratory Analyses: Isotopic Uranium	Laboratory Analyses: VOA (SW 8240) (D)	Laboratory Analyses: Semivolatiles (SW 8270) (E)	Laboratory Analyses: Metals (SW 6010) (F)	Laboratory Analyses: PCBs (SW 8080) (G)	Laboratory Analyses: High Explosives (SW 8330) (H)	Laboratory Analyses: Cyanide
11-005(c)	Outfall	Soil					1	2	2	1	3	3	3					3	3		3	3			2			2	2	2	2	2			2
11-011(d)	Outfall	Soil					1	2	2												3	3								2	2	2			
11-011(a)	Outfall	Soil					2	2	4	1												6									4	4			
11-011(b)	Outfall	Soil					2	2	4				6								6									4	4				

A, C, G, H = not applicable; B, D, E = full suite; F = 1082 suite.

Geomorphologic mapping will provide an accurate picture of where outfall sediment sampling locations should be placed. The geomorphologic survey will consist of the mapping of the drainage channels downslope of any identified drain outfall.

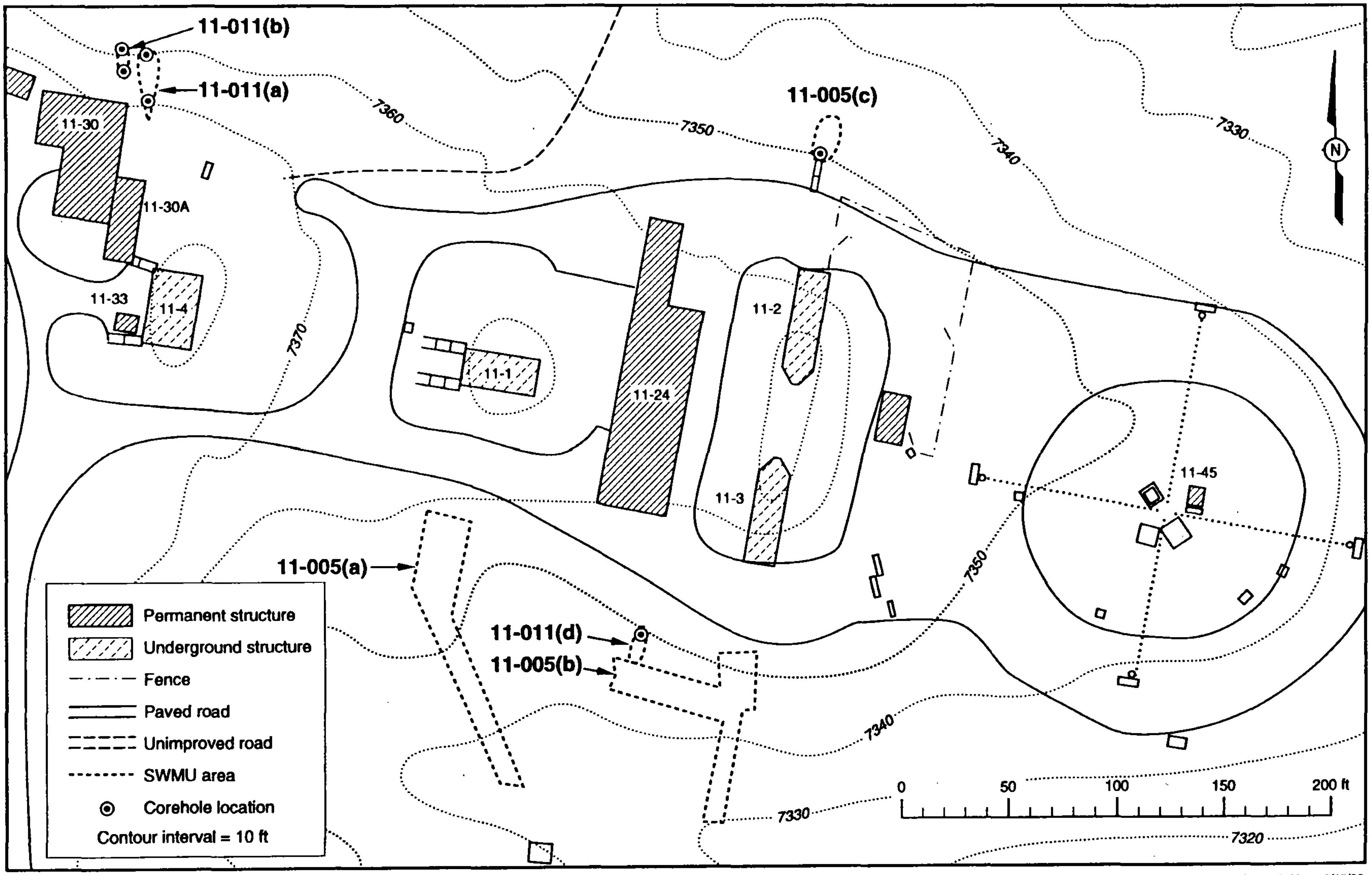
5.15.4.2 Sampling

Outfalls on moderate slopes: SWMUs 11-005(c) and 11-011(d). One hand-augered core sample will be bored to a maximum of 18 in. immediately adjacent to the outfall. Specimens will be selected from the samples at surface, 12 in., and 18 in. and will be 0.2 ft minimum in length. If the soil in the sediment trap is shallow, then a spade or scoop will be used to collect the sample. Field screening may be used to select the location of the hand-augered sample location (Fig. 5-53).

Outfalls on steep slopes: SWMUs 11-011(a) and 11-011(b). Two hand-augered core sample will be bored to a maximum of 18 in. One from the catchment immediately adjacent to the outfall, and one from the first sediment trap downslope in the drainage. Specimens will be selected from the samples at surface, 12 in., and 18 in. and will be 0.2 ft minimum in length. If the soil in the sediment trap is shallow, then a spade or scoop will be used to collect the sample. Field screening may be used to select the location of the hand-augered sample location.

Each sample from SWMU 11-005(c) will be field screened for radioactivity by FIDLER, volatiles by PID, and metals by XRF. The samples from SWMU 11-011(b) will be screened for volatiles only. The samples from SWMU 11-011(d) will be screened for metals and volatiles. This screening will be performed to guide the selection of samples submitted for laboratory analysis. Field screening methods are described in Subsection 4.7.

The two highest field screening readings will dictate the selection of two analytical samples for each core. If the screening of the core results in negative results, then 0.2 ft minimum intervals at the bottom and middle of the core will be submitted for laboratory analysis. If the soil-bedrock interface is encountered and screening detects no PCOCs, then 0.5 ft sample at the soil-bedrock interface will be submitted for analysis.



cARTography by A. Kron 6/15/93

Fig. 5-53. Schematic sampling plan for TA-11 outfalls.

5.15.4.3 Laboratory Analysis

Laboratory analyses of samples will be at Level III for radionuclides (LANL or DOE method), metals (SW-846 Method 6010), SVOCs (SW-846 Method 8270), and VOCs (SW-846 Method 8240). The principal radionuclides of concern are uranium and plutonium isotopes, the principal VOCs are organic cleaning solvents, and an analysis for a full OU 1082 suite of metals will be performed. Cyanide is also an organic of concern.

5.15.4.4 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the latest revision of the IWP (LANL 1992, 0768). Any QA/QC duplicate samples to be collected during the course of the field investigation are outlined in Table 5-71.

5.16 TA-11, Potential Surface Contamination Aggregate, SWMU 11-001(c), SWMU 11-012(a-d), C-11-002

5.16.1 Background

This aggregate (Table 5-73) consists of five small PRSs, all of which have potential surface contamination from past activities. PRSs 11-012(c,d) and C-11-002 are shown on Fig. 5-54. PRSs 11-012(a), 11-012(b), and 11-001(c) are shown on Fig. 5-7. They have been grouped in an aggregate since they will all have reconnaissance sampling. These PRSs will be remediated, if necessary, to protect human health and the environment.

5.16.1.1 Description and History

SWMU 11-012(a): TA-11-7. SWMU 11-012(a), located approximately 225 ft north of TA-16-370, is an area of potential soil contamination. This SWMU is associated with former HE storage magazine TA-11-7, a 9 x 11 ft wooden structure with earth berms on three sides. The structure was built in 1944 and destroyed by intentional burning in 1960.

SWMU 11-012(b): TA-11-8. SWMU 11-012(b) is an area of potential soil contamination. It is located approximately 225 ft north of TA-16-370. SWMU 11-012(b) is associated with former storage magazine TA-11-8, a 9 x 11 ft wooden structure with earth berms on three sides. The structure was built in 1945 and destroyed by intentional burning in 1960.

SWMU 11-012(c): TA-11-9. SWMU 11-012(c), located at the top of a small knoll approximately 500 ft west of TA-11-4 is an area of potential soil contamination. This SWMU is the site of a former storage building TA-11-9, a 16 x 16 ft wooden structure. The structure was built in 1945 and destroyed by intentional burning in 1960.

SWMU 11-012(d): TA-11-10. SWMU 11-012(d) is an area of potential soil contamination. It is located approximately 75 ft south-southeast of TA-11-4 and is associated with former personnel shelter TA-11-10, a 6 x 6 ft wooden structure. The personnel shelter was built in 1945 and destroyed by intentional burning in 1960. The exact use of this building is unknown. However, an informal conversation with a former site worker indicated that it may have been an emergency retreat. Prior to the construction of TA-11-36, it may have been used to store small amounts of HE scraps until enough

TABLE 5-73

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, TA-11 SURFACE CONTAMINATION AGGREGATE

				HE				RAD		METALS	ORGANICS
PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	UNDETONATED HE	HE DETONATION PRODUCTS	HE DEGRADATION PRODUCTS	HE BURN PRODUCTS	URANIUM ISOTOPES	PLUTONIUM ISOTOPES	METALS SUITE	CYANIDE
11-001(c)	Firing site	Precise use unknown	N	x	x	x	x	x		x	
11-012(a)	Area of potential soil contamination	HE storage magazine	N	x		x	x			x	
11-012(b)	Area of potential soil contamination	HE storage magazine	N	x		x	x			x	
11-012(c)	Area of potential soil contamination	Storage building	N	x		x	x			x	
11-012(d)	Area of potential soil contamination	Personnel shelter	N	x		x	x			x	
C-11-002	Area of potential soil contamination	Possible site of photofission laboratory	N	x			x	x	x	x	x

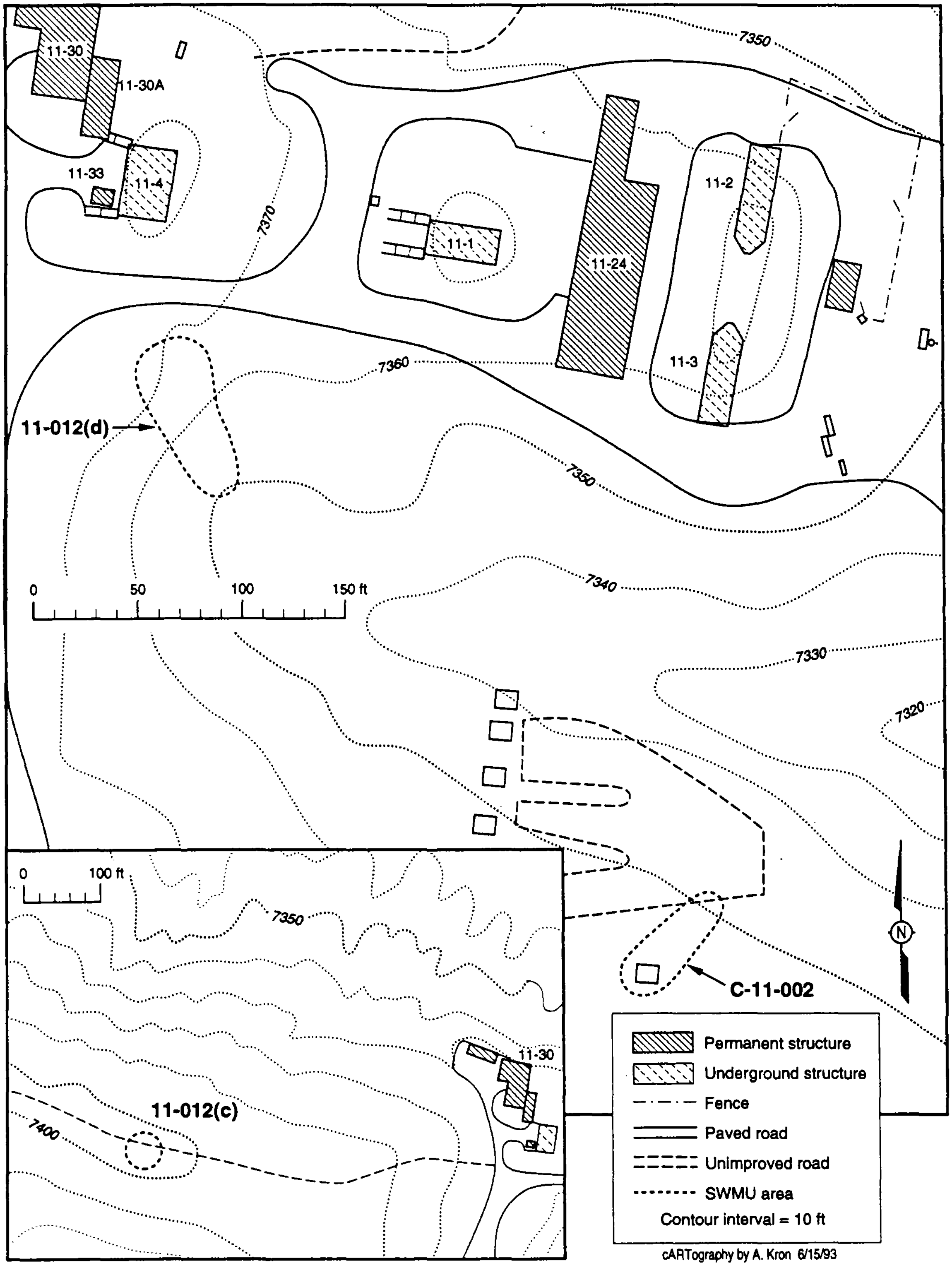


Fig. 5-54. TA-11 surface contamination.

accumulated for disposal. This area is presently covered by several concrete blocks approximately one foot thick.

A February 1956 survey found buildings TA-11-7, TA-11-8, TA-11-9, and TA-11-10 free of radioactive contamination (Blackwell 1956, 15-11-013). A 1959 inspection of the buildings found all four clean of radioactivity but showed contamination with HE (LASL 1959, 15-11-018). All four storage magazines were burned in late February of 1960 (Wingfield 1961, 15-16-111).

It was standard Laboratory procedure to burn buildings of this type once they were declared excess. Burning these structures ensured that any small amounts of residual explosives missed in the pre-burn visual inspection would be consumed. Any remaining post-burn combustible materials were segregated and removed to the TA-16 burning ground and burned again. Post-burn noncombustibles were taken to the TA-16 Area P landfill for disposal (Courtright 1966, 15-16-128).

C-11-002: TA-11-12. Area of concern C-11-002 is the site of a 7 x 9 ft wood frame building (TA-11-12). No current visible signs of the building exist; however, scaling of Engineering drawing ENG-R 126 places it approximately 65 ft east-northeast of the air gun target's earth berm. This building may have housed the laboratory used to prepare samples for the P Division photofission experiments on uranium and plutonium isotopes. TA-11-12 might also have been used as a darkroom. Surrounding soils may have been contaminated with HE, photoprocessing chemicals (silver and cyanide), and uranium and plutonium isotopes that may have resulted from the preparation of photofission experiments. TA-11-12 was monitored in 1956 and found free of radioactive contamination (Blackwell 1956, 15-11-013) and was removed to salvage in March 1959.

SWMU 11-001(c). SWMU 11-001(c) is the location of a former firing pit. It was a 12.5 ft semicircular wall, 4.5 ft high constructed of 37-in. thick concrete, southwest of TA-11-15. This area was known as K-Site west, and is located west of the main K-Site facility (Fig. 5-7). No known documentation as to the precise use of this firing pit has been found.

5.16.1.2 Conceptual Exposure Model

The conceptual exposure model for the potential surface contamination aggregate is presented in Chapter 4, Fig. 4-8. Subsection 5.16.1.2.1 presents the PCOCs for each PRS. PRS-specific information on potential receptors is discussed in Subsection 5.16.1.2.2.

5.16.1.2.1 Nature and Extent of Source

Table 5-73 summarizes PCOCs for the PRSs in this aggregate. The nature of the PCOCs is primarily the possible debris and PCOCs that may remain after demolition of the structures.

SWMUs 11-012(a,b,c,d). HE, HE impurities, and HE degradation products are the potential contaminants associated with these buildings. With the exception of HE, these buildings were all found to be clean before their D&D. They were burned and the ashes removed. Therefore, it is unlikely that residual contamination exists.

C-11-002: TA-11-12. Although unlikely, soils at the former location of this building could have residual contamination from photographic materials, HE, and uranium and plutonium isotopes from photofission experimentation.

11-001(c): Associated with TA-11-15. No documentation has been found which describes activities that occurred at this firing pit. An engineering sketch (ENG-R 126) depicts the firing pit with the same graphic as SWMU 11-001(a). SWMU 11-001(a) was a firing pit used for testing the integrity of aluminum, steel, and copper nose shields that covered the x-ray ports of TA-11-2 and TA-11-3. However, because of the uncertain history of SWMU 11-001(c), it would be prudent to sample not only for HE and its by-products, but also for natural and depleted uranium (used to simulate weapons geometry in documented K-Site experiments).

5.16.1.2.2 Potential Pathways and Exposure Routes

PRSs in this aggregate contain potential surface soil contamination. Contaminants are thought to be in a localized area and not in drainages based on past operations and the relatively flat terrain. In addition, SWMUs 11-012(a,b,c) have been re-vegetated and there are no adjacent drainages. SWMU 11-012(d) is covered by cement blocks.

These sites are located in an inactive area within the boundaries of TAs 11 and 16. Because of the current institutional controls, there is no public access to this area. Current and foreseeable site uses are limited to on-site workers. Chapter 4 contains a detailed discussion of the migration pathways, conversion mechanisms, potential human receptors, and exposure routes.

5.16.2 Remediation Decisions and Investigation Objectives

The remediation alternative of choice is to remove contaminated surface soil if it exists. Remediation is considered unlikely at these sites and the primary objective of the Phase I investigation is to determine if concentrations of PCOCs are above SALs. This site survey will also generate the information necessary to confirm the site PCOC and to design the Phase II studies if needed.

Problems Statement (DQO Step 1)

SWMUs 11-012(a,b,c,d). The Phase I investigation will determine if residual HE at these sites is at a level of concern. Previous D&D activities indicate that residual contamination is unlikely at these SWMUs.

C-11-002: TA-11-12. The Phase I investigation will determine if surface soils associated with this SWMU location contain HE, metals, cyanide, or uranium and plutonium isotopes at a level of concern.

SWMU 11-001(c). The Phase I investigation will determine if surface soils associated with this former firing pit location contain HE, and natural and depleted uranium at a level of concern.

Decision Process (DQO Step 2)

The decision process is the same for all SWMUs. If potential contaminants are found above SALs, then a baseline risk assessment will be performed to determine if a corrective action to remove contaminated soil is required to protect human health and the environment. If potential contaminants are not found above SALs, the sites will be proposed for NFA.

5.16.3 Data Needs and Data Quality Objectives

Decision Inputs and Investigation Boundary (DQO Steps 3 and 4)

The exact locations of the former structures are difficult to determine. However, areas that are sufficiently large to encompass the locations of the previous structures will be determined through the use of period photographs, surveyed, and staked. Field screening data for the PCOCs will be collected and positive samples will be submitted to the central laboratory for confirmation. Concentration data for each PCOC will be needed.

SWMUs 11-012(a,b,c,d). Concentrations of HE in surface and subsurface soils in the surveyed locations will be determined.

C-11-002: TA-11-12. Concentrations of HE, metals, cyanide, and radioactivity (uranium and plutonium isotopes) in surface soils in the surveyed location will be determined.

SWMU 11-001(c). Concentrations of HE and radioactivity (natural and depleted uranium) in surface soils in the surveyed location will be determined.

Decision Logic (DQO Step 5)

SWMUs 11-012(a,b,c,d). The maximum of the concentration of PCOCs from the surface and near surface soil samples collected at each location will be compared to the SAL for HE and HE by-products. If the SAL is exceeded, then a baseline risk assessment will be undertaken to determine if worker risk is unacceptable.

C-11-002: TA-11-12. The maximum of the concentration of the potential contaminants from surface soil samples collected at this location will be compared to their SALs. If the SAL is exceeded, then a baseline risk assessment will be undertaken to determine if worker risk is unacceptable.

SWMU 11-001(c). The maximum of the concentration of the potential contaminants from surface soil samples collected at this location will be compared to their SALs. If the SAL is exceeded, then a baseline risk assessment will be undertaken to determine if worker risk is unacceptable.

Design Criteria (DQO Step 6)

A reconnaissance sampling approach will be used (IWP, Appendix H). A total of four laboratory samples will be taken at each of these SWMUs. Based on field observances, field screening will not be used because of the small size of these SWMUs. Using the reconnaissance approach, a sample of size 4 will detect contamination with a probability of .57 if 20% of the site is contaminated or with a probability of .81 if 40% of the site is contaminated.

5.16.4 Sampling and Analysis Plan

SOPs that control field activities in this sampling plan are listed in Table 5-74. Sampling numbers and required analysis are shown on Table 5-75.

TABLE 5-74

STANDARD OPERATING PROCEDURES FOR FIELD ACTIVITIES

LANL-ER-SOP	TITLE	NOTES
01.02, R0	Sample Containers and Preservation	Applied to all laboratory analytical samples
01.04, R1	Sample Control and Field Documentation	Applied to all laboratory analytical samples
06.10, R0	Hand Auger and Thin-Wall Tube Sampler	Applied to augered soil samples

5.16.4.1 Engineering Surveys

The SWMUs and an AOC composing this aggregate will be field-surveyed before sample collection. Site mapping is required to accurately record the location of SWMUs. In the field, the engineering survey will locate, stake, and document the location of each SWMU. Sample locations will be registered on a base map, scale 1:7 200. If during the course of sampling any sample points must be relocated, the new position will be surveyed and the revised locations will be indicated on the map. The engineering survey will be performed by a licensed professional under the supervision of the field team leader.

5.16.4.2 Sampling

Sample cores will be augered to 18 in. deep at a maximum. A sufficient volume of soil will be removed from the entire length of the core to yield

TABLE 5-75

SUMMARY OF SITE SURVEYS, SAMPLING, AND ANALYSIS FOR TA-11 POTENTIAL SURFACE CONTAMINATION AGGREGATE

PRS	PRS TYPE	Sampled Media	Laboratory Samples: Structure	Laboratory Samples: Structure Field dup	Laboratory Samples: Surface	Laboratory Samples: Surface Field dup	Laboratory Samples: Sub-surface No. of cores	Laboratory Samples: Sub-surface No. of samples per core	Laboratory Samples: Sub-surface Total	Laboratory Samples: Sub-surface Field dup	Field Screening: Gross Alpha	Field Screening: Gross Gamma/Beta	Field Screening: Organic Vapor	Field Screening: HE Spot Test	Field Screening: Geophysics Surface	Field Screening: Barium - LIBS	Field Screening: A Geological Characterization	Field Lab.: Gross Alpha	Field Lab.: Gross Gamma/Beta	Field Lab.: Tritium	Field Lab.: Volatile Organics	Field Lab.: B XRF	Field Lab.: Soil Moisture	Laboratory Analyses: Alpha spectroscopy	Laboratory Analyses: Gamma spectroscopy	Laboratory Analyses: C Beta spectroscopy	Laboratory Analyses: Total Uranium	Laboratory Analyses: Isotopic Plutonium	Laboratory Analyses: Isotopic Uranium	Laboratory Analyses: D VOA (SW 8240)	Laboratory Analyses: E Semivolatiles (SW 8270)	Laboratory Analyses: F Metals (SW 6010)	Laboratory Analyses: G PCBs (SW 8080)	Laboratory Analyses: H High Explosives (SW 8330)	Laboratory Analyses: Cyanide
11-012 (a)	Former HE magazine	Soil					4	1	4																						4	4		4	
11-012 (b)	Former storage	Soil					4	1	4	1																					4	4		4	
11-012 (c)	Former storage	Soil					4	1	4																						4	4		4	
11-012 (d)	Personnel shelter	Soil					4	1	4	1																					4	4		4	
C-11-002	Former storage	Soil					4	1	4																			4	4		4	4		4	4
11-001(c)	Firing site	Soil					4	1	4	1																	4				4	4		4	

A, B, C, D, G = not applicable; E, H = full suite; F = 1082 suite.

300 ml (Fig. 5-55 and Fig. 5-56). The summary of site sampling and analysis requirements is provided in Table 5-75.

SWMUs 11-012(a,b,c,d). The sampling of each of these sites of former wooden storage structures will include hand-augered boreholes to a depth of 18 in. The surface of each SWMU will be divided into quadrants and one borehole will be placed within each quadrant. Only HE and HE by-products will be analyzed at this first set of SWMUs.

AOC 11-002. The technique for collection of samples of this area of concern will be identical to the above SWMUs. The only departure will be that in addition to HE and HE by-products, the presence of uranium, plutonium isotopes, organics, metals, and cyanide will be investigated.

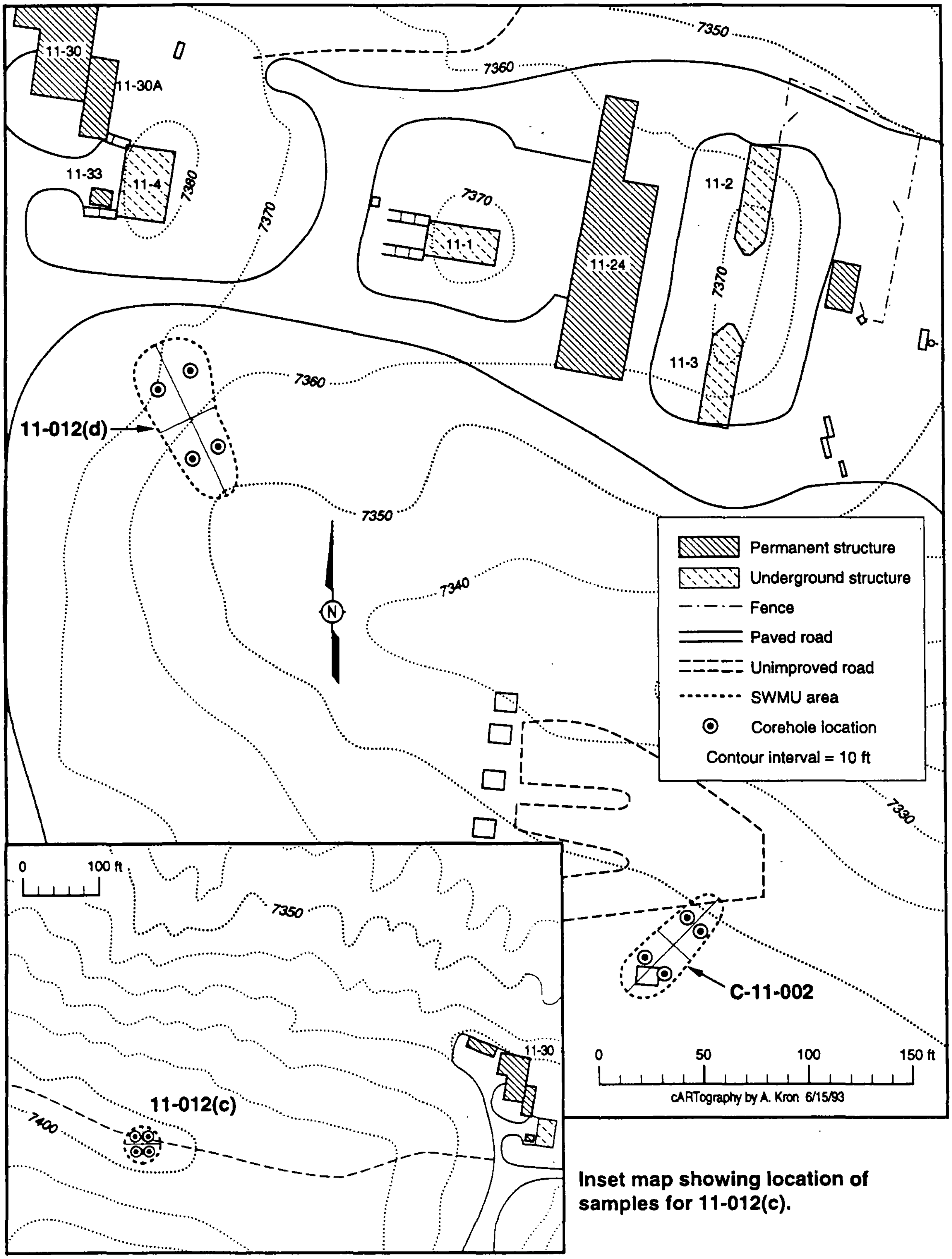
SWMU 11-001(c). This former firing pit will be sampled identically to the first set of SWMUs. Specimens will be analyzed for HE and HE by-products, uranium, and beryllium.

5.16.4.3 Laboratory Analysis

Laboratory analyses of samples will be at Level III for radionuclides (LANL or DOE method), metals (SW-846 Method 6010), SVOCs (SW-846 Method 8270), and HE and its by-products (SW-846 Method 8330). The principal radionuclides of concern are uranium and plutonium isotopes, the principal HE by-products of concern are DNT, TNB, and DNB; the principal organic is cyanide; and, the full suite of metals.

5.16.4.4 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the latest revision of the IWP (LANL 1992,0768). Any QA/QC duplicate samples to be collected during the course of the field investigation are outlined in Table 5-75.



Inset map showing location of samples for 11-012(c).

Fig. 5-55. Schematic sampling map for TA-11 potential surface contamination.

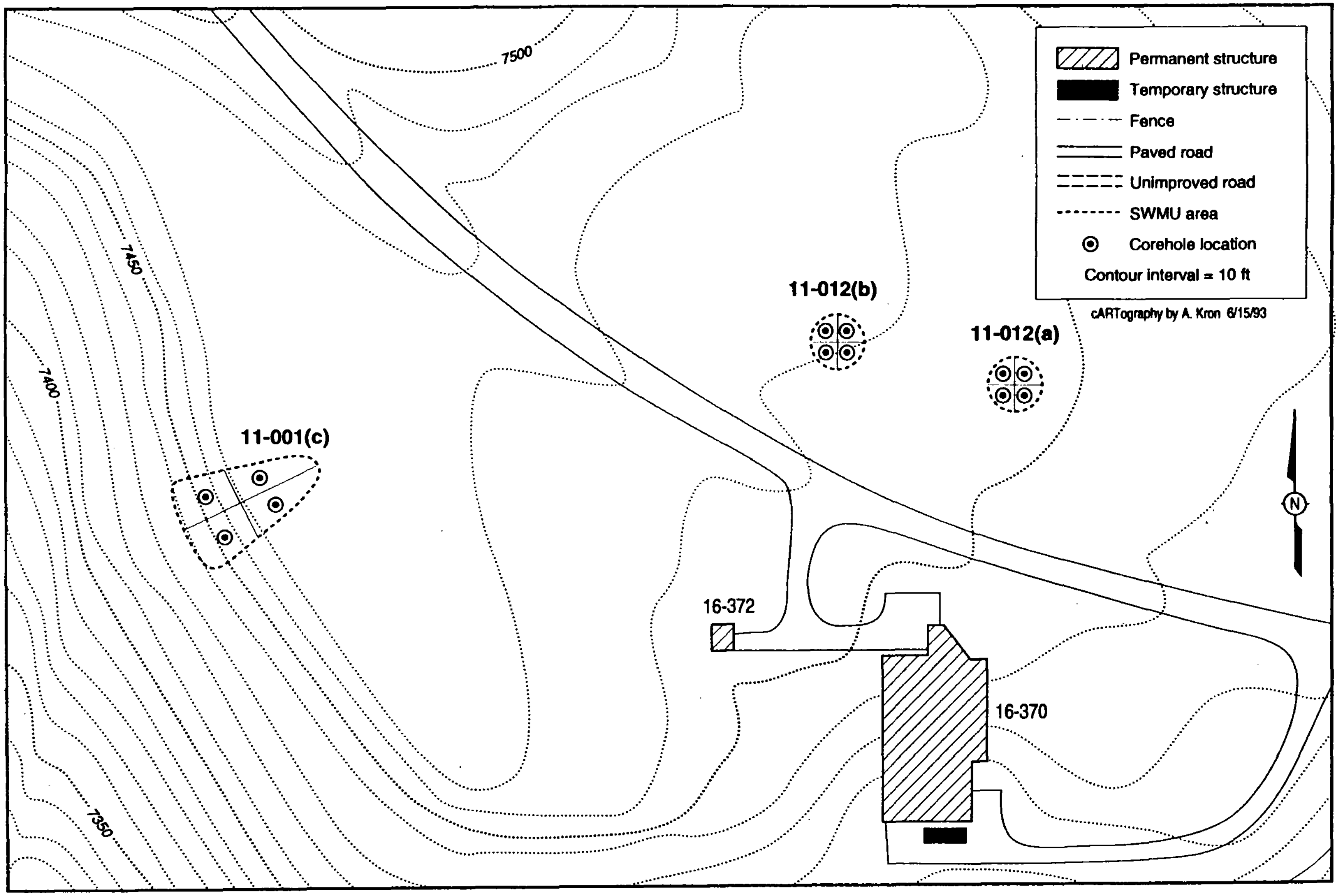


Fig. 5-56. Schematic sampling map for K-Site West.

5.17 Decommissioned Waste Storage Area, SWMU 16-013

5.17.1 Background

5.17.1.1 Description and History

SWMU 16-013 is a waste storage area located in the courtyard surrounded by buildings TA-16-518, TA-16-519, and TA-16-520, which form an L-shaped connected complex (Fig. 5-57, Table 5-76). Buildings TA-16-516 and TA-16-517 complete a U-shaped complex surrounding three sides of the courtyard. The mesa is level at this site. TA-16-518 is a covered shed with an open side facing the courtyard, which is about 75 ft square and paved with asphalt. The fourth side, facing north, opens to a level field of grasses. This area is not a satellite storage area for hazardous waste (LANL 1990, 0145). Drums of usable material and other items are stored in the covered area.

The area was once part of V-Site, constructed in 1944 for testing components of implosion devices, including explosive lenses, inner charges, and final process work on explosive parts (Wilder 1946, 15-16-155). It later housed an x-ray system used to inspect explosive charges (Ackerman 1945, 15-162). Components of the Trinity device were tested for fit in TA-16-516 before being shipped to Trinity Site for detonation as the first atomic bomb. In July 1945, the entire V-Site area was absorbed into TA-16. The buildings and courtyard have been used for programmatic activities and storage since that time (DOE 1987, 0264).

5.17.1.2 Conceptual Exposure Model

The conceptual exposure model for the potential surface contamination aggregate is presented in Chapter 4, Fig. 4-8. Subsection 5.17.1.2.1 presents the PCOCs for each PRS. PRS-specific information on potential receptors is discussed in Subsection 5.17.1.2.2.

5.17.1.2.1 Nature and Extent of Contamination

Table 5-76 summarizes the PCOCs for this aggregate. The storage yard at V-Site has been in use for almost 50 years. The 1987 CEARP Report noted that some drums stored at the site were leaking. Some of the drums were marked "used solvent" while others appeared to contain hydraulic fluid. The

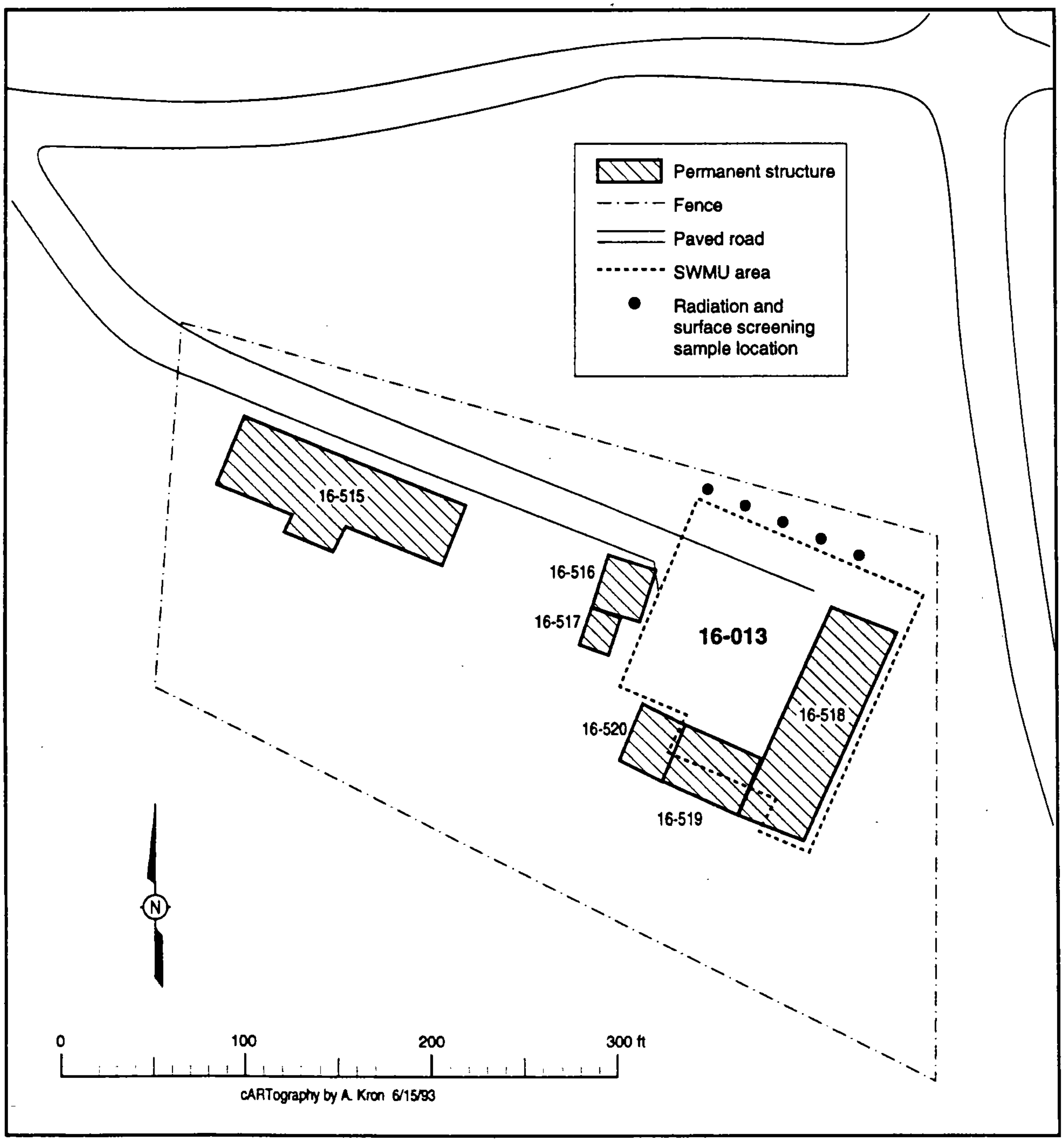


Fig. 5-57. Sampling plan for decommissioned waste storage area.

TABLE 5-76

POTENTIAL RELEASE SITES AND POTENTIAL CONTAMINANTS OF CONCERN CONTAINED IN OU 1082, V-SITE STORAGE AGGREGATE

				RAD	METALS	ORGANICS	
PRS	DESCRIPTION	PRIMARY ACTIVITY LEADING TO A POTENTIAL PROBLEM	ACTIVE	URANIUM	METALS SUITE	VOLATILE	SEMI VOLATILE
16-013	V-Site storage yard	Drum storage of solvents, barium nitrate, and uranium	N	x	x	x	x

CEARP Report also noted that empty boxes and cans containing radioactive material were in the area along with open drums containing barium nitrate and what appeared to be empty drums that had contained lithium hydride (DOE 1987, 0264). The area has since been cleaned (LANL 1990, 0145). The nature of all activities that occurred during that time is unknown, as are the possibilities for a release of materials used at the site. No data exist that suggest significant contamination of the asphalt courtyard, of the storage sheds at SWMU 16-013, or of the soils surrounding the site. It is suspected that various chemicals, such as acetone, n-butyl acetate, chloroethene, 1,2-dichloroethane, dimethylformamide, ethyl acetate, dimethyl sulfoxide, methanol, methylene chloride, methyl ethyl ketone, and toluene (Panowski and Salgado 1971, 15-16-038); and barium nitrate and uranium were stored in these areas.

5.17.1.2.2 Potential Pathways and Exposure Routes

At SWMU 16-013 potentially hazardous contaminants may have been deposited on the paving, on cracks therein, or in soil beneath it. Runoff and snowmelt may have carried hazardous material into the surrounding fields, where contaminants may migrate via sorption onto surface soil or infiltration into deeper soils. Although the mesa is wide, level, and covered with grasses, with no obvious drainage pattern, surface water overflow may have collected in ditches beside roadbeds near the site.

At SWMU 16-013 excavation or erosion of soil can lead to dermal contact or involuntary ingestion. Though the site is currently paved with asphalt and the surrounding soil well-vegetated with grasses, this may become disrupted at some future date, leading to potential for inhalation through wind-driven volatiles or dust. Exposure via a water route is unlikely on this level mesa.

5.17.2 Remediation Decisions and Investigation Objectives

Problem Statement (DQO Step 1)

The nature and extent of contamination at SWMU 16-013 is unknown. No large releases of material have been documented and contamination is expected to be low due to natural dispersion processes and weathering over many years. Reconnaissance sampling is necessary to determine the presence or absence of contaminants in the most probable locations in soil and asphalt based upon site use.

Decision Process (DQO Step 2)

The question to be addressed by Phase 1 sampling is as follows: Have PCOCs above SALs migrated to the ditches along roadsides near the site or does multiple contaminant screening indicate a potential problem? If so, then a baseline risk assessment will be conducted to determine if a Phase II study will be necessary. If not, then the site will be proposed for NFA.

The question clearly indicates that reconnaissance sampling is the appropriate approach. The remaining DQO steps describe this approach. If the answer to this question is yes, then a Phase II investigation to determine the extent of contamination will be proposed. If results of Phase I analyses are all below SALs, then the SWMU will be recommended for NFA.

The most likely area of contamination is a strip of soil along the north edge of the paved area where contaminants may have accumulated because of runoff. The samples taken in this area will provide a bound for possible contamination.

5.17.3 Data Needs and Data Quality Objectives

Decision Inputs (DQO Step 3)

The drainage pattern at SWMU 16-013 must be confirmed. The topography of the site affects the sampling plan as discussed in Subsection 5.17.4. Drainage patterns made by runoff or snowmelt water are not obvious. Such a setting affects the distribution of contaminants migrating from the site. It is assumed that contaminants originated from point source(s) and underwent a uniform distribution. Without the flushing action associated with a steep drainage gradient, contaminants will settle near the site and be sequestered by clays, organic debris, and plants. Surveying should indicate subtle drainage patterns which may disturb an otherwise even sheet migration.

Sampling will be specified at points most likely to be contaminated. Analytical contaminant concentration data from Phase I sampling of the RFI are needed to determine whether levels of all PCOCs are below SALs. The site PCOCs are identified in Subsection 5.17.1.2.1.

Investigation Boundary (DQO Step 4)

The regions of potential contamination at SWMU 16-013 are the soils downgradient from and adjacent to the asphalt apron associated with the courtyard and sheds.

Soil/sediment samples in the adjacent drainage areas will be analyzed to determine if PCOCs have accumulated and are present above acceptable levels.

Decision Logic (DQO Step 5)

For each region of the domain of the decision, the sample maximum will be used to perform the following two steps, which define the decision rule.

1. For each PCOC determine if the concentration of that PCOC is different from background and, if so, is it above or below the SAL. Assuming that background or SALs are not exceeded, propose NFA.

2. If the SAL(s) for the observed PCOC(s) are exceeded, a Phase II characterization investigation will be performed. The Phase I data will be used to conduct an initial risk assessment and to design the Phase II study.

Design Criteria (DQO Step 6)

The Phase I design is biased to areas where the site activity history for SWMU 16-013 would lead to a high probability of a contaminant finding, if it were present. This is a very conservative approach to determining if the site activities have led to possible environmental contamination. The sampling approach is described in Subsection 4.5. At SWMU 16-013 the following strategy will be implemented. The soil and sediment sample will be biased (i.e., located downgradient and adjacent to the potential source and field screened) and will reflect the area most likely to have a PCOC finding at the site.

5.17.4 Sampling and Analysis Plan

SOPs that control field activities in this sampling plan are listed in Table 5-77. Sample numbers and required analysis are shown on Table 5-78.

TABLE 5-77

STANDARD OPERATING PROCEDURES FOR FIELD ACTIVITIES

LANL-ER-SOP	TITLE	NOTES
01.02, R0	Sample Containers and Preservation	Applied to all laboratory analytical samples
01.04, R1	Sample Control and Field Documentation	Applied to all laboratory analytical samples
06.11, R0	Stainless Steel Surface Soil Sampler	Applied to surface soil samples

5.17.4.1 Engineering Surveys

SWMU 16-013 will be field surveyed, which will consist of site engineering (geodetic) mapping and geomorphologic mapping. Site mapping is required to accurately record the location of the SWMUs. In the field, the engineering survey will locate, stake, and document the location of the SWMUs. Sample locations will be registered on a base map, scale 1:7 200. If during the course of sampling any sample points must be relocated, the new position will be surveyed and the revised locations will be indicated on the map. The engineering survey will be performed by a licensed professional under the supervision of the field team leader.

Geomorphologic mapping of the source area will be performed to determine drainage patterns. This mapping will include drainage patterns and sediment traps adjacent to the paved storage area.

5.17.4.2 Sampling

Surface soil samples (0 to 6 in.) will be collected at intervals downgradient along the edge of the asphalt pavement (Fig. 5-57). The specific locations will be determined by site mapping. Five samples will be collected in a 5 ft wide band beyond the pavement in the area that drains the paved area. However, sample collection points may be varied to include possible nearby sediment traps. Each sample will be field screened for all PCOCs. Field screening methods are described in Subsection 4.7. Any samples that show positive screening for PCOCs above SALs will be submitted for laboratory analysis. If no samples have a positive screening for PCOCs, then two

TABLE 5-78

SUMMARY OF SITE SURVEYS, SAMPLING, AND ANALYSIS FOR DECOMMISSIONED WASTE STORAGE AREA

		Laboratory Samples							Field Screening							Field Lab.						Laboratory Analyses											
PRS	PRS TYPE	Sampled Media	Structure	Structure Field dup	Surface	Surface Field dup	Subsurface	Subsurface Field dup	Gross Alpha	Gross Gamma/Beta	Organic Vapor	HE Spot Test	Geophysics Surface	Barium - LIBS	Geological Characterization A	Gross Alpha	Gross Gamma/Beta	Spot Tests	Volatile Organics	XRF B	Soil Moisture	Alpha spectroscopy	Gamma spectroscopy	Beta spectroscopy C	Total Uranium	Isotopic Plutonium	Isotopic Uranium	VOA (SW 8240) D	Semivolatiles (SW 8270) E	Metals (SW 6010) F	PCBs (SW 8080) G	High Explosives (SW 8330) H	Cyanide
16-013	Waste storage	Soil			2#	1				5	5						5		5	5					2#			2#	2#	2#			

A, C, G, H = not applicable; B, D, E = full suite of analytes; F = 1082 suite.
= Minimum number of samples; additional samples may be taken based on field screening.

samples will be randomly selected and the analytical sample will be sent for laboratory analyses of PCOCs (Table 5-78).

5.17.4.3 Laboratory Analysis

Laboratory analyses of samples will be at Level III for radionuclides (LANL or DOE method), metals (SW-846 Method 6010), VOCs (SW-846 Method 8240), and SVOCs (SW-846 Method 8270). The principal radionuclide of concern is uranium, the principal VOCs are hydrocarbon solvents, and the full suite of metals.

5.17.4.4 Sample Quality Assurance

Field quality assurance samples will be collected according to the guidance provided in the latest revision of the IWP (LANL 1992, 0768). Any QA/QC duplicate samples planned to be collected during the course of the field investigation are outlined in Table 5-78.

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- MDA S
- Decommissioned Septic Systems
- Active Septic Systems
- Rest Houses/Container Storage Area
- Container Storage Area
- Outfall
- Decommissioned Waste Pond
- Mortar Impact Area
- Boneyard
- Septic System
- Lanthanum Spill
- Firing Pits, Open Burning Area and Pit, Drop Tower Complex, Sumps, Mortar Impact Area, Soil Contamination

6.0 POTENTIAL RELEASE SITES RECOMMENDED FOR NO CURRENT RCRA FACILITY INVESTIGATION WITHOUT FURTHER CHARACTERIZATION

The purpose of this chapter is to identify those potential release sites (PRSs) that do not require a current Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI). All PRSs covered in this chapter are recommended for no further action (NFA) or deferred action (DA). The locations of these PRSs are shown in Appendix E. To this end, a four-step evaluation criteria for NFA and DA following archival investigation was developed and is described in Subsection 4.1 of Appendix I in the 1992 Installation Work Plan (IWP) (LANL 1992, 0768). This material is summarized in Table 6-1.

TABLE 6-1

FOUR-STEP CRITERIA FOR NFA OR DA

STEP	CRITERIA
Step 1 NFA	• PRS has undergone regulatory closure • SWMU Report is inaccurate
Step 2 NFA	• PRS is an approved accumulation area
Step 3 DA	• PRS is undergoing regulatory closure • PRS is active site with no credible off-site pathways • PRS is undergoing voluntary corrective (VCA) • PRS is inactive; characterization disrupts active site
Step 4 NFA	• PRS poses no threat to on-site or off-site workers, the general public, or the environment

Based on the 1992 IWP Appendix I criteria, the PRSs listed in Table 6-2 are recommended for either:

- NFA and delisting from the solid waste management unit (SWMU) Report and the Hazardous and Solid Waste Amendment (HSWA) Module (if the SWMU is included on the HSWA Module);
- DA, resulting in deferred characterization until the closure of the interim status unit under the Closure and Post Closure Plan in the RCRA Part B permit application;

TABLE 6-2

PRSs RECOMMENDED FOR NO CURRENT RCRA FACILITY INVESTIGATION

SWMU AND AOC AGGREGATE NUMBER(S) / DESCRIPTION	EVALUATION STEP CRITERION	SUBSECTION
16-010(b,c,d,e,f,j) interim status open burn/open detonation units, and 16-005(g) filter bed	Third (DA)	6.1.1.1
16-008(b) inactive surface impoundment	First (NFA)	6.1.2.1
16-010(g) filter/treatment unit	Second (NFA)	6.1.3.1
16-012(d,i,j,l,m,n,t,u,x) satellite storage areas, 16-012(p) less-than-ninety-day storage area, and 16-012(a2) interim storage area	Second (NFA)	6.1.3.2
16-018 Material Disposal Area (MDA) P	Third (DA)	6.1.4.1
11-007 surface disposal	Fourth (NFA)	6.1.5.1
11-009 MDA S	Fourth (NFA)	6.1.5.2
16-005(n) decommissioned septic system	Fourth (NFA)	6.1.5.3
16-005(o) decommissioned septic system	Fourth (NFA)	6.1.5.4
16-006(b) active septic system	Fourth (NFA)	6.1.5.5
16-006(f) active septic system	Fourth (NFA)	6.1.5.6
16-012(a,b,c,e,f,g,h,k,o,q,r,s,v,w,y,z) rest houses, and 11-010(a) container storage area	Fourth (NFA)	6.1.5.7
11-010(b) container storage area	Third (DA)	6.2.1.1
11-011(c) boiler discharge	Third (DA)	6.2.1.2
16-007(b) decommissioned waste pond	First (NFA)	6.2.2.1
11-003(a) mortar impact area	Fourth (NFA)	6.2.3.1
11-008 boneyard	Fourth (NFA)	6.2.3.2
37-001 septic system	Fourth (NFA)	6.2.3.3
C-11-003 lanthanum spill	Fourth (NFA)	6.2.3.4
11-001(a,b), 11-002, 11-004(a,b,c,d,e,f), 11-003(b), C-11-001, 11-006(a,b,c,d)	Not applicable	6.3.1

- DA, resulting in deferred characterization until the site is decommissioned if the PRS is an active operation that does not have a closure plan and presents no current human health or environmental risk; or,
- DA, resulting in deferred characterization when the site is undergoing a formal RCRA closure (MDA P only).

According to Subpart S of 40 CFR 264, a SWMU can be recommended for NFA if it can be demonstrated that the SWMU poses no threat to human health or the environment (EPA 1990, 0432). The same criterion will be applied to an area of concern (AOC) in this work plan.

The first column of Table 6-2 provides the number/letter designation of the PRS (as listed in the 1990 SWMU Report) and the description of the site (LANL 1990, 0145).

The second column of the table indicates which of the four-step evaluation criterion was used in recommending no current RFI for the PRS identified in the first column.

The third column iterates the subsection in Chapter 6 that covers the PRS.

A detailed description of each PRS and the rationale for the associated decision and applicable references are contained in the subsection of Chapter 6 devoted to that PRS or aggregate of PRSs. The order of presentation is HSWA Module VIII SWMUs, non-HSWA Module SWMUs and AOCs, and HSWA and non-HSWA SWMUs and AOCs that are recommended for DA in conjunction with sampling to explore off-site migration.

6.1 SWMUs Listed in the HSWA Module VIII Recommended for Deferred Action or No Further Action

With three exceptions noted below, this subsection covers SWMUs which are listed in the HSWA Module VIII that are being recommended for NFA or DA. The three exceptions are included either because they are in intimate association with Module VIII SWMUs [16-005(g)] or because their history and description is the same as for the similar Module VIII SWMUs under consideration, [11-010(a) and 16-012(a2)].

6.1.1 SWMUs Recommended for Deferred Action Under Step Three of the Four-Step Criteria

6.1.1.1 Interim Status Open Burn/Detonation Facilities, SWMUs 16-010(b,c,d,e,f,j); and Filter Bed SWMU 16-005(g)

6.1.1.1.1 Background

The SWMUs in Table 6-3 are located at the Technical Area (TA) 16 burning ground. They are operated under interim status as open burning/open detonation facilities or are beneath one of these interim status units [16-005(g)].

TABLE 6-3

SWMUs WITH INTERIM STATUS

SWMU	STRUCTURE	FUNCTION
16-010(b)	TA-16-387	Flash pad
16-010(c)	TA-16-388	Burn table
16-010(d)	TA-16-399	Burn table
16-010(e)	TA-16-401	Filter tank
16-010(f)	TA-16-406	Filter tank
16-010(j)	TA-16-394	Filter bed
16-005(g)	TA-16-393	Filter bed [under 16-010(f)]

SWMU 16-010(b) is an active flash pad associated with structure TA-16-387. The pad was constructed in 1951 and used for flash burning high explosives-(HE) contaminated material. The burn area is enclosed by a 100 ft long x 100 ft wide fence and is composed of a layer of sand several inches thick over a soil surface (LANL 1990, 0145).

SWMU 16-010(c) is a former burn slab converted to a burn table, structure TA-16-388. It is used for disposing of HE scrap. Currently, the 100 ft long by 100 ft wide enclosed area consists of a concrete pad, used for unloading explosives, and a burn table. The burn table is 2 ft above the ground and holds a tray that is 16 ft long x 4 ft wide. HE is placed on the tray and burned. The table has a metal-covered rain guard that can be rolled back to expose the tray (LANL 1990, 0145).

SWMU 16-010(d) is also a former burn slab, TA-16-399. The physical layout and operation of this burn table is the same as SWMU 16-010(c) (LANL 1990, 0145).

SWMU 16-010(e) is a pressure filter tank, structure TA-16-401, built in 1961 to filter HE-laden wash water from the basket wash facility, TA-16-390. Wash water was carried from the basket wash facility to the pressure filter tank via trough TA-16-1129. This arrangement was in use until 1966, when building TA-16-390 was decommissioned.

The steel pressure filter tank is 8 ft in diameter and 10 ft high. It is equipped with a jib-crane-operated cone-shaped steel cover. Approximately 3 ft of the tank is above grade. The structure is a cone-shaped steel container with a surface layer of sand overlying layers of fine and coarse gravel.

The tank is now used for filtering HE/water sludge from HE sumps. The sludge, which is brought in on tank trucks from HE sumps site wide, is pumped into the structure and dried by blowing hot air across the filtered residue. The residue is burned in the tank and any residual is raked out and put into drums for later re-burning (LANL 1990, 0145).

A drainage system takes the filtered water from the pressure filter tank to a filter/treatment unit, TA-16-363, SWMU 16-010(g) (LANL 1990, 0145).

SWMU 16-010(f) is a pressure filter tank associated with structure TA-16-406. The dimensions and function of this tank are the same as SWMU 16-010(e), TA-16-401, described above. This tank replaced filter bed TA-16-393 which was taken to TA-54 for disposal in 1965 (LANL 1990, 0145).

SWMU 16-005(g) is the former location of a filter bed, structure TA-16-393, that was decommissioned and removed when TA-16-406 was constructed on the same location. The unit was built to receive HE-residue wash water from the basket wash facility, TA-16-390. A pipe drained the filtered wash water to the adjacent area.

SWMU 16-010(j) is a filter bed, structure TA-16-394, built in 1951 to receive HE-residue wash water from the basket wash facility, TA-16-390. A pipe drained the filtered wash water to the adjacent area southeast of the bed. The filter bed has been modified and now consists of a 12 ft long x 12 ft wide x 1 ft deep metal tray filled with 6 to 8 in. of sand. This tray contains two elevated shallow steel pans. Oil and solvents contaminated with HE are poured into the trays and burned (LANL 1990, 0145).

6.1.1.1.2 Recommendation

SWMUs 16-010(b,c,d,e,f,j) are recommended for DA until closure because they are operating under interim status, and are inspected routinely with any release dealt with appropriately.

SWMU 16-005(g) is recommended for DA until closure of the permitted units because it is located at the same point as SWMU 16-010(f) (LANL 1992, 0768).

6.1.1.1.3 Rationale for Recommendation

Six of the PRSs covered in this subsection, SWMUs 16-010(b,c,d,e,f,j), are interim status open burn/open detonation treatment units that are included in the Laboratory's RCRA Part B Permit Application. Their future characterization and closure (scheduled for the year 2100) is covered in Subsection 9.2.2 of Chapter 9, Closure and Post-Closure Plan, in the RCRA Part B Permit Application (LANL 1988, 15-16-388).

SWMU 16-005(g) is located in the same spot as SWMU 16-010(f).

6.1.2 SWMUs Recommended for No Further Action Under Step One of the Four-Step Criteria

6.1.2.1 Inactive Surface Impoundment, SWMU 16-008(b)

6.1.2.1.1 Background

This SWMU was a Hypalon-lined pond at the TA-16 burning ground. The pond was 60 ft long x 35 ft wide x 4 ft deep and received liquid from two pressure filter tanks, TA-16-401 and TA-16-406, located north of the pond. To reduce the barium nitrate level in the pond, on one occasion liquid sodium sulfate was added to precipitate barium as barium sulfate. When barium nitrate levels had been reduced to less than 100 ppm, the liquid was discharged to an outfall (Baytos 1986, 15-16-365).

6.1.2.1.2 Recommendation

SWMU 16-008(b) is recommended for NFA and delisting from the SWMU Report and the HSWA Module because site closure was completed on June 12, 1990 (LANL 1992, 0768).

6.1.2.1.3 Rationale for Recommendation

On February 2, 1990, Jack Ellvinger, Chief, Hazardous Waste Bureau of the New Mexico Health and Environment Department forwarded to James R. Anderson, US Department of Energy (DOE), Los Alamos Area Office, "...the final closure plan approved by the New Mexico Environmental Improvement Division (NMEID) for the Los Alamos National Laboratory (LANL) TA-16 surface impoundment. This plan consists of the plan submitted by LANL February 6, 1989, as modified by the NMEID, February 2, 1990. These modifications are contained in the closure plan and a copy of the reasons for these modifications is included. NMEID approves this closure plan in accordance with the New Mexico Hazardous Waste Management Regulations (HWMR-5, as amended 1989), Part VI, 40 CFR 265.112 (d)(4), with an effective date of February 12, 1990. This date will become the starting date for the final closure schedule in Subsection 5.1.9 of the closure plan" (Ellvinger 1990, 15-16-372). The surface impoundment referred to in that correspondence is the Hypalon pond at the TA-16 burning ground designated SWMU 16-008(b).

On September 19, 1990, Harry T. Season, Jr., Acting Area Manager, Department of Energy, Los Alamos Area Office, submitted the closure documentation for the TA-16 Surface Impoundment to Ms. Kathleen Sisneros, Director Hazardous Waste Bureau, NMEID. This transmittal read in part, "Los Alamos National Laboratory (LANL) received an approved Resource Conservation and Recovery Act (RCRA) closure plan for the TA-16 Surface Impoundment on February 12, 1990. Upon the receipt of this document, LANL proceeded with the closure of this unit. This closure was completed on June 12, 1990" (Ellvinger 1990, 15-16-372).

6.1.3 SWMUs Recommended for No Further Action Under Step Two of the Four-Step Criteria

6.1.3.1 Filter/Treatment Unit, SWMU 16-010(g)

6.1.3.1.1 Background

SWMU 16-010(g) is a carbon filter/treatment unit, TA-16-363 (previously designated as structure TA-16-228). This unit was constructed in 1988 to treat waste water draining from the pressure filter tanks (TA-16-401 and TA-16-406). The drainage from the tanks enters the filtering system through a common drain line that originates at a manhole located approximately 75 ft north of building TA-16-363. The waste water is filtered and monitored before discharge from national pollutant discharge elimination system (NPDES) Outfall 05A055 located on the southeast side of the building.

6.1.3.1.2 Recommendation

SWMU 16-010(g) is recommended for delisting from the SWMU Report and the HSWA Module because it was built after 1987 and has always operated under an NPDES permit (LANL 1992, 0768).

6.1.3.1.3 Rationale for Recommendation

SWMU 16-010(g) was built in 1988 and operates under an NPDES permit (LANL, 1990, 0145).

6.1.3.2 Satellite Storage Areas, SWMUs 16-012(d,i,j,l,m,n,t,u,x); Less-Than-Ninety-Day Storage Area, SWMU 16-012(p); and Interim Storage Area, SWMU 16-012(a2)

6.1.3.2.1 Background

Satellite, less-than-ninety-day, and interim storage areas listed in Table 6-4 are active units that are currently regulated under 40 CFR 262, Standards Applicable to Generators of Hazardous Waste. The Laboratory conducts training classes for the operation of these areas. It also inspects and has institutional controls governing the closure of these units. The New Mexico Environment Department (NMED) also performs annual inspections.

6.1.3.2.2 Recommendation

SWMUs 16-012(d,i,j,l,m,n,t,u,x), 16-012(p), and 16-012(a2) are recommended for NFA and delisting from the SWMU Report and the HSWA Module [SWMU 16-012(a2) is not on the HSWA Module] because they are either satellite storage areas, less-than-ninety-day storage areas, or interim storage areas [SWMU 16-012(a2)] (LANL 1992, 0768).

6.1.3.2.3 Rationale for Recommendation

If a release occurred at one of these areas, it would be cleaned up immediately in accordance with the Laboratory's Contingency Plan, Spill Prevention Countermeasures and Control Plan, and/or administrative

TABLE 6-4

SATELLITE, LESS-THAN-NINETY-DAY, AND INTERIM STORAGE HAZARDOUS WASTE ACCUMULATION AREAS AT TA-16

SWMU	BUILDING	LOCATION	GROUP
16-012(d)	TA-16-260	Dock	WX-3
16-012(i)	TA-16-300	102	WX-3
16-012(j)	TA-16-303	Building	WX-3
16-012(l)	TA-16-304	103	WX-3
16-012(m)	TA-16-306	103	WX-3
16-012(n)	TA-16-340	Building	M-1
16-012(p)	TA-16-342	101	M-1
16-012(t)	TA-16-370	101	WX-1
16-012(u)	TA-16-430	3	WX-3
16-012(x)	TA-16-460	1	M-1
	TA-16-460	101	M-1
	TA-16-460	102	M-1
	TA-16-460	113	M-1
	TA-16-460	114	M-1
	TA-16-460	115	M-1
	TA-16-460	Dock	M-1
16-012(a2)	TA-16-88	Building	WX-11

requirements. Because any releases will be cleaned up immediately, these units do not have the potential to become historical release sites. Therefore, these areas will continue to be regulated under 3004(a) of the RCRA and not 3004(u) of the Hazardous and Solid Waste Amendments.

6.1.4 SWMUs Recommended for Deferred Action Under Step Three of the Four-Step Criteria

6.1.4.1 Material Disposal Area P, SWMU 16-018

6.1.4.1.1 Background

6.1.4.1.1.1 Description and History of SWMU 16-018

SWMU 16-018 is MDA P, which is located in TA-16 near the south rim of Cañon de Valle, just north of the TA-16 thermal treatment area's pad TA-16-387 (see Fig. 5-34) .

The SWMU is an industrial landfill that contains wastes from the synthesis, processing, and testing of HE; from the TA-16 photo development process; from the residues of the burning of HE-contaminated equipment; and from the demolition of the S-Site WW II complex. The landfill contains construction debris such as large timbers, concrete rubble, and pipes, and non-construction debris, such as flasks, bottles, mortician's tables, and other items used in the formulation, processing, and assembly of HE components. It also contains barium-contaminated sands that are residual from burning HE.

Prior to being designated as a disposal area for S-Site wastes in the early 1950s, the area that currently is MDA P served as a detonator burning ground. Both lead azide and thallium azide detonators are known to have been used during this time and are assumed to have been burned at the site. HE waste disposal activities at the landfill started in the early 1950s and ceased in 1984. Waste disposal activities were initiated at the western end of the landfill and proceeded eastward. The landfill was used to dispose of residues resulting from the burning of HE-contaminated materials. Much of the old S-Site complex was demolished in the 1960s, and most of the 'flashed' residues of these demolition activities were disposed of in MDA P. This WW II complex debris is contained mainly in the west end of the landfill (Nyhan 1989, 0154). An estimated 1 975 truckloads of material were removed in the WW II complex demolition. Historical data suggest that at least 670 truckloads went to disposal areas other than MDA P (Courtright 1969, 15-16-318). However, it is unclear what portion of the remaining 1 325 truckloads went to MDA P, or what was the volume of the truckloads.

The landfill is located in a saddle of a short, eastern-trending mesa north of the burning ground operations area and occupies approximately 2 acres. The shape of the impacted area is a half-ellipse, approximately 170 ft (north/south) by 400 ft (east/west) (Nyhan 1989, 0154).

The landfill extends down the slope of Cañon de Valle and forms a shelf over the original slope of the canyon. An intermittent stream runs through the canyon bottom. The landfill does not reach the canyon bottom, but a few large items have fallen down the slope. Visual inspection of the landfill indicates that soil on the slope is sliding.

The estimated total volume of the landfill is 13 000 cubic yards (Delta H Engineering, Ltd. 1988, 15-16-407). The landfill depth is 12 to 14 ft at the rim of the canyon and becomes shallower to the south and down the slope to the north. Cross sections suggest that waste may begin 30 to 40 ft south of the canyon rim (Nyhan 1989, 0154).

The western portion of the landfill was leveled and covered with crushed tuff and sandy-clay soils. It is now covered with grass, wild rose, wormwood, and oak brush. There are numerous protrusions of concrete rubble, pipe, steel, and reinforcing bars on the northern slope of the landfill. The leveling process overflowed the rim in the northwest quadrant, the surface remains covered and intact. In the eastern area, fill progressed from south to north with cover soil being added as the waste deposition progressed (Nyhan 1989, 0154). The depth of the eastern cover is unknown and is probably less than the estimated one foot or more of cover on the western area. There is no vegetation on the covered portion of the east area and the north slope remains completely exposed. No historical evidence has been found to differentiate waste materials placed in the western or eastern areas (Delta H Engineering, Ltd. 1985, 15-16-408).

Surface water runoff is currently collected by a drainage trench that skirts the southern boundary of the landfill. The runoff is directed around the eastern edge of the landfill into the canyon. On the western edge of the landfill, an access road that leads around the perimeter is heavily eroded by surface runoff.

Several geologic and hydrologic investigations have been conducted at MDA P since landfill use was discontinued. These include: "Site Geology of Technical Area 16, Area P" (Brown et al. 1988, 0034); "Vadose Zone Monitoring Observations at the TA-16 Area P Landfill" (McLin 1989, 15-16-405); and "A Hydrologic Modeling Study of Water Balance Relationships at the Area P Landfill" (Nyhan 1989, 0154). A summary of geologic and hydrologic properties of the landfill area is presented in Chapter 3 of this work plan.

6.1.4.1.1.2 Existing Information on Nature and Extent of Contamination

Disposal records documenting the types, amounts, and locations of wastes buried in MDA P do not exist (McLin 1989, 15-16-405). Potential contaminants of concern include barium, nitrate, residual HE, HE burn and degradation products, lead and other heavy metals, polychlorinated biphenyl residues, volatile organics, asbestos, cyanide, and uranium.

The following hazardous constituents have been detected at MDA P: nitrate (up to 6.0 mg/L), barium [up to 18 000 mg/L by extraction procedure (EP) toxicity], lead (up to 1.7 mg/L by EP toxicity), and high explosives (up to 1.7 wt %). The results of these analyses are reported in McLin (1989, 15-16-405) and in "TA-16 Area P Landfill Closure and Post-Closure Plan, Appendix D" (Delta H Engineering, Ltd. 1985, 15-16-408).

Based on the data from these previous investigations, HE and barium are the primary contaminants of concern. Several landfill core samples have exceeded the EP toxic limit for barium (100 mg/L). HE levels are well above the screening action level (SAL). Most of these samples were collected from the eastern half of the landfill (McLin 1989, 15-16-405).

Vertical migration of barium into the tuff underlying the landfill has been documented to a depth of approximately 6 ft (McLin 1989, 15-16-405). Additionally, pressure/vacuum lysimeter water samples taken near the waste materials showed a maximum concentration of barium of 37.8 mg/L. These same samples showed a maximum nitrate concentration of 3.4 mg/L, which is less than the maximum contaminant level (MCL) for nitrate of 10 mg/L. In many instances, the lysimeters located within the landfill failed to yield any water. In addition, no lysimeters yielded water from the tuff materials under the landfill and all wells surrounding the landfill have also failed to yield any water samples (McLin 1989, 15-16-405).

Stream water and sediment samples taken from upstream and downstream have not indicated that the landfill is a significant source of elevated barium concentration in the stream water (McLin 1989, 15-16-405). There is no significant increase in barium concentrations above and below the landfill. These data are presented in Subsection 5.9 as existing data for Cañon de Valle.

6.1.4.1.2 Recommendation

SWMU 16-018 is recommended for DA insofar as the RFI work plan is concerned because the SWMU will go through a formal RCRA closure overseen by the NMED. NMED has indicated that they require receipt of a revised closure plan by August 31,1993, rather than include MDA P in the RFI process.

6.1.4.1.3 Rationale for Recommendation

The DOE decided to discontinue disposal activities at MDA P in the mid 1980s. DOE concluded that a RCRA permit was not required. As required by the loss of interim status provisions (40 CFR 270.10), DOE subsequently submitted a closure and post-closure plan. A closure plan was developed by Delta H Engineering, Ltd. and was submitted in 1985 to NMEID (Nyhan 1989, 0154). The plan was later revised by HSE-8 staff and resubmitted to NMEID in 1988. In addition, a review of viable closure plans was conducted by International Technologies Corporation in January, 1990. Currently, no approved closure plan exists and NMED has required a revised closure plan for this regulated unit to be submitted in August 1993. This unit will require a post-closure permit.

6.1.5 SWMUs Recommended for No Further Action Under Step Four of the Four-Step Criteria

6.1.5.1 Surface Disposal Area (Concrete Targets and Debris), SWMU 11-007

6.1.5.1.1 Background

SWMU 11-007 is a surface disposal area containing large blocks of concrete and some road-building debris. This surface disposal area is at the head of the small canyon drainage that borders the south side of the major developed area at TA-11. At this location the drainage has been filled for the access road. On the east-facing slope of this fill, several 12 x 12 ft x 12 in. concrete blocks, which first served as targets for the air gun in TA-11-24, have been laid for erosion control. These blocks and their use are described in Subsection 5.14.1.1. Other concrete scraps are scattered about; to the south, several sections of concrete culvert are scattered near the road.

Some road-building debris (asphalt, rebar, gravel, etc.) is also in evidence in the immediate area.

Over the years, as the concrete targets from the air gun facility were used for erosion control, it became expedient to use other concrete debris for erosion control in the immediate area. The small amount of road-building debris has likewise accumulated over the years (Griffin 1992, 15-11-052).

6.1.5.1.2 Recommendation

SWMU 11-007 is recommended for NFA and delisting from the SWMU Report and the HSWA Module because there is no reasonable basis for characterization of the site based on considerations of human health and environmental risk, community concern, Laboratory operations, and value of information (LANL 1992, 0768).

6.1.5.1.3 Rationale for Recommendation

The history of the air gun facility targets associated with this SWMU is found in Subsection 5.14.1.1. Based on interviews with site personnel and a review of post-test photographs, no evidence has been found that the outer envelope of any of the test devices containing hazardous materials launched into these targets was breached. Therefore, the targets associated with this SWMU contain no hazardous or radioactive constituents as a result of mortar impacts. No archival information has been found that would indicate that the road-building debris contains RCRA hazardous or radioactive constituents.

6.1.5.2 MDA S, SWMU 11-009

6.1.5.2.1 Background

SWMU 11-009 is a fenced, active experimental plot approximately 10 x 10 ft located just south of the *cul-de-sac* in front of the storage magazine, TA-11-36. The area is used to study the effect of soil and weather on the decomposition of explosives (DuBois and Baytos 1972, 15-16-286). The area, which slopes to the southwest, is well vegetated with grasses and weeds, locust shrubs, and two small ponderosa pines. The general area is covered with ponderosa pines and oak thickets. There is no sign of erosion and no drainage transects the site. This experiment continues with a maximum of less than 80 grams of HE remaining in the experimental plot (DuBois and Baytos 1991, 0718; Griffin, 1992, 15-11-048). The sample materials that remain are in 7-in. diameter x 6-in. high tubing. The tubing has a fine mesh stainless steel screen on the bottom and hardware cloth (.25 x .25 in.) over the top. The sample containers are buried in the experimental plot: their tops are flush with the surrounding surface.

The experiments that were, and in some cases continue to be, conducted in SWMU 11-009 were initiated in March 1965 to determine the persistence of explosives in the soil in the area of the drop tower complex at TA-11 where the sensitivity of HE is studied. In addition to the less than 80 grams of total HE that remain in the experimental area, decomposition by-products may be present. These by-products would represent the weight difference between the remaining HE and 80 grams. Only those explosives containing water-soluble components (TNT, barium nitrate, or boric acid) disappear at a rate that can be considered significant (DuBois and Baytos 1991, 0718).

The current source of contamination is the residual HE at less than 80 grams and the decomposition by-products at 80 grams minus the residual HE. This material is confined to the 10 x 10 ft experimental plot to an estimated maximum depth of 2 ft.

6.1.5.2.2 Recommendation

SWMU 11-009 is recommended for DA until the site is decommissioned because it is an active experimental site and presents no current human health or environmental risk on or off site (LANL 1992, 0768).

6.1.5.2.3 Rationale for Recommendation

Within the MDA S test plot (10 x 10 x 2 ft), a maximum of 80 grams total of several types of HE is in the central area. The main compounds remaining at the site are RDX and HMX components. The maximum HE concentration diffused throughout the area would be 0.00004%, or 0.4 ppm. If all 80 grams of material were one of the types of HE in Table 6-5, the SALs would not be exceeded for this site.

TABLE 6-5

HIGH EXPLOSIVES SCREENING ACTION LEVELS IN SOIL

HIGH EXPLOSIVE COMPOUND	SAL (ppm)[a]
RDX	64
HMX	4 000
TNT (2,4,6-trinitrotoluene)	40
TNB (1,3,5-trinitrobenzene)	13
DNB (1,3-dinitrobenzene)	8

[a] Calculated using method described in the IWP, Appendix J.

6.1.5.3 Decommissioned Septic System, SWMU 16-005(n)

6.1.5.3.1 Background

SWMU 16-005(n), a septic tank with a capacity of 600 gal., is structure TA-16-173. The septic system was constructed in 1949 (LANL 1990, 0145). It is associated with TA-16-162, a latrine that was removed in 1971 (Blackwell 1983, 15-16-076). The 1990 SWMU Report states that the septic tank was removed; however, a 1983 memo indicates that the tank was still in place at that time (Stephens 1983, 15-16-074). The current Laboratory Technical Area Structure Location Plan lists the tank as abandoned in 1971 (Engineering drawing ENG-R 5111). A series of 1971 memoranda leads to the conclusion that this septic tank does not pose a threat to humans or the environment: "...the history of its use (TA-16-173) indicates the possibility of chemical or toxic contamination is insignificant" (DeField 1971, 15-16-028); and "...TA-16-173 can be considered free of explosive contamination" (Courtwright 1971, 15-16-029). Finally, a contamination survey on March 3, 1971, found that gross alpha and gross beta activity in water from the septic tank (TA-16-173) was below limits of detection (0+/- 20 pCi/l) (Purtymun 1971, 15-16-030).

A November 17, 1983, memorandum from Charles Blackwell (HSE-1) to A. John Ahlquist (HSE-8) indicates "none" under a column headed "Structure Use and/or Hazardous Material Use" in reference to TA-16-162, the building serviced by this septic tank (Blackwell 1983, 15-16-076).

6.1.5.3.2 Recommendation

SWMU 16-005(n) is recommended for NFA and delisting from the SWMU Report and the HSWA Module because there is no reasonable basis for characterization of the site based on considerations of human health and environmental risk, community concern, Laboratory operations, and value of information (LANL 1992, 0768).

6.1.5.3.3 Rationale for Recommendation

Documentation indicates that this septic tank received only sanitary waste from a latrine which was located several hundred feet from the nearest process building and, in the absence of hazardous constituents, there is no potential for a release to the environment. Septic tanks that manage only domestic waste are excluded from being SWMUs under 40 CFR 261.4(a)(1)(i).

6.1.5.4 Decommissioned Septic System, SWMU 16-005(o)

6.1.5.4.1 Background

SWMU 16-005(o) is identified as a septic tank in the Laboratory Technical Area Structure Location Plan as TA-16-420. According to the 1990 SWMU Report it was removed in 1962 (LANL 1990, 0145). However, the Laboratory Technical Area Structure Location Plan indicates that it was abandoned in 1962, Engineering drawing ENG-R 5111, sheet 2 of 7. Joe Bustos of the Field Operations Group (ENG-5) has stated that while trenching in the area in the late 1980s, a section of clay sewer pipe was unearthed (Palmer 1992, 15-16-373). This septic tank, which served building TA-16-101 (a guard house), had a drain field associated with it, Engineering drawing ENG-C 2674. There is no information that suggests handling or storage of hazardous substances in TA-16-101.

6.1.5.4.2 Recommendation

SWMU 16-005(o) is recommended for NFA and delisting from the SWMU Report and the HSWA Module because there is no reasonable basis for characterization of the site based on considerations of human health and environmental risk, community concern, Laboratory operations, and value of information (LANL 1992, 0768).

6.1.5.4.3 Rationale for Recommendation

There is no documentation to indicate that this septic tank received anything other than sanitary waste from its associated guard house and, in the absence of hazardous constituents, there is no potential for a release to the environment. Septic tanks that manage only domestic waste are excluded from being SWMUs under 40 CFR 261.4(a)(1)(i).

6.1.5.5 Active Septic System, SWMU 16-006(b)

6.1.5.5.1 Background

SWMU 16-006(b) is a reinforced concrete septic tank with a capacity of 380 gal., designated TA-16-178, and built in 1952. This septic tank serves TA-16-210, an inactive guard house. The tank overflows to a leach field. Its NMED number is LA-39 (LANL 1990, 0145).

6.1.5.5.2 Recommendation

SWMU 16-006(b) is recommended for NFA and delisting from the SWMU Report and the HSWA Module because there is no reasonable basis for characterization of the site based on considerations of human health and environmental risk, community concern, Laboratory operations, and value of information (LANL 1992, 0768).

6.1.5.5.3 Rationale for Recommendation

There is no documentation that would indicate that this septic tank received anything other than sanitary waste from its associated guard house.

6.1.5.6 Active Septic Tank, SWMU 16-006(f)

6.1.5.6.1 Background

This SWMU is a 1 000 gal. septic tank, TA-16-1153, that was constructed in 1987 (LANL 1990, 0145). This tank was installed to service new toilet facilities on the first floor of TA-16-370. An absorption field with a double branch, each approximately 45 ft long, is located 20 ft southwest of the septic tank. The tank is connected to a lavatory and water closets (Palmer 1992, 15-16-373).

6.1.5.6.2 Recommendation

SWMU 16-006(f) is recommended for NFA and delisting from the SWMU Report and the HSWA Module because there is no reasonable basis for characterization of the site based on considerations of human health and environmental risk, community concern, Laboratory operations, and value of information (LANL 1992, 0768).

6.1.5.6.3 Rationale for Recommendation

This septic tank was placed in service after March 1987, receives only sanitary waste, and has been covered under the authority of the Clean Water Act.

6.1.5.7 Rest Houses, SWMUs 16-012(a,b,c,e,f,g,h,k,o,q,r,s,v,w,y,z); and Container Storage Area, SWMU 11-010(a)

6.1.5.7.1 Background

Rest houses are auxiliary buildings used as intermediate storage points in the distribution of HE material. Rest houses were incorporated into the design of the TA-16 explosives process buildings that were constructed in the late 1940s and early 1950s. They function as intermediate storage areas for raw explosives being delivered to process buildings, for finished products ready for transport, or for scrap being removed for disposal. Usually, but not always, different rest houses are used for incoming and outgoing materials.

Rest houses at TA-16 and the container storage area at TA-11 that functions similarly to the rest houses are remote from other buildings and are often surrounded by a berm. In most cases they are connected to the process building by an enclosed, shed-like walk way up to several hundred feet long.

A typical rest house at the S-Site complex is a reinforced-concrete building about 40 ft long x 20 ft wide. Heavy double doors open to an exterior loading dock at the front. There are no windows. Floors are painted, polished concrete. Open-lattice metal doors connect the rest house with the walk way.

High-explosive material is transported to and from the rest house on 6 ft long x 3 ft wide flat-bed, wheeled, Colson carts. The carts are open-sided but have bungee ropes along the sides to cushion the contents and prevent containers from slipping off. High explosives are always packaged in cardboard but may be stored on the carts in a variety of secondary outer containers including cardboard boxes, cardboard drums, wooden boxes, or wooden crates.

Rest houses without exterior drains to a high-explosives sump are listed in Table 6-6, and those with exterior drains to a high-explosives sump are listed in Table 6-7. The SWMUs associated with the high-explosives sumps attached to the rest houses in Table 6-7 are addressed in Chapter 5, Subsection 5.2.

6.1.5.7.2 Recommendation

SWMUs 16-012(a,b,c,e,f,g,h,k,o,q,r,s,v,w,y,z) and 11-010(a) are recommended for NFA and with the exception of SWMU 11-010(a), which is not a HSWA SWMU, delisting from the SWMU Report and the HSWA Module because there is no reasonable basis for characterization of these sites based on considerations of human health and environmental risk, community concern, Laboratory operations, and value of information (LANL 1992, 0768).

6.1.5.7.3 Rationale for Recommendation

All listed rest houses are currently part of active operations, managed under rigid safety procedures. Activities are currently covered under standard operating procedures (SOPs) listed in Table 6-8 (Barr 1992, 15-16-329). Activities have always been conducted in compliance with DOE Explosives Safety Manual DOE/E1/06194 (DOE 1991, 15-16-309) and its Department of Defense predecessors.

Containerized HE material is delivered to and from rest houses under strictly controlled operating procedures. Rest houses are cleaned and maintained on regular schedules. Then, cleaning water and all materials are collected, packaged, and transported to the TA-16 burning ground for treatment. Any special activities in a rest house require a safety work permit issued by the Engineering and Information Resources Group (WX-12) safety office or its predecessors. Recent field screening indicates that no HE material has leaked or spread from any of these structures to the exterior loading docks (Barr 1992, 15-16-329).

TABLE 6-6

REST HOUSES AND CONTAINER STORAGE AREAS AT TA-16 AND TA-11 WITHOUT EXTERIOR DRAINS

SWMU	BUILDING
16-012(a)	TA-16-221
16-012(b)	TA-16-223
16-012(c)	TA-16-225
16-012(e)	TA-16-261
16-012(f)	TA-16-263
16-012(g)	TA-16-281
16-012(h)	TA-16-285
16-012(o)	TA-16-341
16-012(q)	TA-16-343
16-012(v)	TA-16-435
16-012(w)	TA-16-437
16-012(y)	TA-16-463
16-012(z)	TA-16-283
11-010(a)	TA-11-36

TABLE 6-7

REST HOUSES WITH EXTERIOR DRAINS

SWMU	BUILDING
16-012(k)	TA-16-303
16-012(r)	TA-16-345
16-012(s)	TA-16-360

TABLE 6-8

REST HOUSE STANDARD OPERATING PROCEDURES

GROUP	SOP	TITLE
WX-3	2.4.0	Inspection and Packaging of Explosives and Additives
WX-3	12.1.2	Packaging and Collection of Waste Material for Disposal
WX-12	24.1.3.16	Janitorial Services

These rest houses are governed by handling, safety, and cleaning procedures, precluding a pathway for contaminants to the surrounding environment. Therefore, under the fourth step of the detailed review for no current RCRA facility investigation and delisting, there is no reasonable basis for characterization of these SWMUs. They should be recommended for NFA and, since included on the HSWA Module [with the exception of SWMU 11-010(a)], delisted from the HSWA Module.

6.2 SWMUs and Areas of Concern not Listed in the HSWA Module VIII Recommended for Deferred Action or No Further Action

6.2.1 SWMUs Recommended for Deferred Action Under Step Three of the Four-Step Criteria

6.2.1.1 Container Storage Area, SWMU 11-010(b)

6.2.1.1.1 Background

SWMU 11-010(b) is described as a wooden pallet contained in an exterior, asphalt-paved, 10 x 20 ft container storage area located under a steel canopy at the northeast corner of TA-11-24. TA-11-24 formerly housed the air-gun facility and is currently used as an office and light machine shop. At the time this SWMU was identified, a wooden pallet was being used as a storage platform for suspected hazardous waste (LANL 1990, 0145). There is no documentation as to what, if any, hazardous materials might have been stored here. The pallet is now gone and the area is an active Laboratory satellite storage area. There is visual evidence of what appears to be a small oil spill on the asphalt.

6.2.1.1.2 Recommendation

SWMU 11-010(b) is recommended for DA until the site is decommissioned because it is part of an active experimental site and presents no current human health or environmental risk on or off site (LANL 1992, 0768).

6.2.1.1.3 Rationale for Recommendation

There is no documentation that hazardous wastes were stored at this location or a spill has occurred that would be a risk to human health or the environment. The location is now a satellite storage area from which no known prior release has occurred.

6.2.1.2 Outfall, SWMU 11-011(c)

6.2.1.2.1 Background

SWMU 11-011(c), described as the outfall from the boiler steam vent pipe associated with building TA-11-24. The SWMU is the area where condensates may collect on the asphalt adjacent to the building. TA-11-24 formerly housed the air-gun facility and is currently used as an office and light machine shop. Possible contaminants from this SWMU are unknown. Current treatment chemicals for water in boilers do not produce hazardous constituents; however, it is not known if past water treatments might have produced surface contamination on the asphalt.

6.2.1.2.2 Recommendation

SWMU 11-011(c) is recommended for DA until the site is decommissioned because it is an integral part of active operations and presents no current human health or environmental risk on or off site (LANL 1992, 0768).

6.2.1.2.3 Rationale for Recommendation

The steam condensate that may soak into the asphalt presents no current human health or environmental risk.

6.2.2 SWMUs Recommended for No Further Action Under Step One of the Four-Step Criteria

6.2.2.1 Decommissioned Waste Pond, SWMU 16-007(b)

6.2.2.1.1 Background

The 1990 SWMU Report describes a small earth pond west of TAs 16-89, 16-90, 16-91, 16-92, and 16-93, into which floor drains emptied (LANL 1990, 0145). This appears to have been based on a 1970 memo that states, "Buildings TA-16-89 through 93 floor drains discharged into earth tank west of buildings. Water sample collected from tank contain no detectable gross alpha emitters and only a trace of gross beta emitters. As a result of our survey there appears to be no environmental hazard due to radioactivity" (Kennedy 1970, 15-16-006).

A thorough review of aerial photographs, topographic maps, and engineering drawings coupled with extensive field reconnaissance by the Operable Unit

(OU) 1082 Project Leader (OUPL) have failed to find any evidence of an earthen tank west of this series of buildings. Furthermore, engineering drawings and field observations by the OUPL indicate that the drains in TAs 16-89, 16-90, and 16-91 empty into HE sumps attached to the buildings. These sumps then drain to a pond to the northeast of the buildings. TA-16-92 and TA-16-93 have similar systems that drain to a small tributary of Cañon de Valle on the northwest.

6.2.2.1.2 Recommendation

SWMU 16-007(b) is an example of an error in the SWMU Report. It is the conclusion of the OUPL that this SWMU does not exist. The Environmental Protection Group (EM-8) will be notified, and may conduct field screening or decide to recommend this SWMU for delisting from the SWMU Report and the HSWA Module VIII (LANL 1992, 0768). A permit modification will be submitted to remove this unit from Module VIII.

6.2.2.1.3 Rationale for Recommendation

Based on field observations and a review of the existing documentation of the drainage system for TAs 16-89 through 16-93, there is no evidence of a pond west of these buildings. It is more likely that the water sampled in 1970 came from the pond to the northeast of TAs 16-89, 16-90, and 16-91. That pond is still in existence as SWMU 16-008(a), which is covered in Chapter 5, Subsection 5.12.

6.2.3 SWMUs and AOCs Recommended for No Further Action Under Step Four of the Four-Step Criteria

6.2.3.1 Mortar Impact Area, SWMU 11-003(a)

6.2.3.1.1 Background

SWMU 11-003(a), a mortar impact area, is a swath one hundred feet wide by several hundred feet long that was cleared through the forest north of TA-11. The swath runs generally southeast to northwest from the drop tower complex. Currently, older growth pine trees define the outer margins of the swath, with younger pines of varying heights in the swath itself. The general area is well vegetated with grasses, oaks, and weeds. A tributary of Water Canyon transects the impact area from west to east.

This mortar impact area was used in the late 1950s and early 1960s for test operations involving a 155 mm recoilless launcher. According to project engineer William A. Spencer, the launcher was used to conduct acceleration tests on the Davy Crockett warhead. The test devices sometimes contained small amounts of HE and depleted uranium within the inert outer envelope. A parachute was attached to the test device to prevent it from falling outside of the impact area. Plastic foam pads were attached to the nose of the device to cushion its impact. Spencer is certain that no devices detonated, broke open, or otherwise contaminated the soil. All devices were recovered for diagnostic analysis (Griffin 1992, 15-11-052).

6.2.3.1.2 Recommendation

SWMU 11-003(a) is recommended for NFA and delisting from the SWMU Report because there is no reasonable basis for characterization of the site based on considerations of human health and environmental risk, community concern, laboratory operations, and value of information (LANL 1992, 0768).

6.2.3.1.3 Rationale for Recommendation

Based on the interview with William A. Spencer, none of the outer envelopes of any of the test devices launched at this location were breached, nor were any hazardous or radioactive materials released. Therefore, this SWMU received no hazardous or radioactive constituents as a result of mortar impacts.

6.2.3.2 Boneyard, SWMU 11-008

6.2.3.2.1 Background

SWMU 11-008 is a surface storage area. The 1990 SWMU Report describes this area as a boneyard south of the old air-gun target area. When the SWMU Report was tabulated, the boneyard contained scrap concrete, iron, equipment, and other debris (LANL 1990, 0145).

The Release Site Database, Task 12, Record 25, which was published in August 1989, states that during the Environmental Restoration (ER) Program site reconnaissance, it was learned that only unused materials are stored at this site. As an example, raw materials (steel, etc.) are bought when prices are low and stored for future use (LANL 1989, 15-16-361).

This boneyard lies south of the major developed area at TA-11. The area is east of and adjacent to the paved road leading to TA-11-36. The area was once cleared but is now grown to grasses. No specific information has been found regarding when the area was cleared or if any controls were placed on the movement of material to and from the site. On March 2, 1992, the 1082 OUPL found the surface of the area to be clean with the exception of small pieces of concrete and wood. A stack of steel plates for future use at the drop tower is stored nearby.

6.2.3.2.2 Recommendation

SWMU 11-008 is recommended for NFA and delisting from the SWMU Report because there is no reasonable basis for characterization of the site based on considerations of human health and environmental risk, community concern, Laboratory operations, and value of information (LANL 1992, 0768).

6.2.3.2.3 Rationale for Recommendation

All available information indicates the site was used for the storage of unused and nonhazardous materials; no evidence of any release has been noted.

6.2.3.3 Septic System, SWMU 37-001

6.2.3.3.1 Background

SWMU 37-001 is a septic tank, TA-37-28, that serves TA-37-1, an inactive guard house. The tank has a capacity of 540 gal. and overflows into a 2 400-sq-ft drain field. Its NMED registration number is LA-43 (LANL 1990, 0145).

6.2.3.3.2 Recommendation

SWMU 37-001 is recommended for NFA and delisting from the SWMU Report because there is no reasonable basis for characterization of the site based on considerations of human health and environmental risk, community concern, Laboratory operations, and value of information (LANL 1992, 0768).

6.2.3.3.3 Rationale for Recommendation

This septic tank received only sanitary waste from its associated guard house and, in the absence of hazardous constituents, there is no potential for a release to the environment. Septic tanks that manage only domestic waste are excluded from being SWMUs under 40 CFR 261.4(a)(1)(i).

6.2.3.4 Lanthanum Spill, Area of Concern C-11-003

6.2.3.4.1 Background

AOC C-11-003 is the slope northeast of TA-11-4 where radioactive lanthanum was spread as a result of leakage from a broken source capsule. The slope is on the south side of a tributary to Water Canyon. It is moderately steep, with a grade of about 30%. Grasses and scrub oak, with a few stands of ponderosa pine, grow on the slope. The precise location of the lanthanum spill is not known.

In 1949, a series of tests involving lanthanum-140 were conducted at TA-11. One source containing 9 Ci of lanthanum-140 was dropped and dragged a short distance before being picked up and put in a storage hutment. When the source was found to be leaking, it was dragged to a remote area, strung between two trees, and then washed off with a fire hose. Considerable contamination spread to surrounding areas. Contaminated soil was shoveled into cardboard boxes and removed from the site. All buildings associated with the spill were monitored and hot spots cleaned (Blackwell 1949, 15-11-009). In 1956, the health protection technician who monitored the original spill re-monitored the area and found no contamination (Blackwell 1956, 15-11-013).

6.2.3.4.2 Recommendation

C-11-003 is recommended for NFA and delisting from the SWMU Report because there is no reasonable basis for characterization of the site based on considerations of human health and environmental risk, community concern, Laboratory operations, and value of information (LANL 1992, 0768).

6.2.3.4.3 Rationale for Recommendation

With a half-life of 40.2 hours, any remaining lanthanum-140 has decayed to insignificant levels. Product of decay is cerium-140, a non-hazardous, stable element. Of concern is strontium-90, with a half-life of 28.5 years, which may have been a contaminant in the barium-140 from which the lanthanum was obtained. Lanthanum was separated chemically from barium at the Bayo Canyon facility by precipitation and filtration, first as the hydroxide and then as the oxalate, which was stabilized as lanthanum trifluoride. Strontium-90 contamination in the product was 0.003% on a pCi basis (Mayfield et al. 1979, 15-16-342).

In 1949, the total strontium-90 in the 9 Ci lanthanum-140 source was 2.7E-4 Ci or 270 000 pCi. With a half-life of 28.5 years, total strontium-90, 1.5 half-lives later in 1992, is about 100 000 pCi. Local background level is 0.34 pCi/g (Purtymun et al. 1987, 0211). The screening action level for strontium-90 is 8.90 pCi/g. Therefore, one could add an additional 8.56 pCi/g to background and still be within acceptable levels.

If no cleanup had occurred, further calculation indicates that dispersion of the remaining 100 000 pCi strontium-90 in greater than 151.5 kg of the local soil would reduce contamination to acceptable levels. However, given the large area over which the spill occurred (as a result of washing it down with a fire hose), the subsequent cleanup, and follow-up monitoring, it is much more likely that a smaller amount of strontium-90 remains and that it is dispersed in far more than 151.5 kg of the local soil.

6.3 SWMUs and AOCs Recommended for Deferred Action in Conjunction with a Sampling Strategy to Explore the Potential for Off-Site Migration

6.3.1 Firing Pits, SWMUs 11-001(a,b); Open Burning Area and Pit, SWMU 11-002; Drop Tower and Associated Hoists and Drop Pads, SWMUs 11-004(a,b,c,d,e,f); Sumps, SWMUs 11-006(a,b,c,d); Mortar Impact Area, SWMU 11-003(b); and Soil Contamination, AOC C-11-001

6.3.1.1 Background

The complete background for this aggregate is given in Chapter 5, Subsection 5.14.1. A sampling strategy is presented in Subsection 5.14.2 that will explore the potential for off-site migration and, if such potential is found, a recommendation for interim action to prevent further migration will be made.

6.3.1.2 Recommendation

SWMUs 11-001(a,b), 11-002, 11-004(a,b,c,d,e,f), and 11-006(a,b,c,d) and AOC C-11-001 are recommended for DA until the sites are decommissioned because they are all integral to the TA-11 active firing site operation and present no current human health or environmental risk on site (LANL 1992, 0768).

6.3.1.3 Rationale for Recommendation

This aggregate is composed solely of PRSs that make up an active firing site or physically lie beneath or immediately adjacent to the structures of the active firing site.

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Annex I

Project Management Plan

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1.0 PROJECT MANAGEMENT PLAN

This annex presents the technical approach, organizational structure, schedule, budget, and reporting milestones for implementation of the Operable Unit (OU) 1082 Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) work plan. This plan is an extension of the Environmental Restoration (ER) Program Project Management Plan in Annex I of the Installation Work Plan (IWP) (LANL 1992, 0768). The OU 1082 RFI work plan does not contain any deviations from the IWP. This annex addresses the project management requirements of the Hazardous and Solid Waste Amendments (HSWA) Module (Task II, E., p. 39) of the Laboratory's RCRA Part B Permit (EPA 1990, 0306). The facility transition (FT) and decontamination and decommissioning (D&D) programs will be integrated into this RFI characterization as these programs evolve.

1.1 Technical Approach

The technical approach employed for the OU 1082 RFI work plan is described in Chapter 4. This approach is based on the ER Program's overall technical approach to the RCRA facility investigation/corrective measures study (CMS) process described in Chapter 3 of the IWP (LANL 1992, 0768). The following key features characterize the ER Program approach:

- use of action levels as criteria to trigger a CMS;
- sampling approach to site characterization;
- decision analysis and cost effectiveness to support the selection of remedial alternatives;
- application of the observational approach to the RFI/CMS process as a general philosophical framework; and,
- integration of Resource Conservation and Recovery Act, Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), National Environmental Policy Act (NEPA), Atomic Energy Act (AEA), and other applicable regulations.

The general philosophy is to develop and iteratively define the nature and extent of contamination at OU 1082 through a planned, phased investigation and data interpretation. An objective is to support voluntary corrective action (VCA) or a CMS using the minimum data necessary.

The technical objectives of the phased RFI, as detailed throughout this work plan, are to:

- Identify contaminants present at each solid waste management unit (SWMU) and, if none are present, proceed to no further action (NFA)
- 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 including VCAs
- Provide the basis for planning detailed CMSs
- Use of RCRA Subpart S regulation's conditional remedy concept to adopt an approach of stabilization in-place for material disposal areas (MDAs) as appropriate

1.1.1 Implementation Rationale

Scheduling of investigations is based on the following rationale and priorities.

Initial efforts are focused on obtaining OU-wide environmental data that form the basis for understanding contaminant transport processes. These investigations, described in Chapter 4, include:

- geomorphic characterization of drainage channels to determine locations for representative sampling of mobile sediments, surface geophysics measurements to locate buried pipes, and radiation surveys to define areas contaminated by radioactive elements; and,

- measurement of contaminant levels in surface soils 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.

Generic investigations include surface sampling at individual SWMUs, channel sediment sampling, sampling at subsurface structures such as septic tanks and sumps, near-surface sampling at buried outfalls and leach fields, and sampling of landfills and berms. Sites with unique problems, such as MDAs, are addressed separately.

1.2 Schedule

The schedule for the entire RFI/CMS process at OU 1082 is provided in Table I-1.

TABLE I-1

PROJECTED SCHEDULE FOR CORRECTIVE ACTION PROCESS, OPERABLE UNIT 1082

MILESTONE	DATE
Submit EPA/NMED work plan	07/16/93
Start RFI	10/01/93
Start RFI report	09/04/96
Complete RFI fieldwork	10/19/98
Complete draft RFI report	11/19/98
Complete RFI	02/28/00
Complete assessment	06/27/02

Where possible, fieldwork has not been scheduled between November 15 and March 15 each year, to allow for inclement weather.

1.3 Reporting

Results of RFI fieldwork will be presented in four principal documents: quarterly technical progress reports, RFI phase reports/work plan modifications, the RFI report, and the CMS report if required. The purpose of each of these reports is detailed below. A schedule for submission of draft and final reports is presented in Table I-2.

TABLE I-2

REPORTS PLANNED FOR OPERABLE UNIT 1082 RFI

REPORT TYPE	EPA	DOE	DATE DUE
Monthly reports	X	X	25th of the following month
Quarterly reports	X		February 15, yearly
	X		May 15, yearly
	X		August 15, yearly
Annual reports	X	X	November 15, yearly
Phase reports			
Draft RFI work plans	X	X	07/07/94 07/07/95
Draft Phase I report	X	X	03/27/98
Draft RFI report	X	X	12/19/99

1.3.1 Quarterly Technical Progress Reports

As the OU 1082 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, p. 46). Detailed technical assessments will be provided in RFI phase report/work plan modifications.

1.3.2 RFI Phase Report/Work Plan Modifications

RFI phase reports/work plan modifications will be submitted for work conducted on aggregates of SWMUs or on individual SWMUs. These phase reports 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).

1.3.3 RFI Report

The RFI report will summarize all fieldwork 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, p. 46), the Laboratory will submit an RFI report within 60 days of completion of the RFI. As stated in the IWP, Subsection 3.5.1.2 (LANL 1992, 0768), the RFI report will describe the procedures, methods, and results of field investigations and will include information on the type and extent of contamination, sources and migration pathways, and actual and potential receptors. The report will also contain adequate information to support justification for no further action and corrective action decisions for SWMUs.

1.3.4 CMS Report

The CMS report will propose methods of remediation for selected SWMUs listed in the RFI report. Not all SWMUs will need remediation because some will have been delisted based on recommendations made in the RFI report. The CMS report will describe the proposed remediation methods, procedures, and expected results, along with a plan, schedule, and cost estimate.

1.4 Budget

The schedule presented above is based on fixed budgets for the first two years of the RFI. The fixed budgets in fiscal years 1993 and 1994 (FY93 and FY94) are based on expected DOE funding levels. DOE funding requests are set two years in advance: thus, the first year in which the RFI is not constrained by past budget estimates will be FY95. Funding requests for FY95 and beyond will reflect the cost and schedule that most efficiently complete the RFI plans. Table ES-1, Executive Summary, presents a cost estimate for the OU 1082 RFI. Schedules and costs will be updated through DOE change control procedures as appropriate with revisions submitted to the EPA for approval.

1.5 Organization

The organizational structure for the ER Program is presented in Section 3.0 and Annex I of the IWP. Organization of the ER Program is presented in Fig. 3-2 of the IWP (LANL 1992, 0768).

This section details the management organization for the OU 1082 RFI. A list of contributors to the OU 1082 RFI Work Plan is in Appendix C.

The following are the responsibilities of the program manager, programmatic project leader, technical team, field team leaders, and field teams.

Program Manager

- ensures that the Laboratory's ER activities are consistent with the goals and objectives of the Environmental Management (EM) Division Leader, Department of Energy (DOE), Environmental Protection Agency (EPA), New Mexico Environment Department (NMED), and others, as appropriate;
- ensures compliance with the HSWA Module;
- ensures compliance with change control procedures;
- evaluates costs, schedules, and performance;
- submits monthly and quarterly reports to DOE, EPA, and NMED;
- tracks deliverables and milestones established by DOE, EPA, and NMED;
- ensures the establishment and implementation of the quality, health and safety, records management, and community relations programs; and,
- ensures that policies, guidance, and relevant information are communicated to ER personnel by
  - periodically conducting meetings,
  - distributing essential guidance memoranda and letters, using a receipt acknowledgment system when necessary,
  - ensuring the preparation and controlled distribution of administrative procedures, and,

- establishing a standard routing system for routine guidance.

Programmatic Project Leader

The programmatic project leader provides technical and administrative programmatic guidance to operable unit project leaders and technical team leaders including the following:

- meeting regulatory compliance requirements (especially RCRA and CERCLA), RFI/CMS/CMI, document content, administrative and technical standard operating procedures, quality assurance and health and safety requirements, and general policies and requirements for doing business in the Laboratory's ER Program;
- defining allocation of resources to Laboratory and contractor personnel to accomplish required technical and management activities, and tracking progress and fiscal spending;
- assisting operable unit project leaders (OUPLs) and technical team leaders (TTLs) in obtaining appropriate and sufficient resources to perform their assigned duties;
- performing technical and policy reviews of documents prepared for the ER Program by OUPLs, TTLs, and affiliated staff;
- reviewing and recommending management action for scopes of work, proposals, or requests for work to be supported by the ER Program;
- reviewing progress of OUPLs and TTLs;
- recommending to management, corrective or enhancement actions to expeditiously meet ER Program goals;
- working closely with other programmatic project leaders and group leaders to assure proper integration of program

activities and fiscal responsibility, and to ensure compliance with applicable federal and state regulations;

- interacting with federal and state regulatory agencies; and,
- providing input to monthly, quarterly, and/or annual progress reports as required.

OU 1082 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;
- 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 to resolve quality concerns and to coordinate with the quality assurance (QA) staff for audits;
- complies with the ER Program Health and Safety (H&S), records management, and community relations requirements;
- oversees RFI fieldwork and manages the field teams manager; and,
- complies with the Laboratory's technical and QA requirements for the ER Program.

Technical Team Members

Technical team members are responsible for providing technical input for their discipline throughout the RFI/CMS process. They have participated in the development of this work plan and the individual field sampling plans and will participate in the fieldwork, data analysis, report preparation, work plan modifications, and planning of subsequent investigations as necessary.

The primary disciplines currently represented on the 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 RFI changes.

Field Teams Manager

- oversees day-to-day field operations;
- conducts planning and scheduling for the implementation of the RFI field activities detailed in Chapters 4 and 5; and,
- manages field team members.

Field Team Leader

The field teams manager will assign fieldwork 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 appropriate for the activity. Field team leaders may be contractor personnel.

Field Team Member(s)

Field team members may include

- 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

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Annex II

Quality Assurance Project Plan

1.0 APPROVAL FOR IMPLEMENTATION

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2. NAME: Ted Norris
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4. NAME: Margaret Gautier
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5. NAME: Barbara Driscoll
   TITLE: Geologist, Region 6, Environmental Protection Agency

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6. NAME: Alva Smith
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7. NAME: Brad Martin
   TITLE: Operable Unit Project Leader, CLS-DO, Los Alamos National Laboratory

   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.

Introduction

This Quality Assurance Project Plan (QAPjP) for the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Work Plan for Operable Unit (OU) 1082 was written as a matrix report (Table II-1) that is based on the Los Alamos National Laboratory (the Laboratory) Environmental Restoration (ER) Program generic QAPjP. The generic QAPjP is Appendix T in the Installation Work Plan (IWP) (LANL 1991, 0553).

The Laboratory ER Program generic QAPjP describes the format for the individual OU QAPjPs. In the generic QAPjP, Section 1.0 is the Approval For Implementation, which is included in the front of this annex. Section 2.0 of the generic QAPjP is the table of contents, which was omitted from this annex because the OU 1082 QAPjP is presented as a matrix. Section 3.0 of the generic QAPjP is the Project Description, and Subsection 3.1 is the Introduction. This introduction will serve as the equivalent of Subsection 3.1 and the matrix (Table II-1) will begin with Subsection 3.2, Facility Description.

The OU 1082 QAPjP matrix (Table II-1) lists the generic QAPjP criteria in the first column; these criteria correspond to the sections of the generic QAPjP. The second column lists the specific requirements of the generic QAPjP that the OU 1082 QAPjP must meet; the subsection titles and numbers in the second column correspond directly with those contained in generic QAPjP. Sections of the generic QAPjP that do not contain specific requirements are not included in the matrix, e.g., 3.4. The third column lists the location in the IWP and/or the OU 1082 work plan of information that fulfills the requirements in the generic QAPjP. If OU 1082 will follow the requirements in the generic QAPjP and no further information is necessary, the column contains the phrase "generic QAPjP accepted." In some cases, a standard operating procedure (SOP) and/or a clarification note is included.

Note 1: **Section 4.0 Project Organization and Responsibility**

The organizational structure of the ER Program is presented in Section 2.0 of the LANL ER Quality Program Plan (QPP) to the project leader (PL) level, including quality assurance (QA) functions. The OU 1082 work plan, Annex I, describes the organizational structure from the PL level down, and presents an organizational chart to demonstrate line authority.

TABLE II-1

OU 1082 QAPjP MATRIX

GENERIC QAPjP CRITERIA	GENERIC QAPjP[1] REQUIREMENTS BY SUBSECTION	OU 1082 INCORPORATION OF GENERIC QAPjP REQUIREMENTS
Project description	3.2 Facility Description	Los Alamos National Laboratory (LANL) ER Program IWP[2], Section 3.0, and OU 1082 Work Plan, Chapter 2
	3.3 ER Program	LANL ER Program IWP, Section 2.0
	3.4.1 Project Objectives	OU 1082 Work Plan, Chapters 1 and 5
	3.4.2 Project Schedule	OU 1082 Work Plan, Annex I
	3.4.3 Project Scope	OU 1082 Work Plan, Chapters 1 and 5
	3.4.4 Background Information	OU 1082 Work Plan, Chapters 1, 2, and 3
	3.4.5 Data Management	OU 1082 Work Plan, Annex IV, and LANL ER Program IWP, Annex IV
Project organization	4.1 Line Authority	OU 1082 Work Plan, Annex I
	4.2 Personnel Qualifications, Training, Resumes	Maintained as records within OU 1082 record system
	4.3 Organizational Structure	LANL-ER-QPP, Section 2.0, *Note 1.*
Quality assurance objectives for measurement data in terms of precision, accuracy, representativeness, completeness, and comparability	5.1 Level of Quality Control	Generic QAPjP accepted
	5.2 Precision, Accuracy, and Sensitivity of Analyses	Generic QAPjP accepted
	5.3 QA Objectives for Precision	Generic QAPjP accepted
	5.4 QA Objectives for Accuracy	Generic QAPjP accepted
	5.5 Representativeness, Completeness, and Comparability	Generic QAPjP accepted
	5.6 Field Measurements	Generic QAPjP accepted
	5.7 Data Quality Objectives	OU 1082 Work Plan, Chapter 5
Sampling procedures	6.0 Sampling Procedures	OU 1082 Work Plan, Chapter 4
	6.1 Quality Control Samples	Generic QAPjP accepted including ER Program SOP-01.05. See also *Note 2.*
	6.2 Sample Preservation During Shipment	Generic QAPjP accepted including ER Program SOP-01.02
	6.3 Equipment Decontamination	Generic QAPjP accepted including ER Program SOP-01.06
	6.4 Sample Designation	Generic QAPjP accepted including ER Program SOP-01.04
Sample custody	7.1 Overview	Generic QAPjP accepted including ER Program SOP-01.04
	7.2 Field Documentation	Generic QAPjP accepted including ER Program SOP-01.04
	7.3 Sample Management Facility	Generic QAPjP accepted
	7.4 Laboratory Documentation	Generic QAPjP accepted
	7.5 Sample Handling, Packaging, and Shipping	Generic QAPjP accepted including ER Program SOP-01.03
	7.6 Final Evidence File Documentation	Generic QAPjP accepted
Calibrations procedures and frequency	8.1 Overview	Generic QAPjP accepted
	8.2 Field Equipment	Generic QAPjP accepted
	8.3 Laboratory Equipment	Generic QAPjP accepted

TABLE II-1 (continued)

OU 1082 QAPjP MATRIX

GENERIC QAPjP CRITERIA	GENERIC QAPjP REQUIREMENTS BY SUBSECTION	OU 1082 INCORPORATION OF GENERIC QAPjP REQUIREMENTS
Analytical procedures[3]	9.1 Overview	Generic QAPjP accepted
	9.2 Field Testing and Screening	Generic QAPjP accepted including ER Program SOP-06.02
	9.3 Laboratory Methods	Generic QAPjP accepted. Sampling plans are described in OU 1082 Work Plan, Chapter 5
Data reduction, validation, and reporting	10.1 Data Reduction	Generic QAPjP accepted
	10.2 Data Validation	Generic QAPjP accepted
	10.3 Data Reporting	Generic QAPjP accepted
Internal quality-controlled checks	11.1 Field Sampling Quality Control Checks	Generic QAPjP accepted
	11.2 Laboratory Analytical Activities	Generic QAPjP accepted
Performance and system audits	12.0 Performance and System Audits	Generic QAPjP accepted
Preventive maintenance	13.1 Field Equipment	Generic QAPjP accepted
	13.2 Laboratory Equipment	Generic QAPjP accepted
Specific routine procedures used to assess data precision, accuracy, representativeness, and completeness	14.1 Precision	Generic QAPjP accepted
	14.2 Accuracy	Generic QAPjP accepted
	14.3 Sample Representativeness	Generic QAPjP accepted. See also *Note 3*.
	14.4 Completeness	Generic QAPjP accepted
Corrective action	15.1 Overview	Generic QAPjP accepted including LANL-ER-QP-01.3Q
	15.2 Field Corrective Action	Generic QAPjP accepted
	15.3 Laboratory Corrective Action	Generic QAPjP accepted
Quality assurance reports to management	16.1 Field Quality Assurance Reports to Management	Generic QAPjP accepted. See also *Note 4*.
	16.2 Laboratory Quality Assurance Reports to Management	Generic QAPjP accepted
	16.3 Internal Management Quality Assurance Reports	Generic QAPjP accepted

1 LANL 1991, 0553
2 LANL 1992, 0768
3 Although the generic QAPjP criteria are accepted, special sampling limits, parameters, and analyses will be established for operable unit-specific cases. See the note at the top of page 9-2, Generic QA Project Plan (LANL 1991, 0553).

Note 2: **Section 6.1 Quality Control Samples**

If soil samples for geotechnical analyses are collected during the OU 1082 RFI, then the following QA procedures will be used. In contrast to samples submitted for chemical analyses, field quality control samples are not routinely associated with geotechnical samples. Quality control (QC) for geotechnical sample-analysis results is prescribed in the specific laboratory procedure. An additional measure of QC for geotechnical samples is achieved by the collection and submittal of a larger-than-sufficient volume of sample. A large sample volume may provide for reanalysis of an individual sample in the event that results from the initial aliquot did not meet specific method requirements.

QA and QC sampling for RFI Phase I in OU 1082 will provide samples to address variability in the sampling and analytical procedures. Most of these will be prescribed generically as follows:

- Rinsate samples (in general, one per day) will be collected if on-site decontamination of sampling equipment is being performed.
- A trip blank (one per sample delivery group) will be included whenever volatile organic compounds are a potential contaminant at the site.
- Field reagent blanks will be submitted only if reagents are brought in bulk to the site and measured out on site.
- The Sample Coordination Facility (SCF) will add blanks, surrogate spikes, and other QA samples to each batch following its standard practices. (Batch sizes will be determined by the SCF and will vary depending on the type of analyses to be performed. The SCF will attempt to keep samples from a sample delivery group together as much as possible when batching samples for the analytical laboratories.)
- The analytical laboratories will report analyses of instrument blanks, calibration standards, and other QC samples as specified in their contracts with the SCF.
- Field instrument calibration checks will be performed as specified in the SOPs controlling the use of those instruments. The results will be recorded in the field documentation of the survey.

- The field laboratories will provide laboratory splits, replicate analyses, and calibration checks as specified by their SOPs or QC programs. The results will be documented and reported to the field team leader daily.

In general, the QA/QC samples listed above are at most single blind samples.

The only types of QA sampling that are described in site-specific detail in Chapter 5 are double blind collocated samples, field splits, and field duplicates to be prepared in the field for both field and off-site laboratories. We define these as follows:

- A collocated sample is a second sample collected next to the first sample, as close as practicable (usually 1 to 2 ft away), using the same method as the first (another spade or scoop sample, another manual shallow core, etc.). In general, subsamples for the collocated sample are prepared for each proposed analysis as for the first sample.

- A field split is a second subsample collected in the field from a prepared (e.g., homogenized) sample for a designated type of analysis. This can be appropriate for inorganic, radionuclide, and most semivolatile organic analyses, but in general is not useful for volatile organic analyses.

- A field duplicate is a second subsample collected for a minimally disturbed field sample (usually a core) for a designated type of analysis. Field duplicates are used in place of field splits for volatile compounds.

Collocated samples provide an estimate of "total study error" (apart from overall population variability, which is captured by taking a number of samples from the site). Field splits and field duplicates are used to estimate incremental error introduced by imperfect homogenization, handling, transport, and analysis. Field duplicates and collocated samples provide estimates of micro-scale variability of contaminants such as radionuclides in sediments and dioxins in soil.

Note 3: Section 14.3 Sample Representativeness

The field sampling plans presented in the OU 1082 work plan, Chapter 5, were developed to meet the sample representativeness criteria described in Subsection 14.3 of the Laboratory ER Program generic QAPjP (Appendix T) (LANL 1991, 0553).

Note 4: Section 16.1 Field Quality Assurance Reports to Management

The OU field teams leader or a designee will provide a monthly field progress report to the ER PL. This report will consist of the information identified in Subsection 16.1 of the ER Program generic QAPjP (Appendix T) (LANL 1991, 0553).

REFERENCES

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

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1.0 INTRODUCTION

1.1 Purpose

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

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

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

1. Installation Work Plan, Health and Safety Program Plan (IWPHSPP) (LANL 1992, 0768)
2. Operable unit health and safety plan
3. Site-specific health and safety plan

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

1.2 Applicability

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

1.3 Regulatory Requirements

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

The first federal effort to address hazardous waste problems followed the passage of the Resource Conservation and Recovery Act of 1976 (RCRA). RCRA mandated the development of federal and state programs for the disposal and resource recovery of waste materials. RCRA regulates generation, treatment, storage, disposal, and transportation of hazardous waste.

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

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

Under SARA, the Secretary of Labor is required to promulgate worker protection regulations. After consulting with many organizations, including EPA, OSHA, the US Coast Guard, and the National Institute for Occupational Safety and Health (NIOSH), a set of regulations was published in March 1989. This is 29 Code of Federal Regulations (CFR) Part 1910.120, Hazardous Waste Operations and Emergency Response (HAZWOPER) (OSHA 1991, 0610).

DOE Orders 5480.4 and 5483.1A require DOE employees and contractors to comply with OSHA regulations (DOE 1990, 0733; DOE 1983, 0058). DOE 5480.11 sets radiation protection standards for all DOE activities (DOE 1990, 0732). The DOE Radiological Control Manual established practices for the conduct of radiological control activities at all DOE sites and is used by DOE to evaluate contractor performance.

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

1.4 Variances From Health and Safety Requirements

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

1.5 Review and Approval

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

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

2.0 ORGANIZATION, RESPONSIBILITY, AND AUTHORITY

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

2.1 General Responsibilities

The Laboratory's Environment, Safety, and Health (ES&H) Manual delineates managers' and employees' responsibilities for conducting safe operations and providing for the safety of contract personnel and visitors. The general safety responsibilities for ER activities are summarized in the IWPHSPP (LANL 1992, 0768). Line management is responsible for implementing health and safety requirements.

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

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

2.1.1 Kick-Off Meeting

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

2.1.2 Readiness Review

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

2.2 Individual Responsibilities

Laboratory employees and supplemental work force personnel are responsible for health and safety during ER Program activities.

2.2.1 Environmental Management and Health and Safety Division Leaders

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

2.2.2 Environmental Restoration Program Manager

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

2.2.3 Health and Safety Project Leader

The HSPL is responsible for preparing and updating the IWPHSPP (LANL 1992, 0768). The HSPL helps the OUPL in identifying resources to be used for the preparation and implementation of the OUHSP. Final approval of the IWPHSPP, OUHSP, and SSHSP is the responsibility of the HSPL. In conjunction with the field team leaders, the HSPL oversees daily health and safety activities in the field, including scheduling, tracking deliverables, and resource utilization. The HSPL is also responsible for reviewing contractor HS plans to ensure that they meet the requirements of the OUSHP.

2.2.4 Operable Unit Project Leader

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

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

2.2.5 Operable Unit Field Team Leader

The OU field team leader is responsible for:

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

2.2.6 Field Team Leader

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

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

2.2.7 Site Safety Officer

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

The SSO is responsible for ensuring that trained and competent personnel are onsite. This includes industrial hygiene and health physics technicians and first aid/cardiopulmonary resuscitation responders. The SSO may fill any or all of these roles. The WX-Division SSO will have final approval of all safety procedures to be implemented in the HE exclusion area.

The SSO has the following responsibilities:

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

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

2.2.8 Field Team Members

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

2.2.9 Visitors

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

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

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

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

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

2.2.10 Supplemental Work Force

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

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

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

2.3 Personnel Qualifications

The HSPL will establish minimum training and competency requirements for on-site personnel. These requirements will meet or exceed 29 CFR 1910.120 regulations (OSHA 1991, 0610).

2.4 Health and Safety Oversight

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

2.5 Off-Site Work

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

3.0 SCOPE OF WORK

3.1 Comprehensive Work Plan

The Installation Work Plan targets OU 1082 for investigation. The initial phase is the investigation and characterization, involving environmental sampling and field assessment of the areas. This OUHSP addresses the tasks in the Phase I study. Tasks for additional phases will be addressed in revisions to this document.

3.2 Operable Unit Description

OU 1082 consists of 27 types of potential release sites (PRSs), as shown in Chapter 1, Table 1-4. These include solid waste management units and areas of concern. Thorough descriptions and histories of these sites can be found in Chapter 5. Table III-1 summarizes the PRSs, the potential hazards, and the work planned at this time.

4.0 HAZARD IDENTIFICATION AND ASSESSMENT

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

4.1 Physical Hazards

Injuries caused by physical hazards are preventable. Some physical hazards such as open trenches, loud noise, and heavy lifting are easily recognized. Others, such as heat stress and sunburn, are less apparent. The purpose of this section is to list some anticipated physical hazards. These hazards are listed because they often occur during these types of ER activities. Some, such as altitude sickness, are more unique. For these unique

TABLE III-1

SUMMARY OF PRSs, OU 1082

DESCRIPTION	TASKS	CHEMICALS OF CONCERN	RADIONUCLIDES OF CONCERN
SWMU 16-001 Blowdown Tanks and Dry Wells	Surface soil sampling, core samples, excavation	Chromates, solvents, oils	None
SWMU 16-003 Active HE Sumps	Surface soil sampling, sediment sampling, core sampling	HE, solvents, metals	Depleted uranium
SWMU 16-004 Sanitary Waste Treatment Plant	Effluent water sampling, sludge sampling	Lead, methylene chloride, toluene, chromium, silver, copper, zinc, beryllium	Uranium; plutonium-238, 239, 240
SWMU 16-006 Septic Tanks	Sludge sampling, core sampling, sediment/soil sampling	Volatile organics, barium trichloroethylene	None
SWMU 16-007 Wastewater Ponds	Core sampling (drilled or augered)	HE, barium, organics, metals	Uranium
SWMU 16-009 Decommissioned Bum Area	Radiation screening, surface and subsurface sampling	Metals, semivolatile organics	Uranium
SWMU 16-010 Inactive Burn and Treatment Area	Radiation screening, HE field screening, surface sampling, spilt-spoon core sampling	Barium, lead, HE, volatile and semi-volatile organics	Depleted uranium
SWMU 16-013 Decommissioned Waste Storage Area	Radiation screening, HE screening, surface sampling	Organics, metals, HE	Uranium
SWMU 16-016 Surface Disposal	Radiation screening, HE screening, surface sampling, subsurface sampling	Barium, HE, metals	None
SWMU 16-018 Material Disposal Area P	RCRA closure	HE, metals, barium	Uranium
SWMU 16-019 Material Disposal Area R	Radiation screening, HE screening, surface and subsurface sampling	HE, HE burn products, barium, metals	Uranium
SWMU 16-021 Operational Release	One core sample	HE, metals, cyanide, acids, paints, solvents, oils	None
SWMU 16-026 Inactive Outfalls for HE Sumps	HE screening, radiation screening, surface sampling, sediment sampling	HE, organics, metals barium	Uranium
SWMU 16-029 Inactive Outfalls for HE Sumps	HE screening, radiation screening, surface and sediment sampling	HE, organics, barium, metals	Uranium
SWMU 16-030 Active Outfalls for HE Sumps	HE screening, radiation screening, surface sampling, augered core sampling	HE, organics, barium	Uranium
SWMU 16-035 P-Site Soil Contamination	HE screening, surface sampling	HE, metals	None

TABLE III-1 (continued)

SUMMARY OF PRSs, OU 1082

DESCRIPTION	TASKS	CHEMICALS OF CONCERN	RADIONUCLIDES OF CONCERN
SWMU 16-036 P-Site Soil Contamination	HE screening, surface sampling	HE, metals	None
SWMU 13-001 P-Site, Firing Site	Radiation screening, sediment/surface sampling	Metals	Uranium
SWMU 13-002 P-Site, Landfills	Radiation screening, surface soil sampling	Metals	Uranium
SWMU 13-003 Septic Tanks	Sludge sampling, core sampling, sediment/soil sampling	Volatiles, barium	None
SWMU 13-004 P-Site, Burn Site	Surface sampling	HE, metals	None
SWMU 11-001 K-Site Aggregate A Firing Pits	Surface sampling, sediment sampling, HE swipe sampling	HE, metals	Uranium
SWMU 11-002 K-Site Aggregate A Burn Site	Surface sampling, sediment sampling, HE screening	HE, metals	Uranium
SWMU 11-004 K-Site Aggregate A Drop Tower Complex	Surface/sediment sampling, HE screening, radiation screening	HE, metals, beryllium	Natural and depleted uranium
SWMU 11-005, K-Site Aggregate B Septic Systems, Outfall, and Drain Lines	Sludge sampling, augered core samples, surface soil/sediment sampling	Organics, silver, cyanide, metals, mercury, oils	Uranium, plutonium
SWMU 11-006 K-Site Aggregate A Sumps and Catch Basin	Surface/sediment sampling, HE screening	HE, metals	Uranium
SWMU 11-011 K-Site Aggregate B Active and Inactive Outfalls	Sludge sampling, core sampling, surface soil/sediment sampling	Organics, silver, metals, cyanide, mercury, oils	Uranium, plutonium

physical hazards, a brief discussion is provided. For other, more common hazards, no detailed discussion is provided. Detailed information about these potential hazards can be found in HS Division HAZWOP Program documentation or almost any industrial hygiene reference book (e.g., *Fundamentals of Industrial Hygiene*, 1988).

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

TABLE III-2

PHYSICAL HAZARDS OF CONCERN

HAZARD DESCRIPTION	PPE*	PREVENTION METHODS	MONITORING METHODS
Noise	Ear plugs and ear muffs	Engineering controls, mufflers, noise absorbers, PPE	Sound level meter, noise dosimeter
Vibration	Gloves	Prevention or attenuation, isolation, increase distance from source	Accelerometers and mechanoelectrical transducers with electronic instrumentation
Energized equipment	Gloves, safety shoes, safety glasses	Lockout/tagout of equipment	Circuit test light/meter, grounding stick
Confined space entry	Gloves, boots, full-body suit, supplied- air or SCBA, safety glasses	Ventilation, oxygen, and combustible gas monitoring	Combustible gas meter, oxygen monitors
Trenching	Hard hats, safety shoes, safety glasses	Protective shoring, proper excavation access, and egress	Visual, oxygen meter. Determine soil type
Fire/explosion	Hard hat, gloves, face shield, fire- resistant full-body suit	Ventilation, containment of fuel source, isolation/insulation from ignition source or heat	Combustible gas meter
High explosives	Latex gloves, safety glasses, blast shields	Identification of contaminated areas, field screening, following procedures, PPE	Visual inspection, screening tests
Welding/ cutting/ brazing	Fire-resistant gloves and clothing (aprons, coveralls, leggings), welding helmets or welding goggles	Ventilation, PPE	Personal sampling for metal fumes
Compressed gas cylinders	Face shield, safety shoes, gloves	PPE. Cylinders should be stored in a areas protected from weather. Cylinders should be secured and stored with protective caps in place. Regulators are not to be used on cylinders	Visual, combustible gas meter, HNU
Material handling	Hard hat, safety shoes, gloves	Use of lifting aids. Use of correct lifting procedure. Work/rest periods	Weigh or estimate weight of typical materials and set limits for lifting
Walking/ working surfaces	Safety shoes	Keep surfaces clean and dry	Visual inspection
Pinch points/ mechanical hazards	Face shield, gloves, safety shoes	Guard interlocks, maintain guards in good condition, PPE	Visual monitoring, observation of work practices
Motor vehicle accidents	Seatbelt	Defensive driving training, reduce speed during adverse conditions	Visual
Heavy equipment accidents	Hard hat, safety shoes, gloves	Operator training. Stay clear of energized sources	
Heat stress	Hat, cooling vest	Follow ACGIH work/rest regimens	Wet bulb globe thermometer
Cold stress	Hat, gloves, insulated boots, coat, face protection	Follow ACGIH work/warm-up schedule, heated shelters	Thermometer and wind, speed measurement. Wind chill chart
Sunburn	Hat, safety sunglasses, full-body protection	Keep body covered with clothing or sunscreen	Solar load
Altitude sickness	None	Acclimatization ascent/descent schedule	Self monitoring for symptoms
Lightning	None	Grounding of all equipment. Stop work during thunderstorms and seek shelter	Weather reports and visual observation
Flash floods	None	Seek shelter on high ground	Weather reports and visual observation

*PPE = Personal protective equipment
NIOSH 1990, 0941
Plog 1988, 0943
OSHA 1989, 0946

4.1.1 High Explosives

Areas that may contain high explosives will be clearly identified by field team members. A fluorescent red flag will be used to mark areas suspected to contain high explosives. Materials should not be handled without proper authorization from the explosives safety expert. The following precautions will be taken with respect to explosive hazards while conducting fieldwork.

1. The location will be monitored before sampling with an appropriate radiation detection and/or organic vapor monitor. Only use equipment UL-approved for Class I and II hazardous locations.

2. The ground will be sprayed or saturated with water before sampling to minimize the potential for sparks or particulate dispersion.

3. A nonsparking sampling device will be pushed into the ground with a minimum amount of turning during surface sampling.

4. All samples will contain at least 10% moisture before being sealed in containers.

5. All samples will be screened by trained personnel using high explosives screening procedures as described in LANL safety procedures for fieldwork in explosive areas. The SSO will ensure that contractor procedures are equivalent to LANL high explosives procedures.

6. Sample containers will be shipped in paint cans padded with vermiculite and placed in a cooler with ice packs. The sample and exterior packaging must be properly labeled. Small amounts of material will be collected to limit sample size.

7. Samples will be handled only in well-ventilated areas and their exposure to light and heat will be minimized.

8. Latex gloves and safety glasses will be worn during sample collection.

9. The skin will be washed thoroughly with soap and water immediately after accidental contact.

Field personnel will not handle any material in the area unless directed by the sampling plan. This precaution will prevent contact with any high explosive fragments present in the area. Material with blue, pink, red, yellow, green, white, or orange coloration could be indicative of high explosive material.

If noticeable surface or buried high explosive residues or fragments are encountered in the immediate vicinity of a drilling location, drilling will be halted. Sample collection will continue only if a blast shield is installed or if a backhoe is used to obtain samples. This decision will be made by the field team leader and the SSO. The HSPL shall be notified before resuming field activities.

4.1.2 Altitude Sickness

Individuals coming to the Laboratory from lower elevations may experience altitude sickness. Workers coming from sea level and who are expected to perform heavy physical labor may be at highest risk. Recognition of individual risk factors and allowance for acclimatization are the keys to prevention.

At higher altitude, atmospheric pressure is reduced. There are a smaller number of oxygen molecules per unit volume and the partial pressure of oxygen is lower. A unit of work, whether performed at altitude or sea level, requires the same amount of oxygen. Oxygen flow to body tissues must remain constant to maintain that level of work. Increased respiration and cardiovascular response can only partially compensate for these factors in individuals suddenly placed at high altitude.

The factors playing a part in determining working capacity at altitude are:

- actual height (low, moderate, high altitude)
- duration of exposure
- individual factors

The Laboratory's moderate altitude (approximately 7 500 feet) will probably have an effect on prolonged endurance for unacclimatized individuals. At this level, acclimatization should be rapid (one or two weeks). Duration of exposure will dictate whether persons have an opportunity to acclimate or not. Individuals working on short-term assignments of less than two weeks will probably not acclimate.

It is not anticipated that work will require ascents of more than 200 to 300 ft at any time. Thus, too rapid ascension to high altitudes should not be a problem. It is assumed that all workers will be enrolled in a medical surveillance program. This will help identify individuals who may have existing conditions, such as respiratory or cardiovascular disease, that would put them at higher risk of altitude sickness. Each individual will adapt at a slightly different rate but in about two weeks the impact of altitude on work capacity should be minimal.

4.2 Chemical Hazards

This section identifies and provides information on chemical contaminants that are known or are suspected to be present at this OU. When unknowns are identified, they will be added to the plan's list of chemical contaminants of concern. The SSO will be responsible for adding chemicals to this table and notifying field personnel as needed.

The SSHSP will provide information for known contaminants, which will include: American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV), immediately dangerous to life and health (IDLH) concentrations, exposure symptoms, ionization potential and relative response factor for commonly used instruments (re-evaluated when the particular instrument is selected), and the best instrument for screening.

Table III-3 lists the chemical contaminants of concern. This table should be used for general recognition of the chemicals to which workers may be exposed. More detailed information should be obtained from reliable references, such as *Patty's Industrial Hygiene and Toxicology* (Clayton and Clayton 1981, 0939).

4.3 Radiological Hazards

The principal pathways by which individuals may be exposed to radioactivity during field investigations include:

TABLE III-3

CHEMICAL CONTAMINANTS OF CONCERN[a]

CONTAMINANT	EXPOSURE LIMIT	IDLH	SYMPTOMS OF EXPOSURE	ROUTES OF EXPOSURE	1P(eV)	MONITORING INSTRUMENT	RELATIVE RESPONSE
Acetone	750 ppm	20 000 ppm	Irritation of eyes, nose, and throat; dermatitis; dizziness	Inhalation, ingestion, skin contact	6.3	PID	
Aluminum	10 mg/m^3	N/A	Weakness, fatigue, respiratory distress	Inhalation, ingestion	N/A	Filter, ICP	N/A
Asbestos	0.2 $fibers/cm^3$	Ca	Dyspnea, fibrosis, restricted pulmonary function	Inhalation, ingestion	N/A	FAM	N/A
Barium	0.5 mg/m^3	1 100 mg/m^3	Gastroeneritis, muscular paralysis	Inhalation, ingestion	N/A	Filter, AA	N/A
Beryllium	0.002 mg/m^3	Ca	Dermatitis, pneumonitis, dyspnea, chronic cough, weight loss, weakness, chest pain	Inhalation, ingestion	N/A	Filter, ICP	N/A
Cadmium	0.05 mg/m^3	Ca	Pulmonary edema, dyspnea, cough, tight chest, chills, nausea, vomiting, muscle aches, diarrhea	Inhalation, ingestion	N/A	Filter, AA	N/A
Chromium	0.05 mg/m, 0.05 mg/m^3 (hexavalent compounds)	N/A, Ca 30 mg/m^3	Fibrosis, dermatitis, perforation of nasal septum, respiratory system irritation	Inhalation, ingestion,	N/A	Filter, AA or IC	N/A
Copper	0.2 mg/m^3 (fume), 1.0 mg/m^3 (dust and mist)	N/A	Fever, chills, nausea, muscle aches, cough, weakness, eye irritation, dermatitis	Inhalation, ingestion, skin contact	N/A	Filter, AA	N/A
Ethylene glycol	0.1 mg/m^3 (skin)	500 mg/m^3	Throbbing head, dizziness, nausea, vomiting, abdominal pain, hypotension, flush, palpitations, methemoglobinemia, delirium, CNS depression, angina, skin irritation	Inhalation, absorption, ingestion, skin contact	N/A	Sampling pump and sorbent tubes	N/A
Hydrochlo-ric acid	Ceiling 5 ppm, 7 mg/m^3	100 ppm	Inflamed nose, throat, cough, burns throat, choking, burns eyes and skin	Inhalation, ingestion, skin contact	N/A	Detector tube	N/A
Lead	0.05 mg/m^3	700 mg/m^3	Weakness, insomnia, constipation, abdominal pain, tremor, anorexia	Inhalation, ingestion, skin contact	N/A	Filter, AA	N/A
Mercury	0.01 mg/m^3 (alkyl compounds), 0.05 mg/m^3 (all forms except alkyl vapor), 0.1 mg/m^3 (aryl and inorganic forms)	10 mg/m^3 28 mg/m^3	Cough, chest pains, tremor, insomnia, weakness, excessive salivation, dizziness, nausea, vomiting, constipation	Inhalation, ingestion, skin contact	N/A	Jerome mercury monitor	N/A
Nickel	0.1 mg/m^3 soluble com-pounds; 1 mg/m^3 metal and insoluble compounds	Ca	Headache, vertigo, nausea, vomiting, epigastric pain, cough, hyperpnea, cyanosis, weakness, pneumonitis, delirium, convulsions	Ingestion, inhalation, skin contact	N/A	RAM, sampling pump and filter	N/A

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TABLE III-3 (continued)

CHEMICAL CONTAMINANTS OF CONCERN[a]

CONTAMINANT	EXPOSURE LIMIT	IDLH	SYMPTOMS OF EXPOSURE	ROUTES OF EXPOSURE	IP(eV)	MONITORING INSTRUMENT	RELATIVE RESPONSE
Nitric acid	5 mg/m³ 2ppm	100 ppm	Nausea, salivation, abdominal pain, vomiting, diarrhea, headache, dizziness, disturbed hearing and vision, confusion, weakness, paroxysmal atrial fibrillation, convulsions, dyspnea	Inhalation, absorption, ingestion, skin contact	N/A	Detector tube	N/A
Silver	0.1 mg/m³ (metal), 0.01 mg/m³ (soluble forms)	N/A	Throat and skin irritation, skin ulceration, gastrointestinal irritation, blue-gray eyes and patches on skin	Inhalation, ingestion, skin contact	N/A	Filter, ICP	N/A
Sodium cyanide	5 mg/m³	50 mg/m³	Asphyxiation and death, weakness, headache, confusion, nausea, vomiting, increased rate of respiration, irritated eyes and skin	Ingestion, absorption, inhalation, skin contact	N/A	Detector tube	N/A
Toluene	100 ppm	2 000 ppm	Eye, nose, throat irritation; headache, stupor	Inhalation, ingestion, skin contact	8.82	PID	10.0
Zinc	5 mg/m³ (fume), 10 mg/m³ (dust)	N/A	Cough, chills, fever, tight chest, blurred vision, dyspnea, nausea, vomiting, cramps	Inhalation	N/A	Filter, x-ray diffraction	N/A
Zinc chloride	1 mg/m³	4 800 mg/m³	Eye, nose, throat irritation; chest pain; dyspnea; cough; fever	Inhalation, skin contact	N/A	Filter, AA	N/A

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[a]High explosives of concern will be added to this table

AA = atomic absorption
Ca = potential human carcinogen
FAM = fibrous aerosol monitor
IC = ion chromotography
ICP = inductively coupled plasma
IDLH = immediately dangerous to life and health
IP(eV) = ionization potential electron volts (eV)
N/A = not available
PID = photoionization detector
RAM = real-time aerosol monitor

- inhalation or ingestion of radionuclide particles or vapors,
- dermal absorption of radionuclide particulates or vapors through wounds,
- dermal absorption through intact skin, and
- exposure to direct gamma radiation from contaminated materials.

Table III-4 provides the specific properties of the radionuclides of concern in this OU, including type of emission and half-life. As concentrations of these radionuclides are determined and additional radionuclides identified, the table will be updated. The SSO will be responsible for adding radionuclides to this table and notifying field personnel as needed.

TABLE III-4

RADIONUCLIDES OF CONCERN

RADIONUCLIDE	MAJOR RADIATION	DAC (μCi/mL)	RADIOACTIVE HALF LIFE	MONITORING INSTRUMENT
Plutonium-238	Alpha, gamma	3×10^{-12}	87.7 years	Alpha scintillometer, FIDLER
Plutonium-239	Alpha, gamma	2×10^{-12}	2.4×10^{4} years	Alpha scintillometer, FIDLER
Plutonium-240	Alpha, gamma	2×10^{-12}	6 537 years	Alpha scintillometer, FIDLER
Polonium-210	Alpha, gamma	3×10^{-10}	138.4 days	Alpha scintillometer
Uranium-235	Alpha, gamma	2×10^{-11}	7×10^{8} years	Alpha scintillometer, FIDLER
Uranium-238	Alpha, gamma	2×10^{-11}	4.5×10^{9} years	Alpha scintillometer, FIDLER

DAC = derived air concentration (DOE Order 5480.11)
FIDLER = field instrument for the detection of low-energy radiation

4.4 Biological Hazards

There are several biological hazards found at Los Alamos that are not common in other parts of the country. These include, but are not limited to: rattlesnakes, wild animals, ticks, plague, giardia lamblia, and black widow spiders. Table III-5 summarizes some of the potential biological hazards for this OU.

TABLE III-5

BIOLOGICAL HAZARDS OF CONCERN, OU 1082

HAZARD DESCRIPTION	PPE	PREVENTION METHODS
Snake bites (rattlesnake)	Long pants, snake leggings, boots	Wear PPE where footing is difficult to see. Avoid blind reaches
Animal bites (dog, cat, coyote, mountain lion)	Long pants, boots	Avoid wild or domestic animals; do not approach or attempt to feed
Ticks (may cause Lyme disease or tick fever)	Long pants, long sleeved shirts, boots	Perform tick inspections of team members after working in brushy or wooded areas
Rodents (prairie dogs and squirrels may carry plague infected fleas)	Long pants, boots	Do not handle live or dead rodents
Human sewage (may contain pathogenic bacteria)	Disposable coveralls and gloves	When sampling in septic systems, wear protective gear and dispose of properly. Wash hands thoroughly after contact
Bloodborne pathogens (blood, blood products, and human body fluids may contain Hepatitis B virus or HIV)	Latex gloves, mouthguards, protective eyewear	Only trained personnel should perform first aid procedures. Follow laboratory bloodborne pathogen control procedures
Poisonous plants (poison ivy)	Gloves, long pants, long-sleeved shirts, boots	Recognize plants, avoid contact, wash hands and garments thoroughly after contact
Waterborne infection agents (stream water may contain giardia)	None	Drink water only from potable sources
Spiders (brown recluse, black widow)	Gloves, long pants, long-sleeved shirt, boots	Use caution when in wood piles or dark, enclosed places

4.5 Task-by-Task Risk Analysis

A task-by-task risk analysis is required by 29 CFR 1910.120 and will be included with each SSHSP (OSHA 1991, 0610). This process analyzes the operations and activities for specific hazards by task. Examples of some of the tasks that should be analyzed and documented in the SSHSP are:

- drilling,
- hand augering,
- trenching,
- septic system sampling,

- high explosive sampling, and,
- canyon-side sampling.

Other site-specific tasks will be considered for inclusion by the SSO.

5.0 SITE CONTROL

5.1 Initial Site Reconnaissance

Initial site reconnaissance may involve surveyors, archaeologists, biological resource personnel, etc. Health and safety concerns that may be present must be addressed to protect personnel. The OUPL and HSPL will identify these concerns and institute measures to protect environmental impact assessment personnel.

5.2 Site-Specific Health and Safety Plans

Each field event within an OU requires an SSHSP. Planning, special training, supervision, protective measures, and oversight needs are different for each event, and the SSHSP addresses this variability.

The OUHSP provides detailed information to project managers, Laboratory managers, regulators, and health and safety professionals about health and safety programs and procedures as they relate to an OU. The SSHSP addresses the safety and health hazards of each phase of site operations and includes requirements and procedures for employee protection. All SSHSPs in that OU derive from the OUHSP.

The standard outline for an SSHSP follows OSHA requirements and serves as a guide for best management practice. Those performing the fieldwork are responsible for completing the plan.

Changes to the SSHSP must be made in writing. The HSPL shall approve changes, and site personnel shall be updated through daily tailgate meetings. Records of SSHSP approvals and changes will be maintained by the SSO.

5.3 Work Zones

Maps identifying work zones will be included with each SSHSP. Markings used to designate each zone boundary (red or yellow tape, fences, barricades, etc.) will be discussed in the plan. Evacuation routes should be upwind or crosswind of the exclusion zone. A muster area must be designated for each evacuation route. Discrete zones are not required for every field event. The SSO will determine work zones. The following sections discuss the work zones.

- **Exclusion zone**. The exclusion zone is the area where contamination is either known or likely to be present or, because of work activities, will present a potential hazard to personnel. Entry into the exclusion zone requires the use of PPE.

- **Decontamination zone**. The decontamination zone is the area where personnel conduct personal and equipment decontamination. This zone provides a buffer between contaminated areas and clean areas. Activities in the decontamination zone require the use of PPE as defined in the decontamination plan. Section 11 contains details of the decontamination plan.

- **Support zone**. The support zone is a clean area where the chance to contact hazardous materials or conditions is minimal. PPE other than safety equipment appropriate to the tasks performed (e.g., safety glasses, protective footwear, etc.) is not required.

5.4 Secured Areas

Secured areas shall be identified and shown on the site maps. Procedures and responsibilities for maintaining secured areas must be described. Standard Laboratory security procedures should be followed for accessing secure areas. All contractors and visitors must be processed through the badge office before entering secure areas. It is the responsibility of the OUPL to see that contractor personnel have badges. It is the responsibility of all Laboratory employees to enforce security measures.

5.5 Communications Systems

Portable telephones, CB radios, and two-way radios may be used for on-site communications. This type of equipment must not be used in areas where there may be high explosives; hand signals and verbal communications should be used in these areas.

5.6 General Safe-Work Practices

Workers will be instructed on safe work practices to be followed when performing tasks and operating equipment needed to complete the project. Daily safety tailgate meetings will be conducted at the beginning of the shift to brief workers on proposed activities and special precautions to be taken.

The following items are requirements necessary to protect field workers and will be reiterated in SSHSPs. Depending on site-specific conditions, items may be added or deleted.

- The buddy system will be used. Hand signals will be established and used.
- During site operations, each worker should be a safety backup to his/her partner. All personnel should be aware of dangerous situations that may develop.
- Visual contact must be maintained between buddies onsite.
- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of potentially-contaminated material is prohibited in any area designated as contaminated.
- Prescription drugs should not be taken by personnel where the potential for contact with toxic substances exist, unless specifically approved by a qualified physian.
- Alcoholic beverage intake is prohibited during the work day.

- Disposable clothing will be used whenever possible to minimize the risk of cross-contamination.
- The number of personnel and equipment in any contaminated area should be minimized, but effective site operations must be allowed for.
- Staging areas for various operational activities (equipment testing, decontamination, etc.) will be established.
- Motorized equipment will be inspected to ensure that brakes, hoists, cables, and other mechanical components are operating properly.
- Procedures for leaving any contaminated area will be planned and reviewed before entering these areas.
- Work areas and decontamination procedures will be established based on prevailing site conditions and will be subject to change.
- Wind direction indicators will be strategically located on site.
- Contact with contaminated or potentially-contaminated surfaces should be avoided. Whenever possible, do not walk through puddles, mud, or discolored ground surface; do not kneel on the ground or lean, sit, or place equipment on drums, containers, vehicles, or on the ground.
- No personnel will be allowed to enter the site without proper safety equipment.
- Proper decontamination procedures will be followed before leaving the site, except in medical emergencies.
- Any medical emergency supersedes routine safety requirements.

- Housekeeping will be emphasized to prevent injury from tripping, falling objects, and accumulation of combustible materials.
- All personnel must comply with established safety procedures. Any staff member or visitor who does not comply with safety policy, as established by the field safety coordinator, will be immediately dismissed from the site.

5.7 Specific Safe-Work Practices

5.7.1 Electrical Safety-Related Work Practices

The most effective way to avoid accidental contact with electricity is to de-energize the system or maintain a safe distance from the energized parts/line. OSHA regulations require minimum distances from energized parts. An individual working near power lines must maintain at least a 10 ft clearance from overhead lines of 50 kilovolts (kV) or less. The clearance includes any conductive material the individual may be using. For voltages over 50 kV, the 10 ft clearance must be increased 4 in. for every 10 kV over 50 kV. For underground electrical service the underground locator service should be contacted before digging.

5.7.2 Grounding

Grounding is a secondary form of protection that ensures a path of low resistance to ground if there is an electrical equipment failure. A properly installed ground wire becomes the path for electrical current if the equipment malfunctions. Without proper grounding, an individual could become the path to ground if he/she touches the equipment. An assured electrical grounding program or ground fault circuit interrupters is required.

5.7.3 Lockout/Tagout

All site workers follow a standard operating procedure for control of hazardous energy sources [Laboratory Administrative Requirement (AR) 8-6, LP 106-01.1). Lockout/tagout procedures are used to control hazardous energy sources, such as electricity, potential energy, thermal energy, chemical corrosivity, chemical toxicity, or hydraulic and pneumatic pressure.

5.7.4 Confined Space

Entry and work to be conducted in confined spaces shall adhere to procedures proposed in the Laboratory Confined Space Entry Program. These procedures require that a Confined Space Entry Permit be obtained and posted at the work site. Prior to entry, the atmosphere shall be tested for oxygen content, flammable vapors, carbon monoxide, and other hazardous gases. Continuous monitoring for these constituents shall be performed if conditions or activities have the potential to adversely affect the atmosphere.

5.7.5 Handling Drums and Containers

Drums and containers used during cleanup shall meet US Department of Transportation, OSHA, and EPA regulations. Work practices, labeling requirements, spill containment measures, and precautions for opening drums and containers shall be in accordance with 29 CFR 1910.120 (OSHA 1991, 0610). Drums and containers that contain radioactive material must also be labeled in accordance with AR 3-5, Shipment of Radioactive Materials; AR 3-7, Radiation Exposure Control; and Article 412, Radioactive Material Laboratory, DOE Radiological Control Manual. Provisions for these activities shall be clearly outlined in the SSHSP, if applicable.

5.7.6 Illumination

Illumination shall meet the requirements of Table H-120.1, 29 CFR 1910.120 (OSHA 1991, 0610). Table III-6 lists OSHA-required illumination levels.

5.7.7 Sanitation

An adequate supply of potable water shall be provided at the site. Nonpotable water sources shall be clearly marked as not suitable for drinking or washing purposes. There shall be no cross-connections between potable and nonpotable water systems.

At remote sites, at least one toilet facility shall be provided, unless the crew is mobile and has transportation readily available to nearby toilet facilities.

Adequate washing facilities shall be provided when personnel are potentially exposed to hazardous substances. Washing facilities shall be in areas where exposures to hazardous materials are below permissible exposure limits (PELs) and where employees may decontaminate themselves before

TABLE III-6

ILLUMINATION LEVELS

FOOT-CANDLES	AREAS OF OPERATION(s)
5	General site areas
3	Excavation and waste areas, accessways, active storage areas, loading platforms, refueling areas, field maintenance areas
5	Indoors (warehouses, corridors, hallways, exits)
5	Tunnels, shafts, and general underground work areas. (Exception: a minimum of 10 ft-candles is required at tunnel and shaft heading during drilling, mucking, and scaling. Bureau of Mines-approved cap lights shall be acceptable for use in the tunnel heading.)
10	General shops (e.g., mechanical and electrical equipment rooms, active storerooms, barracks or living quarters, locker or dressing rooms, dining areas, indoor toilets and workrooms)
30	First aid stations, infirmaries, offices

entering clean areas. When showers and change rooms are required, they shall be provided and meet the requirements of 29 CFR 1910.141 (OSHA 1991, 0610). In this instance, employees shall be required to shower when leaving the decontamination zone.

5.7.8 Packaging and Transport

The OUPL should contact the Waste Mangement Group (EM-7) to determine requirements for storing and transporting hazardous waste to ensure that practices for storage, packaging, and transportation comply with ARs 10-2 and 10-3. Disposal of hazardous wastes generated from a project will be handled by EM-7.

5.7.9 Government Vehicle Use

Only government vehicles can be driven onto contaminated sites. No personal vehicles are allowed. All personnel must wear a seat belt when in a moving vehicle, whether it is government or personally owned.

5.7.10 Extended Work Schedules

Scheduled work outside normal work hours must have the prior approval of the OUPL and SSO.

5.8 Permits

5.8.1 Excavation Permits

Any excavation at OU sites must be conducted in accordance with Laboratory AR 1-12, Excavation or Fill Permit Review. Field team leaders will be responsible for determining when excavation permits are required. The OUPL and field team leader are responsible for requesting the excavation permit (Form 70-10-00.1) from the support services contractor. At the top of the form, indicate that this is an ER Program activity. The permit is reviewed by HS and EM Divisions for environmental safety and health concerns.

5.8.2 Other Permits

The following permits may be required for field activities. The SSO and OUPL are responsible for obtaining permits and maintaining documentation. Permits are specifically addressed in the SSHSP.

- Radiation Work Permits
- Special Work Permit for Spark/Flame-Producing Operations
- Confined Space Entry
- Lockout/Tagout

6.0 PERSONAL PROTECTIVE EQUIPMENT

6.1 General Requirements

Personal protective equipment (PPE) shall be selected, provided, and used in accordance with the requirements of this section.

If engineering controls and work practices do not provide adequate protection against hazards, PPE may be required. Use of PPE is required by OSHA regulations in 29 CFR Part 1910 Subpart I (see Table III-7) (OSHA 1991, 0610). These regulations are reinforced by EPA regulation 40 CFR Part 300, which requires private contractors working on Superfund sites to conform to applicable OSHA provisions and any other federal or state safety requirements deemed necessary by the lead agency overseeing the activities (EPA 1990, 0559).

TABLE III-7

OSHA STANDARDS FOR PPE USE

TYPE OF PROTECTION	REGULATION
General	29 CFR 1910.132 29 CFR 1910.1000 29 CFR 1910.1001-1045
Eye and face	29 CFR 1910.133(a)
Hearing	29 CFR 1910.95
Respiratory	29 CFR 1910.134
Head	29 CFR 1910.135
Foot	29 CFR 1910.136
Electrical protective devices	29 CFR 1910.137

In addition, the use of PPE for radiological protection shall be governed by the Radiation Work Permit (or Safety Work Permits/Radiation Work). AR 3-7 and Article 325, Article 461, Table III-1, and Appendix 3C of the DOE Radiological Control Manual contain guidelines for the use of PC during radiological operations. Efforts should be made to keep disposable PPE used exclusively for radiological work from becoming contaminated with hazardous chemicals, which would generate mixed waste unnecessarily. In sites where both types of contaminants are present, this may not be possible.

6.1.1 PPE Program Elements

PPE programs protect workers from health and safety hazards and prevent injuries as a result of incorrect use and/or malfunction of PPE. Hazard identification, medical monitoring, training, environmental surveillance, selection criteria, use, maintenance, and decontamination of PPE are the essential program elements.

6.2.1 Medical Certification

Medical approval may be required before donning certain PPE. See Section 9 of this annex for more details.

6.2 Levels of PPE

The individual components of clothing and equipment must be assembled into a full protective ensemble that protects the worker from site-specific hazards and minimizes the hazards and disadvantages of the PPE. Attachment 1 lists ensemble components based on the widely-used EPA Levels of Protection: Levels A, B, C, and D. These lists can be used as a starting point for ensemble creation; however, each ensemble must be tailored to the specific situation in order to provide the most appropriate level of protection.

The type of equipment used and the overall level of protection should be re-evaluated periodically as information about the site increases and as workers are required to perform different tasks. Personnel should be able to upgrade or downgrade their level of chemical protection with the concurrence of the SSO. The level of radiological PPE may only be changed as specified in the Radiation Work Permits (or Safety Work Permits/ Radiation Work). The following are reasons to upgrade:

- known or suspected presence of dermal hazards,
- occurrence or likely occurrence of gas or vapor emission,
- change in work task that will increase contact or potential contact with hazardous materials, or
- request of the individual performing the task.

The following are reasons to downgrade:

- new information indicating that the situation is less hazardous than was originally thought,
- change in site conditions that decreases the hazard, or
- change in work task that will reduce contact with hazardous materials.

6.3 Selection, Use, and Limitations

Selection of PPE for a particular activity will be based on an evaluation of the hazards anticipated or previously detected at a work site. The equipment selected will provide protection from chemical and/or radiological materials contamination that is known or suspected to be present and that exhibits any potential for worker exposure.

6.3.1 Chemical Protective Clothing

Chemical PC shall be selected based on an evaluation of the performance characteristics of the clothing relative to the requirements and limitations of the site, the task-specific conditions and duration, and the potential hazards identified at the site.

6.3.2 Radiological Protective Clothing

Radiological PC as prescribed by the Radiological Work Permit should be selected based on the contamination level in the work area, the anticipated work activity, worker health considerations, and regard for nonradiological hazards that may be present. A full set of radiological PC includes coveralls, cotton glove liners, gloves, shoe covers, rubber overshoes, and a hood. A double set of PC includes two pairs of coveralls, cotton glove liners, two pairs of gloves, two pairs of shoe covers, rubber overshoes, and a hood. The following practices apply to radiological PC.

1. Cotton glove liners may be worn inside standard gloves for comfort but should not be worn alone or considered a layer of protection.

2. Shoe covers and gloves should be sufficiently durable for the intended use. Leather or canvas work gloves should be worn in lieu of or in addition to standard gloves for work activities requiring additional strength or abrasion resistance.

3. Use of hard hats in contamination areas should be controlled by the Radiological Work Permit. Hard hats designated for use in such areas should be distinctly colored or marked.

Table III-8 provides general guidelines for selection of PC.

TABLE III-8

GUIDELINES FOR SELECTING RADIOLOGICAL PROTECTIVE CLOTHING

WORK ACTIVITY	REMOVABLE CONTAMINATION LEVELS		
	LOW (1 TO 10 TIMES TABLE III-10 VALUES)	MODERATE (10 TO 100 TIMES TABLE III-10 VALUES)	HIGH (>100 TIMES TABLE III-10 VALUES)
Routine	Full set of PC	Full set of PC	Full set of PC, double gloves, double shoe covers
Heavy work	Full set of PC, work gloves	Double set of PC, work gloves	Double set of PC, work gloves
Work with pressurized or large volume liquids, closed system breach	Full set of non-permeable PC	Double set of PC (outer set non-permeable), rubber boots	Double set of PC, nonpermeable outer clothing, rubber boots

6.3.3 Protective Equipment

Protective equipment, including protective eyewear and shoes, head gear, hearing protection, splash protection, lifelines, and safety harnesses, must meet American National Standards Institute (ANSI) standards.

6.4 Respiratory Protection Program

When engineering controls cannot maintain airborne contaminants at acceptable levels, appropriate respiratory protective measures shall be instituted. The HS Division administers the respiratory protection program, which defines respiratory protection requirements; verifies that personnel have met the criteria for training, medical surveillance, and fit testing; and maintains the appropriate records.

All supplemental workers shall submit documentation of participation in an acceptable respiratory protection program to the Industrial Hygiene Group (HS-5) for review and signature approval before using respirators onsite.

7.0 HAZARD CONTROLS

7.1 Engineering Controls

OSHA regulations state that when possible engineering controls should be used as the first line of defense for protecting workers from hazards. Engineering controls are mechanical means for reducing hazards to workers, such as guarding moving parts on machinery and tools or using ventilation during confined space entry.

7.1.1 Engineering Controls for Airborne Dust

Airborne dust can be a hazard when it is a nuisance or when radionuclides and/or hazardous substances attach to soil particles.

During drilling or any other activity where localized dust is being generated, a sprayer containing water or water amended with surfactants may be used to wet the soil and suppress the dust. Spraying must be repeated often to maintain moist soil.

A windscreen may be effective in reducing dust from relatively small earth-moving operations. In extreme cases, a temporary enclosure can be constructed to control dust. This method is the more expensive and may increase the level of PPE required for workers (in the enclosure).

Where there are high winds in an area of little or no vegetation or a large, dusty area, small quantities of water are not effective. In these instances, a water truck may be used to wet the area to suppress the dust. This may require frequent spraying to be effective. Other materials may also be considered for dust suppression. The amount of water applied needs to be carefully controlled so that enough is used to be effective without spreading contamination by runoff or as mud tracked off-site on vehicle tires. Positive air pressure cabs are an effective method for controlling equipment operator dust exposure.

7.1.2 Engineering Controls for Airborne Volatiles

Drilling, trenching, and soil and tank sampling activities may produce gases, fumes, or mists that may be inhaled or ingested by workers without protection. Engineering controls may be implemented to reduce exposure to these hazards. Natural ventilation (wind) can be an effective control measure; workers should be located upwind of the activity whenever possible.

Mechanical ventilation is desirable in closed or confined spaces. The fan or blower may be attached to a large hose to push or pull the contaminant from the confined space. Pulling the air from the space is more effective at removing the vapors, whereas forcing air into the confined area ensures acceptable oxygen levels from ambient air.

7.1.3 Engineering Controls for Noise

Drilling and trenching are likely to produce high noise levels. On most rigs, the highest noise levels are encountered on the side of the rig because the front and rear of the engine are covered, whereas the sides are left open to cool the engine. Additional barriers may be constructed to reduce high noise levels on the sides of the rig. Insulated cabs usually reduce noise to an acceptable level for equipment operators (Berger et al. 1988, 0940).

7.1.4 Engineering Controls for Trenching

Entry into an excavation deeper than 5 ft should be avoided if possible. However, it is sometimes necessary to enter trenches to obtain needed information. OSHA regulations for trenches and excavations require engineering controls to prevent cave-ins. These controls include the use of shoring, sloping, and benching.

Benching is a series of steps dug around the excavation at a specified angle of repose determined by the soil type. Benching will normally be found in large excavations. Sloping is a similar system of stabilizing soil but is performed without the steps. Again, the angle of repose is determined by the soil type. This method is generally used for medium-sized excavations, such as tank removal. Shoring is available in many different varieties, but the principle theory is the same. The sides of the excavation are supported by some type of wall that is braced to prevent cave-ins. This method is used most often in deep, narrow trenches for installing water pipe or drainage systems and exploratory trenching. Engineering controls for excavations should be approved by a competent person before entering the excavation.

7.1.5 Engineering Controls for Drilling

Working with and around drilling rigs presents workers with a number of hazards from moving parts and hazardous energy associated with the equipment. Engineering controls include guards to prevent crushing injuries and a maintenance program to ensure replacement of worn or broken parts. Inspections should be performed at the beginning of the job and periodically during the project.

7.2 Administrative Controls

Administrative controls are necessary when hazards are present and engineering controls are not feasible. Administrative controls are a method for controlling the degree of exposure (e.g., how long or how close to the hazard the worker remains). Worker rotation shall not be used to achieve compliance with PELs or dose limits.

7.2.1 Administrative Controls for Airborne Chemical and Radiological Hazards

Personnel should only enter the exclusion zone when required. Chemical and radiological hazards are to be monitored during performance of duties in the exclusion zone. If the concentration of radionuclides or toxic materials exceeds acceptable limits, personnel should be removed from the area until natural or mechanical ventilation reduces concentrations to an acceptable level.

7.2.2 Administrative Controls for Noise

Another approach to noise exposure control, besides engineering measures, is the use of administrative controls. This is often thought of as the rotation of workers between noisy jobs and less noisy jobs. This is not a good health practice because, while it may reduce the amount of hearing loss individuals incur, it spreads the risk among other workers. The final result tends to be that many workers develop small hearing losses rather than a few workers developing greater loss. One control that can partially mitigate the problem is to provide workers with rest and lunch areas that are quiet enough to allow some recovery from temporary threshold shifts. The levels in these areas should not exceed 70 decibels (dB). Workers should also be located as far from loud noise sources as practicable. This allows for noise attenuation before it reaches the individual. Finally, duration of exposure should be limited to the minimum time. Under no circumstances should workers be exposed to noise levels in excess of the time limits specified in 29 CFR 1910.95, Occupational Noise Exposure, Table G-16.

7.2.3 Administrative Controls for Trenching

Trenches less than 5 ft deep do not require protective systems (sloping, benching, or shoring). All trenches should be excavated to a depth of less than 5 ft if possible. However, monitoring inside the trench and means of egress (every 25 ft) must be implemented when the trench reaches a depth of 4 ft. Soil piles, tools, and other debris must be stored at least 2 ft from the edge of the excavation. Inspections should be made by a competent person before any field team member is allowed to enter the excavation. When the area is not occupied, all excavations must be marked to restrict access.

7.2.4 Administrative Controls for Working Near the Mesa Edge

Slip, trip, and fall hazards exist around the mesa edge. These hazards may be avoided by good housekeeping in the work area near the edge of the mesa. Additionally, personnel shall remain 5 ft from the edge. If necessary, ropes or guards will be used to delineate this restricted area. Exceptions to this requirement are for canyon-side sampling and outfall sampling. In those instances, the worker taking the sample must be tied to a lifeline before descending over the edge. When working with a lifeline, an attendant must always be present (Parmeggiani 1983, 0943).

8.0 SITE MONITORING

This section describes the requirements for chemical, physical, and radiological agent monitoring. This does not include biological monitoring, which is covered in Sections 9.0 and 10.0. This information will be used to delineate work zone boundaries, identify appropriate engineering controls, select the appropriate level of PPE, ensure the effectiveness of decontamination procedures, and protect public health and safety.

A monitoring program or plan that meets the requirements of 29 CFR 1910.120 will be implemented for each OU (OSHA 1991, 0610). Laboratory-approved sampling, analytical, and recordkeeping methods must be used.

A detailed monitoring strategy will be incorporated into each SSHSP. The strategy will describe the frequency, duration, and type of samples to be collected.

If exposures exceed acceptable limits, the ER Program Manager and HSPL will be notified. An investigation of the source, exposures to personnel working in the OU and in adjoining areas, any bioassay or other medical evaluations needed, and an assessment of environmental impacts shall be initiated as soon as possible under the guidance of the HS Division.

Contractors will be responsible for providing their own monitoring equipment and for determining their employees' occupational exposures to hazardous chemical and physical agents during activities performed at the OU. The Laboratory will perform oversight duties during these activities.

8.1 Chemical Air Contaminants

DOE has adopted OSHA permissible exposure limits (PELs) and ACGIH threshold limit values (TLVs) as standards for defining acceptable levels of exposure. The more stringent of the two limits applies.

8.1.1 Measurement

Measurements of chemical contaminants can be performed using direct or indirect sampling methods. Direct methods provide near real-time results and are often used as screening tools to determine levels of PPE, the need for additional sampling, etc. Examples of direct-reading instruments include the HNU photoionization detector, the organic vapor analyzer with flame ionization detector, and a gas detector pump with colorimetric tubes. Generally, these instruments are portable, easy to operate, and durable. They are less specific and sensitive than many indirect methods.

Indirect sampling means that a sample is collected in the field and transported to a laboratory for analysis. This usually involves setting up a sampling train consisting of a portable sampling pump, tubing, and sampling media (cassette, sorbent tube, impinger, etc.). The advantage of the indirect method is greater specificity and sensitivity than many direct-reading instruments. The disadvantage is the longer turnaround time for results and the inconvenience.

Air sampling for chemical contaminants at this OU will use both direct and indirect methods. It will be up to the SSO to determine the most appropriate sampling method for each situation. If there are any questions about sampling methodology, the SSO should consult with the HSPL or a certified industrial hygienist.

8.1.2 Personal Monitoring

The site history should be used to determine the need for monitoring for specific chemical agents. Instruments that monitor for a wide range of chemicals, such as the organic vapor analyzer, combustible gas indicator, and HNU, may be used for screening purposes.

Initial air monitoring shall be performed to characterize the exposure levels at the site and to determine the appropriate level of personal protection needed. In addition, periodic monitoring is required when:

- work is initiated in a different part of the site,
- unanticipated contaminants are identified,
- a different type of operation is initiated (i.e., soil boring versus drum opening), or
- spills or leakage of containers is discovered.

Instrument readings should be taken in or near the worker's breathing zone. Individuals working closest to the source have the greatest potential for exposure to concentrations above acceptable limits. Monitoring strategies will emphasize worst-case conditions if monitoring each individual is inappropriate.

8.1.3 Perimeter Monitoring

Perimeter monitoring shall be performed to characterize airborne concentrations in adjoining areas. If results indicate that contaminants are moving off-site, control measures must be re-evaluated. The perimeter is defined as the boundary of the OU.

8.2 Physical Hazards

Physical hazards of concern that can be readily measured include noise, vibration, and temperature. These variables must be monitored to prevent injuries and illnesses related to overexposure.

8.2.1 Measurement

Most of the instruments used to measure these agents are direct reading. Many have the ability to take short-term measurements and/or integrated, longer term measurements. Typically, short-term measurements are made during an initial survey. The results can then be used to determine whether longer term (i.e., full shift) monitoring is warranted.

8.2.2 Personal Monitoring

Noise dosimeters are used to estimate the actual exposure or dose that a worker receives during the shift. Results of personal noise monitoring should be compared to the ACGIH TLVs in accordance with Laboratory policy. These results dictate whether workers must be included in a hearing conservation program.

Instrumentation is now available for personal monitoring for heat stress. This type of measurement is not mandated but can provide useful exposure information. Use of personal heat stress monitors must be approved by the HSPL prior to field use.

Personal monitoring for vibration and cold stress is generally not performed or warranted for this type of operation.

8.2.3 Area Monitoring

A sound level survey meter should be used to initially characterize sound pressure levels. These data can help guide the personal monitoring efforts. If the sound level survey and personal dosimetry indicate that sound levels exceed acceptable levels, then an octave band analyzer may be used to characterize the noise. This provides important data for designing engineering controls.

Area monitoring for temperature extremes is usually sufficient for determining whether workers are potentially exposed to harmful conditions.

Thermometers, psychrometers, and anemometers are direct-reading instruments that provide the data necessary to make heat and cold stress calculations.

Accelerometers can be used to monitor vibration levels. Vibration is usually an isolated problem and does not warrant an ongoing monitoring program. Rather, the SSO should be alert for equipment and tasks that might expose workers to significant whole-body or hand and arm vibration. Typically, these include operation of dozers, scrapers, and other heavy equipment and power hand tools, such as impact wrenches and concrete breakers.

8.3 Radiological Hazards

When radiological hazards are known or suspected, workplace monitoring shall be performed as necessary to ensure that exposures are within the requirements of DOE Order 4380.11 and are as low as reasonably achievable (ALARA) (DOE 1990, 0732). Workplace monitoring consists of monitoring for airborne radioactivity, external radiation fields, and surface contamination. The Laboratory's workplace monitoring program is described in AR 3-7, Radiation Exposure Control. The success of the monitoring program in controlling exposures is measured by the personnel dosimetry and bioassay programs. Chapter 3, Part 7, of the DOE Radiological Control Manual provides additional guidelines for radiological control during construction and restoration projects. All monitoring instruments shall meet the Laboratory's requirements for sensitivity, calibration, and quality assurance. In addition, all monitoring shall be carried out in accordance with approved procedures.

8.3.1 Airborne Radioactivity Monitoring

Air monitoring shall be performed in occupied areas with the potential for airborne radioactivity. Air monitoring may include the use of portable high and low volume samplers, continuous air monitors, and personnel breathing zone samplers. In areas where concentrations are likely to exceed 10% of any derived air concentration listed in DOE Order 5480.11, real-time continuous air monitoring shall be provided. Action levels based on air monitoring results shall be established to increase dust suppression activities, upgrade PPE, and stop work (DOE 1990, 0732).

8.3.2 Area Monitoring for External Radiation Fields

Area monitoring for external radiation fields shall be performed with portable survey instruments capable of measuring a wide range of beta/gamma dose rates. In areas where dose rates above a preset action level are expected, the monitoring should be continuous. Additional action levels shall be established based on external radiation monitoring results.

8.3.3 Monitoring for Surface Contamination

Area monitoring for surface contamination during operations shall be conducted whenever a new surface is uncovered in a suspected radioactively contaminated area (i.e., the levels may exceed the surface contamination limits in DOE Order 4380.11) (DOE 1990, 0732). Personnel and equipment shall be monitored whenever there is reason to suspect contamination and upon exit from a suspected radioactively contaminated area. Action levels for decontamination shall be established.

8.3.4 Personnel Monitoring for External Exposure

Personnel dosimetry shall be provided to OU workers who have the potential in a year to exceed any one of the following from external sources in accordance with DOE Order 5480.11:

- 100 mrem (0.001 sievert) annual effective dose equivalent to the whole body,
- 5 rem (0.05 sievert) annual dose equivalent to the skin,
- 5 rem (0.05 sievert) annual dose equivalent to any extremity, or
- 1.5 rem (0.015 sievert) annual dose equivalent to the lens of the eye.

Normally, workers meeting the above criteria will be monitored with thermoluminescent dosimeters (TLDs). TLDs shall either be provided by the Laboratory or shall meet DOE requirements if provided by the subcontractor. Section 10.0 (Bioassay Program) discusses personnel monitoring for internal exposure.

8.3.5 ALARA Program

ALARA considerations in the workplace are best served by near real-time knowledge of personnel exposures and frequent workplace monitoring to establish adequate administrative control of exposure conditions. Consequently, for the OU site projects, ALARA efforts consist of two integrated approaches, which are described in the following sections.

8.3.5.1 Workplace ALARA Efforts

Judicious application of basic time, distance, physical controls, and PPE principles will be used to limit exposures to ALARA levels. To verify that established control is adequate, workplace monitoring for radioactive materials and field instrument detectable chemicals will be conducted in direct proportion to expected and/or observed levels of exposure. Activities that result in unexpectedly high potential exposures will be terminated until provisions are made that permit work to proceed in acceptable ALARA fashion.

8.3.5.2 Programmatic ALARA Efforts

External and internal exposures of record are comprised of TLD badges and bioassay data, respectively. Field dose calculation, direct-reading pocket meters, and event-based lapel air sampling data are used to maintain estimates of personnel exposures to both radioactive materials and hazardous chemicals. These estimates are correlated with job-specific activities (work location and work category) and individual-specific activities (job function).

Periodic reviews of personnel exposure estimates are conducted to identify unfavorable trends and unexpectedly high potential exposures. Activities (as functions of work location, work categories, and job functions) that indicate unfavorable trends will be investigated, and recommendations will be made for additional administrative and/or physical controls, as appropriate.

All unfavorable trends and unexpectedly high potential exposures must be reported to the HSPL, who will make recommendations for corrective action.

9.0 MEDICAL SURVEILLANCE AND MONITORING

9.1 General Requirements

A medical surveillance program shall be instituted to assess and monitor the health and fitness of workers engaged in HAZWOP. Medical surveillance is required for personnel who are or may be exposed to hazardous substances at or above established PELs for 30 days in a 12-month period, as detailed in 29 CFR 1910.120 (OSHA 1991, 0610). Medical surveillance is also required for personnel with duties that require the use of respirators or with symptoms indicating possible overexposure to hazardous substances.

Contractors are responsible for medical surveillance of their employees. The HS Division will audit contractor programs.

9.2 Medical Surveillance Program

All field team members who participate in ER Program investigations shall participate in a medical surveillance program. The program shall conform to DOE Order 5480.10 (DOE 1985, 0062), 29 CFR 1910.120 (OSHA 1991, 0610), AR 2-1, and any criteria established by the Occupational Medicine Group (HS-2) at the Laboratory. The program shall provide for initial medical evaluations to determine fitness for duty and subsequent medical surveillance of individuals engaged in HAZWOP. At a minimum, the program shall include:

- **Surveillance.** An occupational and medical history, a baseline exam prior to employment, periodic medical exams, and termination exams shall be included. The frequency of medical exams may vary because of the exposure potential at hazardous waste sites. The frequency of exams will be determined by the physician.
- **Treatment.** Immediate consultation shall be made available to any employee who develops signs or symptoms of exposure or who has been exposed at or above PELs in an uncontrolled or emergency situation.
- **Recordkeeping.** An accurate record of the medical surveillance required by 20 CFR 1910.120 shall be

retained. This record shall be retained for the period specified and meet the criteria of 29 CFR 1910.20 (OSHA 1991, 0610).

- **Program review**. Contractors must provide adequate documentation that their medical program complies with all applicable standards, DOE orders, and Laboratory requirements. This documentation must be submitted for review and approval before work begins.
- **Program participation**. Line management is responsible for identifying employees for inclusion in the surveillance program.

9.2.1 Medical Surveillance Exams

AR 2-1 from the Laboratory's ES&H Manual specifies that medical surveillance examinations are required for employees who work with asbestos, beryllium, carcinogens, hazardous waste, high noise, lasers, and certain other materials. As specified above, Laboratory employees who work with hazardous waste must undergo periodic special examinations by HS-2.

The content and frequency of medical exams is dependent on site conditions, current and expected exposures, job tasks, and the medical history of the workers.

9.2.2 Certification Exams

In addition to the above medical surveillance requirements, medical certification is required for employees whose work assignments include respirator use, Level A chemical PC, and/or operation of cranes and heavy equipment. To become certified and maintain certification, medical evaluations as specified by HS-2 are required.

9.3 Fitness for Duty

A fitness for duty determination will be made for each site worker. The examining physician shall provide a report to the OUPL indicating:

- approval to work on hazardous waste sites,

- approval to wear respiratory protective equipment, and
- a statement of work restrictions.

9.4 Emergency Treatment

In the event of an on-the-job injury, HS-2 will implement required reporting and recordkeeping procedures. The SSHSP describes the actions to be taken by the employee at the time of the injury/illness.

10.0 BIOASSAY PROGRAM

The OU site field characterization efforts will include intrusive investigations of areas of unknown but highly probable contamination potential. Given the uncertainties associated with this type of fieldwork, the project internal exposure monitoring program is based on the assumption that personnel will be exposed to significant quantities of radioactive and/or hazardous chemical contaminants. Accordingly, the project internal dosimetry program will be conducted in accordance with the provisions of the Health Physics Group (HS-12). These provisions are outlined in the following sections. (Monitoring and control of internal contamination by hazardous chemical contaminants is included in the medical surveillance program.)

10.1 Baseline Bioassays

Individuals who are assigned to field activities or who have reason to visit or inspect field activities are assigned one of the following job categories:

I. Work involving full-time on-site activities.

II. Work involving support activities (e.g., supervision or inspection).

III. Work involving routine or frequent visits (e.g., observing, auditing).

IV. Work involving nonroutine or infrequent visits (e.g., management observations.

All such individuals (except individuals in Category IV) must submit urine samples and submit to whole-body counting prior to participation in field activities. The baseline urine samples are analyzed for the solubility Class D and Class W compounds that could reasonably be expected to be encountered at the Laboratory. Whole-body counting analyzes for the gamma-emitting radionuclides that could reasonably be expected to be encountered at the Laboratory.

Results of the baseline bioassay analyses are evaluated by a health physics specialist for evidence of previous exposure. Individuals exhibiting evidence of previous internal contamination will not be permitted to enter OU sites until an evaluation of the previous exposure indicates that additional, planned radiation exposure will not result in doses in excess of applicable regulatory limits. This evaluation may include additional, rigorous sampling and/or counting to establish the physical and temporal parameters necessary to adequately assess the committed effective dose equivalent.

10.2 Routine Bioassays

The routine bioassay program is used as a measure of the effectiveness of the respiratory protection program. As such, the bioassay frequency will be a function of potential exposure to airborne radioactive materials and will be determined by a health physics specialist.

Evidence of inadequate respiratory protection will be cause for an investigation of the responsible field operation(s). The HSPL is responsible for investigating and identifying probable causes of the respiratory protection program failure and for recommending corrective actions.

11.0 DECONTAMINATION

11.1 Introduction

Decontamination is the process of removing or neutralizing contaminants that have accumulated on personnel and equipment and is critical to health and safety at hazardous waste sites. Decontamination protects workers from hazardous substances that may contaminate PC, respiratory protection equipment, tools, vehicles, and other equipment used on site. It minimizes the transfer of harmful materials into clean areas, helps prevent mixing of incompatible chemicals, and prevents uncontrolled transportation of contaminants from the site into the community.

All personnel and equipment exiting an exclusion zone will be monitored to detect possible contamination. Monitoring will verify that all personnel and equipment are free of significant contamination prior to exiting the exclusion zone and shall be performed in accordance with HS Division requirements.

If monitoring indicates that an employee is contaminated with chemicals, biological agents, or radioactive materials, the employee's immediate supervisor shall notify the SSO, who records the details of the incident, determines whether any personal injury is involved, initiates decontamination, and, when necessary, notifies the OUPL and HSPL. All contamination incidents shall be immediately reported following Laboratory Occurrence Reporting Program requirements to ensure that prompt notifications and appropriate emergency response actions are taken.

11.1.1 Decontamination Plan

A site decontamination plan is mandatory. The site decontamination plan shall be part of the SSHSP and must include:

- the number and layout of decontamination stations,
- the decontamination equipment needed,
- appropriate decontamination methods,
- procedures to prevent contamination of clean areas,
- methods and procedures to minimize worker contact with contaminants during removal of personal PC, and,
- methods for disposing of clothing and equipment that are not completely decontaminated.

The plan should be revised whenever the type of personal PC or equipment changes, the site conditions change, or the site hazards are re-assessed based on new information.

11.1.2 Facilities

Clean areas shall be separate from contaminated areas and materials. The SSO will verify that decontamination facilities are maintained in acceptable condition and that supplies of decontaminating agents and other materials are available. Personnel decontamination facilities shall be equipped with showers, clean work clothing, decontamination agents, and, when necessary, a decontamination area where HS Division personnel can assist in decontaminating individuals. All wash solutions shall be retained for appropriate disposal.

11.1.3 General Decontamination Methods

Many factors such as cost, availability, and ease of implementation influence the selection of a decontamination method. From a health and safety standpoint, two key questions must be addressed:

- Is the decontamination method effective for the specific substances present?
- Does the method itself pose any health or safety hazards?

The details of decontamination techniques shall be included in the site decontamination plan (see Subsection 11.1.1). The following are some decontamination methods.

Removal

- Contaminant removal
    - water rinse using pressurized spray or gravity flow shower
    - chemical leaching and extraction
    - evaporation/vaporization
    - pressurized air jets
    - scrubbing/scraping (using brushes, scrapers, or sponges and water-compatible solvent cleaning solutions)
    - stream jets
- Removal of contaminated surfaces
    - disposal of deeply permeated materials (e.g., clothing, floor mats, and seats)
    - disposal of protective coverings/coatings

Inactivation

- Chemical detoxification
  - halogen stripping
  - neutralization
  - oxidation/reduction
  - thermal degradation
- Disinfection/sterilization
  - chemical disinfection
  - dry heat sterilization
  - gas/vapor sterilization
  - irradiation
  - steam sterilization

11.1.3.1 Physical Removal

In many cases, gross contamination can be removed by dislodging/displacement, rinsing, wiping off, and evaporation. Physical methods involving high pressure and/or heat should be used only as necessary and with caution because they can spread contamination and cause burns. Contaminants that can be removed by physical means can be categorized as follows.

- **Loose contaminants**. Dusts and vapors that cling to equipment and workers or become trapped in small openings, such as the weave of fabrics, can be removed with water or a liquid rinse. Removal of electrostatically attached materials can be enhanced by coating the clothing or equipment with antistatic solutions. These are available commercially as wash additives or antistatic sprays.
- **Adhering contaminants**. Some contaminants adhere by forces other than electrostatic attraction. Adhesive qualities vary greatly with the specific contaminants and

temperature. For example, contaminants such as glues, cements, resins, and muds have much greater adhesive properties than elemental mercury, and consequently, are difficult to remove by physical means. Physical removal methods for gross contaminants include scraping, brushing, and wiping. Removal of adhesive contaminants can be enhanced through certain methods such as solidifying, freezing (e.g., using dry ice or ice water), adsorption or absorption (e.g., with powdered lime or ground clay), or melting.

- **Volatile liquids**. Volatile liquid contaminants can be removed from PC or equipment by evaporation followed by a water rinse. Evaporation of volatile liquids can be enhanced by using steam jets. With any evaporation or vaporization process, care must be taken to prevent worker inhalation of the vaporized chemicals.

11.1.3.2 Chemical Removal

Physical removal of gross contamination should be followed by a wash/ rinse process using cleaning solutions. These cleaning solutions normally use one or more of the following methods.

- **Dissolving contaminants**. Chemical removal of surface contaminants can be accomplished by dissolving them in a solvent. The solvent must be chemically compatible with the equipment being cleaned. This is particularly important when decontaminating personal PC. In addition, care must be taken in selecting, using, and disposing of any organic solvents that may be flammable or potentially toxic. Organic solvents include alcohols, ethers, ketones, aromatics, straight-chain alkanes, and common petroleum products.

  Halogenated solvents are generally incompatible with PPE and are toxic. They should only be used for decontamination in extreme cases, when other cleaning agents will not remove the contaminant. Use of halogenated solvents must be approved by the HSPL.

Table III-9 provides a general guide to the solubility of several contaminants in four types of solvents: water, dilute acids, dilute bases, and organic solvents. Because of the potential hazards, decontamination using chemicals should only be performed if recommended by an industrial hygienist or other qualified health professional.

TABLE III-9

GENERAL GUIDE TO CONTAMINANT SOLUBILITY

SOLVENT	SOLUBLE CONTAMINANTS
Water	Low-chain hydrocarbons, inorganic compounds, salts, some organic acids and other polar compounds
Dilute acids	Basic (caustic) compounds, amines, hydrazines
Dilute bases detergent soap	Acidic compounds, phenols, thiols, some nitro and sulfonic compounds
Organic solvents[a] alcohols ethers ketones aromatics straight-chain alkanes (e.g., hexane) common petroleum products (e.g., fuel oil, kerosene)	Nonpolar compounds (e.g., some organic compounds)

[a] WARNING: Some organic solvents can permeate and/or degrade the protective clothing.

- **Surfactants**. Surfactants augment physical cleaning methods by reducing adhesion forces between contaminants and the surface being cleaned and by preventing redeposit of the contaminants. Household detergents are among the most common surfactants. Some detergents can be used with organic solvents to improve the dissolving and dispersal of contaminants into the solvent.

- **Solidification**. Solidifying liquid or gel contaminants can enhance their physical removal. The mechanisms of solidification are: 1) moisture removal through the use of adsorbents such as ground clay or powdered lime; 2) chemical reactions via polymerization catalysts and chemical reagents; and, 3) freezing, using ice water.

- **Rinsing**. Rinsing removes contaminants through dilution, physical attraction, and solubilization. Multiple rinses with clean solutions remove more contaminants than a single rinse with the same volume of solution. Continuous rinsing with large volumes will remove even more contaminants than multiple rinsings with a lesser total volume.

- **Disinfection/Sterilization**. Chemical disinfectants are a practical means of inactivating infectious agents. Unfortunately, standard sterilization techniques are generally impractical for large equipment and for personal PC and equipment. For this reason, disposable PPE is recommended for use with infectious agents.

11.1.4 Emergency Decontamination

In the event of personnel contamination with highly caustic, strongly acidic, and/or high levels of radioactive materials (100 mrad/hour), emergency shower facilities shall be used as a first level decontamination. These facilities shall be adequate to treat a minimum of two contaminated individuals at one time. Appropriate medical and radiation safety personnel will be relied upon to assist as needed. Use of these facilities shall be in accordance with HS Division requirements.

11.2 Personnel

The SSO is responsible for enforcing the decontamination plan. All personnel leaving the exclusion zone must be decontaminated to remove any chemical or infectious agents that may have adhered to them.

11.2.1 Radiological Decontamination

Personnel exiting contamination areas, high contamination areas, airborne radioactivity areas, or radiological buffer areas established for contamination control shall be frisked for contamination. This does not apply to personnel exiting areas containing only radionuclides, such as tritium, that cannot be detected using hand-held or automatic frisking equipment.

Monitoring for contamination should be performed using frisking equipment that, under laboratory conditions, can detect total contamination of at least the values specified in Table III-10. Use of automatic monitoring units that meet the above requirements is encouraged.

Personnel with detectable contamination on their skin or personal clothing, other than inert gases or natural background radioactivity, should be promptly decontaminated.

11.2.2 Chemical Decontamination

The decontamination of chemically contaminated personnel will be detailed in the site decontamination plan. Subsection 11.1.3.2 provides guidance on chemical decontamination.

11.3 Equipment Decontamination

11.3.1 Responsibilities and Authorities

The SSO is responsible for ensuring that tools and equipment are surveyed for contamination before they are removed from the site. The SSO is also responsible for ensuring that tools and equipment are decontaminated to acceptable levels prior to release for unrestricted use.

TABLE III-10

SUMMARY OF CONTAMINATION VALUES

NUCLIDE[a]	REMOVABLE (dpm/100 cm^2)[b,c]	TOTAL (FIXED + REMOVABLE) (dpm/100 cm^2)
Natural uranium, uranium-235, uranium-238, and associated decay products	1 000 alpha	5 000 alpha
Transuranics, radium-226, radium-228, thorium-230, thorium-228, protactinium-231, actinium-227, iodine-125, and iodine-129	20	500
Natural thorium, thorium-232, strontium-90, radium-223, radium-224, uranium-232, iodine-126, iodine-131, and iodine-133	200	1 000
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except strontium-90 and others noted above (includes mixed fission products containing strontium-90)	1 000 beta-gamma	5 000 beta-gamma
Tritium organic compounds, surfaces contaminated by HT, HTO, and metal tritide aerosols	10 000	10 000

a The values in this table apply to radioactive contamination deposited on but not incorporated into the interior of the contaminated item. Where contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for the alpha- and beta-gamma-emitting nuclides apply independently.

b The amount of removable radioactive material per 100 cm^2 of surface area should be determined by swiping the area with dry filter or soft absorbent paper while applying moderate pressure and then assessing the amount of radioactive material on the swipe with an appropriate instrument of known efficiency. For objects with a surface area less than 100 cm^2, the entire surface should be swiped and the activity per unit area should be based on the actual surface area. Except for transuranics, radium-228, actinum-227, thorium-228, thorium-230, protactinium-231, and alpha emitters, it is not necessary to use swiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual contamination levels are below the values for removable contamination.

c The levels may be averaged over 1 m^2 provided the maximum activity in any area of 100 cm^2 is less than three times the guide values.

11.3.2 Facilities

Prior to release from the site, tools and equipment contaminated with removable radioactive and chemical materials in excess of applicable limits will be manually decontaminated at the field location.

Tools and equipment that cannot be field decontaminated to below applicable limits may be appropriately packaged and removed to a decontamination facility. Transportation of contaminated tools or equipment off-site must be approved by the HSPL.

11.3.3 Radiological

Decontamination of equipment must follow approved procedures. A surface shall be considered contaminated if either the removable or total radioactivity is detected above the levels in Table III-10. If an item cannot be decontaminated promptly, then it shall be posted as specified in AR 3-7. Radiological Work Permits or technical work documents shall include provisions to control contamination at the source to minimize the amount of decontamination needed. Work preplanning shall include consideration of the handling, temporary storage, and decontamination of materials, tools, and equipment.

Decontamination activities shall be controlled to prevent the spread of contamination. Water and steam are the preferred decontamination agents. Other cleaning agents should be selected based on their effectiveness, hazardous properties, amount of waste generated, and ease of disposal. Decontamination methods should be used to reduce the number of contaminated areas. Efforts should be made to reduce the level of contamination and the number and size of contaminated areas that cannot be eliminated. Line management is responsible for directing decontamination efforts.

11.3.4 Chemical

Chemical decontamination is performed in accordance with product labels. Random sampling and analysis of final rinse solutions may be performed to check the effectiveness of the decontamination procedures.

11.4 Waste Management

Fluids and materials resulting from decontamination processes will be contained, sampled, and analyzed for contaminants. Those materials determined to be contaminated in excess of appropriate limits are packaged in approved containers and disposed of in accordance with EM Division procedures.

12.0 EMERGENCIES

12.1 Introduction

Emergency response, as defined by 29 CFR 1910.120, will be handled by Laboratory personnel (OSHA 1991, 0610). ER contractors are responsible for developing and implementing their own emergency action plans as defined in 29 CFR 1910.38. All emergency action plans must be consistent with the Laboratory's emergency response plans. The SSO, with assistance from the field team leader, will have the responsibility and authority for coordinating all emergency response activities until the proper authorities arrive and assume control.

12.2 Emergency Response Plan

The Laboratory Emergency Management Office oversees and implements the full range of activities necessary for mitigating, preparing for, responding to, and recovering from emergency incidents at the Laboratory. Additional references for this section include Laboratory AR 1-1, Accident/Incident Reporting; AR 1-2, Emergency Preparedness; AR 1-8, Working Alone; and Technical Bulletin 101, Emergency Preparedness.

The Laboratory Emergency Response Plan establishes an organization capable of responding to the range of emergencies at the Laboratory. Provisions are made for rapid mobilization of the response organizations and for expanding the response commensurate with the extent of the emergency.

An emergency manager with the authority and responsibility to initiate emergency action under the provisions of the Laboratory Emergency Response Plan is available at all times.

When an emergency occurs at the Laboratory, the Laboratory emergency response organization is responsible for all elements of response throughout the duration of the emergency. The incident commander is responsible for initial notification and communications and for providing protective action recommendations to buildings/areas within the emergency response zone and off-site.

The Laboratory Emergency Response Plan is designed to be compatible with emergency plans developed by local, state, tribal, and federal agencies through establishment of communications channels with these agencies and by setting criteria for the notification of each agency. This subsection considers contingency plans for specific types of emergencies. The site safety officer, with assistance from the field teams manager and, if needed, the field team leader, shall have responsibility and authority for coordinating all emergency-response activities until the proper authorities arrive and assume control. A copy of pre-existing OU 1082 emergency response plans shall be available at the work site at all times, and all personnel working at the site shall be familiar with the plans.

For general emergencies that require evacuation (i.e., fire, medical, security, releases, etc.) an emergency response plan specific to OU 1082 is required. This section will establish evacuation routes for personnel to follow in the event of an emergency. In a worst case, an evacuation of all personnel from the OU 1082 work area would be required; in most instances a safe distance may be established to protect personnel.

12.2.1 Fire/Explosion

In the event of a fire, the work area will be evacuated and the Los Alamos Fire Department will be notified. In the event of an explosion, all personnel will be evacuated, and no one will enter the work area until it has been cleared by Laboratory explosives safety personnel.

If a major fire or explosion were to occur, site personnel with fire extinguishers would be of no use. The signal for a fire is a siren ("woop, woop"). The signal for an evacuation is a cam alarm with a wavering tone. The crew is to gather at a specified safe location. One person should find the nearest phone at a safety distance and call the fire department at 9-911. The phone and the evacuation route used by field personnel should be in the direction away from the fire and toward the nearest exit. The site safety officer will determine the next course of action.

A major release or fire involving hazardous or radioactive materials may warrant a different approach. When the emergency signal is heard, personnel will meet at a predetermined area, based on the wind conditions. A portable wind sock or streamer will be positioned at each work location and personnel notified of the location. All personnel will move in an upwind direction as much as possible without entering a plume. If the source of the fire or release is directly upwind, personnel will move to the exit or gate side and away from the plume (if visible). Once a safe distance is reached, all personnel are to be accounted for. The field team manager and the site safety officer will be responsible for this task. At that time, the site safety officer will determine the next course of action.

For a less severe accident, such as a minor release or small fire, a full evacuation may not be necessary. All personnel will meet at a designated area and all personnel will be accounted for. The field team manager and the site safety officer will be responsible for this task, and will be given instructions by the site safety officer. Emergency procedures will be reviewed at least once per week as a reminder to field personnel.

If a combustible gas meter indicates gas concentrations at levels of 20% of the lower explosive limit, personnel will be evacuated. The site safety officer will continue monitoring to determine when equipment should be removed or when personnel may re-enter the area and resume work.

12.2.2 Personnel Injuries

In case of serious injuries, the victim should be transported to a medical facility as soon as possible. The Los Alamos Fire Department provides emergency transport services. Minor injuries may be treated by trained personnel in the work area. All injuries should be reported to HS-2, the 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 Subsection 4.6.2). Treatment of life-threatening or serious injuries will always be undertaken first. If exposure to hydrofluoric acid, occurs special treatment is required. The hospital must be notified immediately and a special paste will be obtained and applied to the affected area. This paste is currently located at HS-2.

12.3 Emergency Action Plan

An emergency action plan provides emergency information for contingencies that may arise during the course of field operations. It provides site personnel with instructions for the appropriate sequence of responses in the event of either site emergencies or off-site emergencies. The emergency action plan will be attached to the SSHSP. The following elements, at a minimum, shall be included in the written plan:

- pre-emergency planning,
- emergency escape procedures and routes/site map,
- procedures to be followed by personnel who remain to operate critical equipment before they evacuate,
- procedures to account for all employees after evacuation,
- rescue and medical duties for those who are to perform them,
- names of those who can be contacted for additional information on the OUHSP,
- emergency communications,
- types of evacuation to be used,
- dissemination of emergency action plan to employees initially and whenever the plan changes,
- agreement with local medical facilities to treat injuries/ illnesses,
- emergency equipment and supplies,
- personal injuries or illnesses,
- motor vehicle accidents and property damage, and,
- site security and control.

12.4 Provisions for Public Health and Safety

Emergency planning is presented in the Laboratory's ES&H Manual (LANL 1990, 0335). The Laboratory identifies four situations in which hazardous materials may be released into the environment. These categories are founded in part on Emergency Response Planning Guideline (ERPG) concentrations developed by the American Industrial Hygiene Association and on the basis of the maximum concentration of toxic material that can be tolerated for up to one hour.

The types of emergencies are defined as follows.

- **Unusual event**. An event that has occurred or is in progress that normally would not be considered an emergency but that could reduce the safety of the facility. No potential exists for significant releases of radioactive or toxic materials off-site.

- **Site alert**. An event that has occurred or is in progress that would substantially reduce the safety level of the facility. Off-site releases of toxic materials are not expected to exceed the concentrations defined in ERPG-1.

- **Site emergency**. An event that has occurred or is in progress that involves actual or likely major failures of facility functions necessary for the protection of human health and the environment. Releases of toxic materials to areas off-site may exceed the concentrations described in ERPG-2.

- **General emergency**. An event that has occurred or is in progress that substantially interferes with the functioning of facility safety systems. Releases of radioactive materials to areas off-site may exceed protective response recommendations, and toxic materials may exceed ERPG-3.

12.5 Notification Requirements

Field team members will notify the SSO of emergency situations; the SSO will notify the appropriate emergency assistance personnel (e.g., fire, police, and ambulance), the OUPL, the HSPL, the Laboratory HS Division according to DOE Order 5500.2B (DOE 1991, 0736), and DOE Albuquerque Operations Office (AL) Order 5000.3 (DOE/AL 1986, 0734). The Laboratory HS Division is responsible for implementing notification and reporting requirements according to DOE Order 5484.1, Change 7 (DOE 1990, 0733).

The names of persons and services to contact in case of emergencies are given in Table III-11. This emergency contact form will be copied and posted in prominent locations at the work site. Two-way radio communication will be maintained at remote sites when possible.

TABLE III-11

EMERGENCY CONTACTS

Site Safety Officer Name:	Pager: Call:	104-6579 665-5144
Environmental Restoration Health and Safety Project Leader Name:	Pager: Call:	104-6579 665-5144
24-Hour LANL Health/Safety Coordinator Call:	Pager: Call:	104-1123 667-4512 (work) 672-3659 (home)

The emergency contact number at the Laboratory is 9-911. Dialing 911 does work on Laboratory phones but it takes longer to get a response.

12.6 Documentation

An unusual occurrence is any deviation from the planned or expected behavior or course of events in connection with any DOE or DOE-controlled operation if the deviation has environmental, safety, or health protection significance. Examples of unusual occurrences include any substantial degradation of a barrier designed to contain radioactive or toxic materials or any substantial release of radioactive or toxic materials.

The Laboratory principal investigator will submit a completed DOE Form F 5484.X for any of the following accidents and incidents, according to Laboratory AR 1-1:

- **Occupational injury**. An injury such as a cut, fracture, sprain, or amputation that results from a work accident or from an exposure involving a single incident in the work environment. Note: Conditions resulting from animal bites, such as insect or snake bites, or from one-time exposure to chemicals are considered injuries.

- **Occupational illness**. Any abnormal condition or disorder, other than one resulting from an occupational injury, caused by exposure to environmental factors associated with employment. It includes acute and chronic illnesses or diseases that may be caused by inhalation, absorption, ingestion, or direct contact with a toxic material.

- **Property damage losses of $1,000 or more**. Regardless of fault, accidents that cause damage to DOE property or accidents wherein DOE may be liable for damage to a second party, are reportable where damage is $1,000 or more, including damage to facilities, inventories, equipment, and properly parked motor vehicles but excluding damage resulting from a DOE-reported vehicle accident.

- **Government motor vehicle accidents with damages of $150 or more or involving an injury,** unless the government vehicle is not at fault; the occupants of the government vechicle are uninjured, and damage of less than $150 is sustained by the government vechicle. Accidents are also reportable to DOE if:

  - damage to a government vehicle not properly parked is greater than or equal to $250;

  - damage to DOE property is greater than or equal to $500 and the driver of a government vehicle is at fault;

- damage to any private property or vehicle is greater than or equal to $250 and the driver of a government vehicle is at fault; or,
- any individual is injured and the driver of a government vehicle is at fault.

The HSPL will work with the OUPL and the field team leader to ensure that health and safety records are maintained with the appropriate Laboratory group, as required by DOE orders. The reports are as follows.

- DOE-AL Order 5000.3, Unusual Occurrence Reporting (DOE/AL 1986, 0734)
- DOE Form 5484.3, Supplementary Record of Occupational Injuries and Illnesses, DOE Order 5484.1, Change 7 (DOE 1990, 0733)
- DOE Form 5484.4, Tabulation of Property Damage Experience, Attachment 2, DOE Order 5484.1, Change 7 (DOE 1990, 0733)
- DOE Form 5484.5, Report of Property Damage or Loss, Attachment 4, DOE Order 5484.1, Change 7 (DOE 1990, 0733)
- DOE Form 5484.6, Annual Summary of Exposures Resulting in Internal Body Depositions of Radioactive Materials, DOE Order 5484.1, Change 7 (DOE 1990, 0733)
- DOE Form 5484.8, Termination Occupational Exposure Report, Attachment 10, DOE Order 5484.1, Change 7 (DOE 1990, 0733)
- DOE Form OSHA-200, Log of Occupational Injuries and Illnesses, Attachment 7, DOE Order 5484.1, Change 7 (DOE 1990, 0733)
- DOE Form EV-102A, Summary of DOE and DOE Contractor Occupational Injuries and Illnesses,

Attachment 8, DOE Order 5484.1, Change 7 (DOE 1990, 0733)

- DOE Form F5821.1, Radioactive Effluent/Onsite Discharges/Unplanned Releases, Attachment 12, DOE Order 5484.1, Change 7 (DOE 1990, 0733)

Copies of these reports will be stored with the appropriate Laboratory group. Specific reporting responsibilities are given in Chapter 1, General ARs, of the Laboratory ES&H Manual (LANL 1990, 0335).

13.0 PERSONNEL TRAINING

13.1 General Employee Training and Site Orientation

All Laboratory employees and supplemental workers must successfully complete Laboratory general employee training (GET). GET training is performed by the HS Division. The OUPL is responsible for scheduling GET training for supplemental workers.

Several types of training are required, including:

- OSHA-mandated,
- facility-specific,
- site-specific or pre-entry, and
- tailgate.

Site workers will receive each type of training during the course of field activities.

13.2 OSHA Requirements

OSHA's HAZWOPER standard (29 CFR 1910.120) regulates the health and safety of employees involved in HAZWOP (OSHA 1991, 0610). This standard requires training commensurate with the level and function of the employee. Persons shall not participate in field activities until they have been trained to a level required by their job function and responsibility. The SSO is responsible for ensuring that all persons entering the exclusion zone are properly trained.

13.2.1 Pre-Assignment Training

At the time of job assignment, all general site workers shall receive a minimum of 40 hours of initial instruction off-site and a minimum of 3 days of actual field experience under the direct supervision of a trained, experienced supervisor. Occasional site workers shall receive a minimum of 24 hours of initial instruction. Workers who may be exposed to unique or special hazards shall be provided additional training. The level of training provided shall be consistent with the employee's job function and responsibilities.

13.2.2 On-Site Management and Supervisors

On-site management and supervisors directly responsible for, or who supervise, employees engaged in HAZWOP shall receive at least 8 hours of additional specialized training on managing such operations at the time of job assignment.

13.2.3 Annual Refresher

All persons required to have OSHA training shall receive 8 hours of refresher training annually.

13.2.4 Site-Specific Training

Prior to granting site access, personnel must be given site-specific training. Attendance and understanding of the site-specific training must be documented. A weekly health and safety briefing and periodic training (as warranted) will be given. Daily tailgate safety meetings will be used to update workers on changing site conditions and to reinforce safe work practices. Training should include the topics indicated in Table III-12 in accordance with 29 CFR 1910.120(i)(2)(ii) (OSHA 1991, 0610).

13.3 Radiation Safety Training

Basic radiation worker training is required for all radiation workers :1) whose job assignments involve operation of radiation-producing devices, 2) who work with radioactive materials, 3) who are likely to be routinely occupationally

TABLE III-12

TRAINING TOPICS

INITIAL SITE-SPECIFIC	WEEKLY	PERIODIC AS WARRANTED	TOPIC
X		X	Site health and safety plan, 29 CFR 1910.120(e)(1)
X		X	Site characterization and analysis, 29 CFR 1910.120(i)
X		X	Chemical hazards, Table 1
X		X	Physical hazards, Table 2
X		X	Medical surveillance requirements, 29 CFR 1910.120(f)
X	X		Symptoms of overexposure to hazards, 29 CFR 1910.120(e)(1)(vi)
X		X	Site control, 29 CFR 1910.120(d)
X		X	Training requirements, 29 CFR 1910.120(e)
X	X	X	Engineering and work practice controls, 29 CFR 1910.120(g)
X	X	X	Personal protective equipment, 29 CFR 1910.120(g), 29 CFR 1910.134
X	X	X	Respiratory protection, 29 CFR 1910.120(g), 29 CFR 1910.134, ANSI Z88.2-1980
X		X	Overhead and underground utilities
X	X	X	Scaffolding, 29 CFR 1910.28(a)
X	X		Heavy machinery safety
X		X	Forklifts, 29 CFR 1910.27(d)
X		X	Tools
X		X	Backhoes, front-end loaders
X		X	Other equipment used at site
X		X	Pressurized gas cylinders, 29 CFR 1910.101(b)
X	X	X	Decontamination, 29 CFR 1910.120(k)
X		X	Air monitoring, 29 CFR 1910.120(h)
X		X	Emergency response plan, 29 CFR 1910.120(l)
X	X		Handling drums and other containers, 29 CFR 1910.120(j)
X		X	Radioactive wastes
X		X	Explosive wastes
X		X	Shock sensitive wastes
X		X	Flammable wastes
X	X	X	Confined space entry
X			Illumination, 29 CFR 1910.120(m)
X	X	X	Buddy system, 29 CFR 1910.120(a)
X		X	Heat and cold stress
X		X	Animal and insect bites
X		X	Spill contaminant

exposed above 0.1 rem (0.001 sievert) per year, or, 4) who require unescorted entry into a radiological area. This training is a 4-hour extension to GET for new employees.

Radiation protection training is required for all Laboratory employees, contractors, visiting scientists, and DOE and Department of Defense personnel. This is a 1-hour presentation as part of GET.

13.4 Hazard Communication

Laboratory employees shall be trained in accordance with HS Division requirements. Contractors shall provide training to their employees in compliance with 29 CFR 1910.120.

13.5 High Explosives Training

At PRSs where high explosives are known or suspected to be present, additional safety training may be required.

13.6 Facility-Specific Training

Certain areas of the Laboratory (e.g., firing sites) require additional facility-specific training before personnel can enter.

13.7 Records

Records of training shall be maintained by the HS Division and in the project file to confirm that every individual assigned to a task has had adequate training for that task and that every employee's training is up-to-date. The SSO or his designee is responsible for ensuring that persons entering the site are properly trained.

REFERENCES

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Clayton, G. D., F. E. Clayton (Eds.), 1981. *Patty's Industrial Hygiene and Toxicology*, Third Edition, Volume 2A, John Wiley & Sons, New York. **(Clayton and Clayton 1981, 0939)**

DOE (US Department of Energy), June 22, 1983. "Occupational Safety and Health Program for DOE Contractor Employees At Government-Owned Contractor-Operated Facilities," DOE Order 5483.1A, Washington, DC. **(DOE 1983, 0058)**

DOE (US Department of Energy), June 26, 1985. "Contractor Industrial Hygiene Program," DOE Order 5480.10, Washington, DC. **(DOE 1985, 0062)**

DOE (US Department of Energy), June 29, 1990. "Radiation Protection for Occupational Workers," DOE Order 5480.11, Change 2, Washington, DC. **(DOE 1990, 0732)**

DOE (US Department of Energy), October 17, 1990. "Environmental Protection, Safety, and Health Protection Information Reporting Requirements," DOE Order 5484.1, Change 7, Washington, DC. **(DOE 1990, 0733)**

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DOE/AL (US Department of Energy, Albuquerque Operations Office), October 24, 1986. "Unusual Occurrence Reporting System," DOE/AL Order 5000.3, Albuquerque, New Mexico. **(DOE/AL 1986, 0734)**

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EPA (US Environmental Protection Agency), March 8, 1990. "National Oil and Hazardous Substances Pollution Contingency Plan," Final Rule, 40 CFR Part 300, Federal Register, Vol. 55, No. 46, p. 8666. **(EPA 1990, 0559)**

LANL (Los Alamos National Laboratory), June 1, 1990. "Environment, Safety and Health Manual," AR 10-3, Chemical, Hazardous and Mixed Waste, Los Alamos, New Mexico. **(LANL 1990, 0335)**

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

NIOSH (National Institute for Occupational Safety and Health), June 1990. "NIOSH Pocket Guide to Chemical Hazards," US Department of Health and Human Services, Washington, DC. **(NIOSH 1990, 0941)**

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

Parmeggiani, L. (Ed.), 1983. *Encyclopaedia of Occupational Health and Safety*, Third Edition, Volume I, International Labour Organization, Geneva, Switzerland. **(Parmeggiani 1983, 0945)**

Plog, B. A. (Ed.), 1988. *Fundamentals of Industrial Hygiene*, Third Edition, National Safety Council, Chicago, Illinois. **(Plog 1988, 0943)**

ATTACHMENT 1

LEVELS OF PPE

LEVEL OF PROTECTION	EQUIPMENT	PROTECTION PROVIDED	SHOULD BE USED WHEN:	LIMITING CRITERIA
A	Recommended: • Pressure-demand, full-facepiece SCBA or pressure-demand supplied-air respirator with escape SCBA • Fully encapsulating, chemical-resistant suit • Inner chemical-resistant gloves • Chemical-resistant safety boots/shoes • Two-way radio communications Optional: • Cooling unit • Coveralls • Long cotton underwear • Hard hat • Disposable gloves and boot covers	The highest available level of respiratory, skin, and eye protection	• The chemical substance has been identified and requires the highest level of protection for skin, eyes, and the respiratory system based on either: — measured (or potential for) high concentration of atmospheric vapors, gases, or particulates — site operations and work functions involving a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates of materials that are harmful to skin or capable of being absorbed through the intact skin • Substances with a high degree of hazard to the skin are known or suspected to be present, and skin contact is possible • Operations must be conducted in confined, poorly-ventilated areas until the absence of conditions requiring Level A protection is determined	• Fully encapsulating suit; material must be compatible with the substances involved

ATTACHMENT 1 (continued)

LEVELS OF PPE

LEVEL OF PROTECTION	EQUIPMENT	PROTECTION PROVIDED	SHOULD BE USED WHEN:	LIMITING CRITERIA
B	Recommended: • Pressure-demand, full facepiece SCBA or pressure-demand supplied-air respirator with escape SCBA • Chemical-resistant clothing (overalls and long-sleeved jacket; hooded, one- or two-piece chemical splash suit; disposable chemical-resistant one-piece suit) • Inner and outer chemical-resistant gloves • Chemical-resistant safety boots/shoes • Hard hat • Two-way radio communications Optional: • Coveralls • Disposable boot covers • Face shield • Long cotton underwear	The same level of respiratory protection but less skin protection than Level A. It is the minimum level recommended for initial site entries until the hazards have been further identified.	• The type and atmospheric concentration of substances have been identified and require a high level of respiratory protection but less skin protection. This involves atmospheres: — with IDLH concentrations of specific substances that do not represent a severe skin hazard — that do not meet the criteria for use of air-purifying respirators • Atmosphere contains less than 19.5% oxygen • Presence of incompletely identified vapors or gases is indicated by direct–reading organic vapor detection instrument, but vapors and gases are not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through the intact skin	• Use only when the vapor or gases present are not suspected of containing high concentrations of chemicals that are harmful to skin or capable of being absorbed through the intact skin • Use only when it is highly unlikely that the work being done will generate either high concentrations of vapors, gases, or particulates or splashes of material that will affect exposed skin

ATTACHMENT 1 (continued)

LEVELS OF PPE

LEVEL OF PROTECTION	EQUIPMENT	PROTECTION PROVIDED	SHOULD BE USED WHEN:	LIMITING CRITERIA
C	Recommended: • Full-facepiece, air-purifying, canister-equipped respirator • Chemical-resistant clothing (overalls and long-sleeved jacket; hooded, one- or two-piece chemical splash suit; disposable chemical-resistant one-piece suit) • Inner and outer chemical-resistant gloves • Chemical-resistant safety boots/shoes • Hard hat • Two-way radio communications Optional: • Coveralls • Disposable boot covers • Face shield • Escape mask • Long cotton underwear	The same level of skin protection as Level B but a lower level of respiratory protection	• The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect any exposed skin • The types of air contaminants have been identified, concentrations measured, and a canister is available that can remove the contaminant • All criteria for the use of air-purifying respirators are met	• Atmospheric concentration of chemicals must not exceed IDLH levels • The atmosphere must contain at least 19.5% oxygen

ATTACHMENT 1 (continued)

LEVELS OF PPE

LEVEL OF PROTECTION	EQUIPMENT	PROTECTION PROVIDED	SHOULD BE USED WHEN:	LIMITING CRITERIA
D	Recommended: • Coveralls • Safety boots/shoes • Safety glasses or chemical splash goggles • Hard hat Optional: • Gloves • Escape mask • Face shield	No respiratory protection. Minimal skin protection	• The atmosphere contains no known hazard • Work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals	• This level should not be worn in the exclusion zone • The atmosphere must contain at least 19.5% oxygen

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Records Management Project Plan

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RECORDS MANAGEMENT PROJECT PLAN

This work plan will follow the records management program plan provided in Annex IV of Revision 2 of the Installation Work Plan (LANL 1992, 0768).

REFERENCE

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

Annex V

Community Relations Project Plan

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COMMUNITY RELATIONS PROJECT PLAN

This work plan will follow the community relations program plan provided in Annex V of Revision 2 of the Installation Work Plan (LANL 1992, 0768). The Environmental Restoration (ER) Program's public reading room is located at 1450 Central Avenue, Suite 101, Los Alamos, New Mexico. The community relations project leader can be reached at (505) 665-5000 for additional information.

REFERENCE

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

Fact Sheet for Operable Unit 1082 Resource Conservation and Recovery Act Facility Investigation Work Plan

July 1993

The Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Work Plan is a document that addresses the site characterization activities for all solid waste management units (SWMUs) at Operable Unit (OU) 1082 . This document will be submitted to the Environmental Protection Agency (EPA) in July 1993. Characterization activities began in October 1991, and are scheduled to continue through December 1996.

The primary purpose of this work plan is to describe the site characterization activities and verification sampling that will address potential contaminant releases from the SWMUs and areas of concern (AOCs) composing OU 1082, thus satisfying the regulatory requirements of Hazardous and Solid Waste Amendments (HSWA) Module VIII of the Los Alamos National Laboratory's RCRA Part B Operating Permit.

Acronyms

AOC
Area of concern
EPA
Environmental Protection Agency
ER
Environmental restoration
HSWA
Hazardous and Solid Waste Amendments
MDA
Material disposal area
OU
Operable unit
PRS
Potential release site
RCRA
Resource Conservation and Recovery Act
RFI
RCRA facility investigation
SWMU
Solid waste management unit
TA
Technical area
VCA
Voluntary corrective action

The Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Work Plan for Operable Unit (OU) 1082 is a document that addresses the site characterization activities for all solid waste management units (SWMUs) at Technical Areas (TAs) 11, 13, 16, 24, 25, 28, and 37. This document will be submitted to the US Environmental Protection Agency (EPA) in July 1993 and is subject to approval by the EPA. Characterization activities will begin in the spring of 1995 and are scheduled to continue through 1997.

The primary purpose of the work plan is to satisfy the regulatory requirements of Module VIII of the Los Alamos National Laboratory's RCRA Part B Operating Permit. Its second purpose is to serve as a field sampling plan for personnel who will implement the RFI.

Background

Operable Unit 1082 is located in the southwest corner of the Laboratory. The land is a portion of that which was acquired by the Department of the Army for the Manhattan Project in 1943. The land was used by the ancestral Indians of the Pajarito Plateau, and prior to World War II, for farming and a sawmill operation.

Operable Unit 1082 is bordered by Bandelier National Monument along State Road 4 to the south and the Santa Fe National Forest along State Road 501 to the west. To the east and the north, the OU is bordered by other Laboratory property. The unit is effectively isolated from State Road 4 by Water Canyon, a 200-ft deep ravine with steep walls.

Operable Unit 1082 occupies 2 410 acres, or 3.8 square miles. The western technical areas (TAs 13, 16, 25) within OU 1082 lie at an average elevation of approximately 7 500 to 7 600 ft. The eastern technical areas (TAs 11, 37) lie at a slightly lower elevation 7 200 to 7 500 ft. The mesa top of OU 1082 overlies at least 850 ft of volcanic deposit of the Bandelier Tuff. The regional aquifer lies at a depth of approximately 1 250 ft below the surface of the mesa.

The technical areas composing OU 1082 were established during World War II to develop, fabricate (cast and machine), and test explosive components employed in the United States' nuclear weapons program. Their present use is essentially unchanged.

Technical Area 11 (K-Site) is the location of a high explosives and environmental testing facility.

Technical Area 13 (P-Site) was decommissioned and absorbed into TA-16. It was constructed in 1944 to conduct x-ray studies of the implosion of high explosive test devices. Existing buildings are now used for high explosives machining safety studies.

Technical Area 16 (S-Site). Operations at this site center around the production of high explosives for weapons and non-weapons research and development. TA-16 includes the locations of former Technical Areas 13, 24, and 25.

Technical Area 24 (T-Site) has been decontaminated and decommissioned. It was used for x-ray examination of high-explosive charges during the 1940s. An explosive storage magazine and laboratories were part of the facility.

Technical Area 25 (V-Site) is no longer operational. It was constructed in 1944 for experimental work with special assemblies. Structures at the site include an assembly bay, laboratory buildings, equipment building, and a warehouse.

Technical Area 28 (MAA; Magazine Area A). This site consists of five magazines used for the storage of high explosives.

Technical Area 37 (MAC; Magazine Area C). This site consists of twenty-four magazines used for the storage of high explosives.

Contaminants and Pathways of Concern

Principal contaminants of concern are high explosives and the burn, detonation, and degradation products of high explosives, principally barium.

Other contaminants of concern include uranium, beryllium, plutonium, silver, lead, mercury, cyanide, and solvents.

Under the current land use patterns in the vicinity of OU 1082, the following primary exposure pathways of concern would be:

- Inhalation of disturbed-soil particulates,
- surface runoff and sediment transport, and
- erosion and surface exposure.

Since the main aquifer is at least 1 250 ft below the mesa top, the potential for impact on the aquifer or the municipal drinking water supply from the SWMUs in OU 1082 is thought to be extremely low.

Characterization Approach

The Laboratory has identified 339 SWMUs and 75 areas of concern (AOCs), which represent potential contamination release sites within OU 1082. The SWMU-aggregate sampling plans focus on contaminant identification and nature and extent of contaminant migration. The SWMUs are grouped into the following three groups:

- surface contamination areas where contaminants were released at, or to, the land surface, such as debris from a firing site, surface spills, residues from burning operations, and surface solid waste disposal areas;
- surface and subsurface liquid releases, such as discharges from septic systems and industrial drainage systems; and,
- subsurface contamination areas, such as material disposal areas (MDAs) and landfills where solid wastes were placed or buried.

Scope and Schedule of Effort

Because of the large number of potential release sites (PRSs) (339 SWMUs and 75 AOCs) in OU 1082, the RFI work plan will be written in three segments. The first segment will address all of the HSWA Module Table A and Table B SWMUs and is scheduled for delivery to the Environmental Protection Agency in July 1993. A number of SWMUs not in the HSWA Module are also addressed as a matter of efficiency and cost containment. The remaining SWMUs and AOCs will be covered in the second and third segments, which will be delivered as an RFI addendum no later than December 1995.

Priority has been given to investigation of surface soil contamination SWMUs because they represent the greatest potential for human exposure to contaminants and for dispersal of contaminants in the environment. Secondary priority is given to subsurface contaminants that pose low risk to workers.

The time period for characterization depends on the extent and degree of contamination (if any exists) and DOE budget constraints. In the event that an investigation uncovers contamination that may pose an immediate risk to public health or the environment, a voluntary corrective action may be started to alleviate that risk.

Reporting

Reports generated in the implementation of the RFI Work Plan for OU 1082 will be made available for review by the public at the Environmental Restoration (ER) Community Reading Room in downtown Los Alamos (1450 Central, Suite 101). The Reading Room is open to the public from 9 a.m. to 4 p.m. on Laboratory business days. Access at other times may be arranged by calling 505-665-2127.

Because of the large number of SWMUs addressed in the work plan and the time required for completion of RFI fieldwork, some interim reports will be generated as appropriate portions of the site characterization are completed. These RFI phase reports will summarize results of initial site characterization activities and describe the follow-on activities being planned (including any modifications to field sampling plans suggested by initial findings). These RFI phase reports will receive EPA approval prior to proceeding to the next phase.

Conclusion

Ensuring the safe management of past, present, and future waste requires the cooperation of government, industry, and the public. The Laboratory is committed to providing the public with information such as this fact sheet. The Laboratory will continue to provide information concerning actions taken during the investigation and throughout the entire cleanup process. If you have additional questions about OU 1082 or about the Laboratory's ER Program, please call or write:

Community Relations Project Leader
Environmental Restoration Program
Los Alamos National Laboratory
Box 1663, MS M314
Los Alamos, NM 87545
505-665-5000 or 505-665-2127

Appendix A

Cultural Resource Summary

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CULTURAL RESOURCE SUMMARY

As required by the National Historic Preservation Act of 1966 (as amended), a cultural resource survey was conducted during the summer of 1992 at Operable Unit (OU) 1082. The methods and techniques used for this survey conform to those specified in the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation (Federal Register Vol. 48, No. 190, September 29, 1983).

Thirty-three archaeological sites eligible for inclusion on the National Register of Historic Places under Criterion D are located within the survey area.

The attributes that make these sites eligible for inclusion on the National Register will not be affected by any Environmental Restoration (ER) Program sampling activities proposed at OU 1082. A report documenting the survey area, methods, results, and monitoring recommendations, if any, will be transmitted to the New Mexico State Historic Preservation Officer for his concurrence in a "Determination of No Effect" for this project. As specified in 36 CFR 800.5(b) and following the intent of the American Indian Religious Freedom Act, a copy of this report will also be sent to the governor of San Ildefonso Pueblo and to any other interested tribal group for comment on possible impacts to sacred and traditional places.

All monitoring and avoidance recommendations contained in the report referenced below must be followed by all personnel involved in ER sampling activities. Environmental Protection Group (EM-8) archaeologists must be contacted 30 days prior to initiation of any ground-breaking activities so that monitoring and avoidance recommendations can be verified.

REFERENCE

Binzen, Timothy, in preparation. "Environmental Restoration Program, Operable Unit 1082, Cultural Resource Survey Report" Los Alamos National Laboratory, Los Alamos, New Mexico.

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Appendix B

Biological Resource Summary

BIOLOGICAL RESOURCE SUMMARY FOR TAs 11, 13, 16, 24, 25, 28, AND 37, OPERABLE UNIT 1082

1.0 INTRODUCTION

During 1992, field surveys were conducted by the Biological Resource Evaluations Team (BRET) of the Environmental Protection Group (EM-8) for Operable Unit (OU) 1082, Technical Areas (TAs) 11, 13, 16, 24, 25, 28, and 37. The surveys were conducted to provide information on the biological components prior to site characterization. Site characterization requires surface and subsurface soil sampling within the technical areas and associated drainages and canyons. Further information concerning the biological field surveys for OU 1082 is contained in the full report "Biological and Floodplain/Wetland Assessment for Environmental Restoration Program, Operable Unit 1082" (Raymer in preparation, 15-16-473). The biological assessment contains specific information on survey methodology, results, and mitigation measures. This assessment will also contain information that may aid in defining ecological pathways and site restoration.

2.0 PERTINENT REGULATIONS

Field surveys were conducted to comply with the amended Federal Endangered Species Act of 1973 (USFWS 1988, 15-16-468), New Mexico's Wildlife Conservation Act (1974, 15-16-476), New Mexico Endangered Plant Species Act (New Mexico Natural Resource Department 1985, 0546), Executive Order 11990 "Protection of Wetlands" (1977, 0635), Executive Order 11988 "Floodplain Management" (1977, 0634), 10 CFR 1022 "Compliance with Floodplain/Wetland Environmental Review Requirements" (DOE 1979, 15-16-464), and Department of Energy (DOE) Order 5400.1 (DOE 1988, 0075).

3.0 METHODOLOGY

The purpose of the surveys was three-fold. The first was to determine the presence or absence of critical habitat for any State or Federal sensitive, threatened, or endangered plant or animal species potentially occurring within OU 1082 boundaries. Secondly, surveys were conducted to determine presence of sensitive areas such as flood plains and wetlands within the areas to be sampled and the extent of such areas and their general characteristics. The third purpose was to provide additional plant and wildlife data concerning the habitat types within OU 1082. These data provide further baseline information about the biological components of the site characterization and a determination of pre-sampling conditions. This information is also necessary to support the National Environmental Policy Act (NEPA) documentation and determination of a categorical exclusion for the sampling plan for site characterization (SEN 1990, 15-90).

OU 1082 personnel propose to collect surface and subsurface sediment samples. Subsurface characterization will involve drilling holes up to or exceeding 200 ft in depth. In some locations, trenching may be necessary.

After searching the data base maintained in EM-8 (which is updated a minimum of twice per year) containing the habitat requirements for all State- and Federally-listed threatened, endangered, and sensitive plant and animal species known to occur within the boundaries of Los Alamos National Laboratory and surrounding areas, a habitat evaluation survey (Level 2) was conducted. A Level 2 survey is performed when there are areas that are not highly disturbed which could potentially support threatened and/or endangered species. Techniques used in a Level 2 survey are designed to gather data on the per cent cover, density, and frequency of both the understory and overstory components of the plant community. The detail of this survey will be incorporated into the full report "Biological and Floodplain/ Wetland Assessment for Environmental Restoration Program, Operable Unit 1082," to be sent to US Fish and Wildlife Service (USFWS) for concurrence.

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

In each location, all wetlands and flood plains within the survey area were noted using a National Wetlands Inventory map and field checks. Characteristics of wetlands, flood plains, and riparian areas are noted using criteria outlined in the Army Corps of Engineers Wetlands Delineation Manual (1987, 0871).

4.0 THREATENED, ENDANGERED, AND SENSITIVE SPECIES

Table B-1 indicates the species of concern for this operable unit.

5.0 RESULTS AND MITIGATION

5.1 Habitat Description

The dominant trees within the mesa overstory vegetation of OU 1082 are ponderosa pine (*Pinus ponderosa*) and aspen (*Populus tremuloides*). The mesa top shrub layer is primarily composed of Gambel oak (*Quercus gambelii*) and New Mexico locust (*Robinia neomexicana*). Dominant forbs and grasses include bluegrass (*Poa sp.*), mountain muhly (*Muhlebergia montana*), blue grama (*Bouteloua gracilis*), pine dropseed (*Blepharoneuron tricholepis*), wormwood (*Artemisia ludoviciana*), false tarragon (*Artemisia dracunculus*), tall lupine (*Lupinus caudatus*), and cinquefoil (*Potentilla sp.*). In areas burned by the La Mesa fire, there is extensive regeneration of New Mexico locust and Gambel oak.

The north-facing slopes of canyons within the OU had overstories dominated by ponderosa pine and Douglas fir (*Pseudotsuga mensesii*). Dominant shrubs were wax currant (*Ribes cerceum*) and New Mexico olive (*Forestiera neomexicana*). The understory layer was dominated by slender wheatgrass (*Agropyron trachycaulum*), mountain muhly, spike muhly (*Muhlenbergia wrightii*), western yarrow (*Achillea lanulosa*), mosses, and wild chrysanthemum (*Bahia dissecta*).

South-facing slopes consisted of overstories dominated by ponderosa pine and juniper (*Juniperus monosprema*); shrub layers dominated by Gambel oak and New Mexico locust; and understories dominated by mountain muhly, little bluestem (*Andropogon scoparius*), pine dropseed, and wormwood.

TABLE B-1

THREATENED, ENDANGERED, AND SENSITIVE (TES) SPECIES POTENTIALLY OCCURRING IN OPERABLE UNIT 1082

SCIENTIFIC NAME	COMMON NAME	STATUS	HABITAT
ANIMALS			
Accipiter gentilis	Northern goshawk	FCC2	Ponderosa pine/Gambel oak, ponderosa pine/gray oak, mixed conifer
Buteogallus anthracinus	Common black hawk	SPG2	Riparian areas with cottonwoods
Cynanthus latirostris	Broad-billed hummingbird	SPG2	Riparian woodland
Empidonax traillii	Willow flycatcher	FCC2 SPG2	Riparian areas with cottonwoods
Euderma maculatum	Spotted bat	FCC2 SPG2	Ponderosa, piñon-juniper, cliffs and rock crevices
Falco peregrinus	Peregrine falcon	FE SPG1	Ponderosa-piñon, cliffs and rock outcrops on cliffs
Haliaeetus leucocephalus	Bald eagle	FE SPG2	Riparian areas near streams and lakes
Ictinia mississippiensis	Mississippi kite	SPG2	Riparian and shelter belts
Lymnaea caperata	Say's pond snail	SPG1	Wetlands at Cerro la Jara in the Jemez Mountains
Martes americana	Pine marten	SPG2	Mature old-growth spruce-fir communities with more than 30% canopy cover and fallen logs
Plethodon neomexicanus	Jemez Mountain salamander	FCC2 SPG2	Spruce-fir, 7 225-9 250 ft, cool, moist, and shaded woods
Strix occidentalis lucida	Mexican spotted owl	FPT	Mixed conifer, mountains and canyons, uneven-aged, multi-storied forest with closed canopy
Zapus hudsonius	Meadow jumping mouse	FCC2 SPG2	Grassy areas dominated by grasses and rushes next to permanent running water
PLANTS			
Fritillaria atropurpurea	Checker lily	SS	Mixed conifer
Heuchera pulchella	Sandia alumroot	SS	Mixed conifer, 8 000-12 000 ft, cliffs
Lilium philadelphicum var. *andium*	Wood lily	SE3	Ponderosa to mixed conifer, 6 000-10 000 ft
Phlox caryophylla	Pagosa phlox	SS	Ponderosa-piñon, 6 500-7 500 ft, open slopes in open woods

Status

FE Federally endangered. Any species that is in danger of extinction throughout all or a significant portion of its range other than a species of class insecta determined by the Secretary of the Interior to constitute a pest whose protection under the provision of the Endangered Species Act would present an overwhelming and overriding risk to man (USFWS 1988, 15-16-468).

FPT Federally proposed as threatened. Taxon that has been proposed for listing under the Endangered Species Act as threatened. These species receive the protection of the Endangered Species Act during the proposal process (USFWS 1988, 15-16-468).

FCC2	Federal candidate as a C2. Taxon for which information now in the possession of the US Fish and Wildlife Service indicates that proposing to the list as endangered or threatened is possibly appropriate, but for which conclusive data on biological vulnerability and threat are not currently available to support a proposed rule. Further information is needed before listing. Federal agencies are requested to evaluate C2 species in their management activities (USFWS 1988, 15-16-468).
SE3	State protected plant, widespread in or adjacent to New Mexico, but its numbers are being significantly reduced to such a degree that its survival within New Mexico is jeopardized (New Mexico Natural Resources Department 1985, 0546).
SPG1	State endangered as a Group 1 species. Species whose prospects of survival or recruitment within the state are in jeopardy (State of New Mexico 1974, 15-16-476).
SPG2	State endangered as a Group 2 species. Species whose prospects of survival or recruitment within the state are likely to become jeopardized in the foreseeable future (State of New Mexico 1974, 15-16-476).
SS	State sensitive plant. Plant species that are not state protected, but may need state protection in the near future.

The canyon bottom of Cañon de Valle within OU 1082 shows ponderosa pine and Douglas fir as the dominant tree species; Gambel oak, New Mexico locust, and cliff bush (*Jamesia americana*) as the dominant shrub species; and, bluegrass and inland rush (*Juncus interior*) as the dominant understory species.

The following habitats were identified:

Location	Habitat Type
Mesa	Ponderosa pine-bluegrass
	Ponderosa pine-Gambel oak
	Ponderosa pine/aspen
North-facing slopes	Ponderosa pine-Gambel oak
	Douglas fir-Gambel oak
South-facing slopes	Ponderosa pine-juniper
	Gambel oak-mountain muhly
Canyon bottoms	Ponderosa pine-Douglas fir

Within OU 1082, there are an estimated 230 species of plants, 70 species of nesting birds, 39 species of mammals, 2 species of amphibians, and 4 species of reptiles.

5.2 Threatened, Endangered, and Sensitive Species

As a result of a habitat evaluation and a review of previous data of OU 1082, at least ten of the previously listed species have potential for occurrence within or near OU 1082. These are the Jemez Mountain salamander, northern goshawk, peregrine falcon, Mexican spotted owl, broad-billed hummingbird, pine marten, meadow jumping mouse, spotted bat, checker lily, and wood lily. These species are discussed below in more detail. The remaining species listed above are dismissed from further consideration because of the lack of more specific suitable habitat components or because they have not been located on more suitable habitat in other areas of the Laboratory. Again, USFWS concurrence will be sought based on the biological assessment.

The spotted bat is found in piñon-juniper, ponderosa, mixed conifer, and riparian habitats. The two critical requirements for the spotted bat are a source of open surface water and roost sites (caves in cliffs or rock crevices). Suitable roost sites were present in portions of Water Canyon and Cañon de Valle. Open water sources are limited and include small cattail areas and several small outfalls. No surveys were conducted for this species in OU 1082. However, during surveys for spotted bats in lower Pajarito Canyon (1992), none were captured. In July of 1992, surveys of Los Alamos Canyon also resulted in no spotted bat captures. In addition, no spotted bats were captured in similar survey attempts at TA-8, TA-36, and Bandelier National Monument. This does not necessarily suggest spotted bats do not occur in OU 1082. However, no adverse impact is expected to occur to the spotted bat (if present) if potential habitat (rock faces, cliffs) and water sources within OU 1082 are not disturbed or altered.

Currently in draft form, a habitat management plan developed by Johnson (1992, 15-16-466) discusses the past and present status of the peregrine falcon in habitat north of this operable unit. According to modeling efforts by Johnson, the peregrine falcon has a low potential of occurrence in OU 1082. It is not expected to nest in OU 1082 but may traverse the area. Sampling is not expected to impact this species.

The northern goshawk occurs in mature ponderosa pine forest. Goshawks have been found hunting on Laboratory property within OU 1082. Nest sites are known to exist just outside operable unit borders and most likely occur within the boundaries as well (Kennedy 1986, 15-16-467). The following measures must be taken to avoid adverse impact to goshawks.

1. Any machine sampling occurring between May and October must be cleared through BRET must be contacted 60 days prior

to sampling to evaluate possible nest sites in and around the specific sampling area.

2. If any area over one-tenth acre will be disturbed, contact BRET for a pre-sampling site-specific survey.

3. Any tree removal (live or snag) must be approved by BRET.

Habitat requirements for the Mexican spotted owl include uneven-aged, multistory mixed conifer forests with closed canopies. Spotted owls are known to occur in Los Alamos County and may be present in mixed conifer areas in Water Canyon. Contact BRET 60 days prior to sampling within Water Canyon for evaluation of specific sampling locations. BRET coordinates all activities with the US Fish and Wildlife Service.

Broad-billed hummingbirds have been reported in Bandelier National Monument, but only as migrants. These hummingbirds require riparian habitat. Although riparian habitat does exist within OU 1082, it is very limited in size and extent. This limited riparian habitat most likely would not support breeding broad-billed hummingbirds. In addition, there have been no reports of this hummingbird occurring on Laboratory land (Travis 1992, 0869). No adverse impacts will occur to the broad-billed hummingbird.

Pine marten occurs in mature old-growth spruce-fir communities with greater than 30% canopy cover and a large per cent of fallen logs. OU 1082 does not characteristically fit this description. However, there have been unsubstantiated reports of pine marten within the general upper areas of OU 1082. These sightings are thought to be mis-identifications (probably long-tailed weasels). However, there has not been a systematic survey for pine marten within Los Alamos County. An effective survey technique involves snow tracking. A survey for the pine marten was conducted in the upper portions of OU 1082 during the winter of 1992-93. Contact BRET prior to sampling for results of survey.

Meadow jumping mouse has a high potential of occurring in OU 1082. It lives in riparian or wetlands zones along permanent water sources. If any sampling will occur along stream-side areas, contact BRET 60 days prior to sampling to evaluate the need for a site-specific survey. A meadow jumping mouse survey must be performed during the rainy season, the optimal month being July. This is the only time the survey can be performed (Morrison 1990, 15-16-472). If a survey is required, sampling cannot proceed until the survey is complete. (Note: some surveys for small mammals occurred within OU 1082 during the summer of 1992, no meadow jumping mice were found).

The wood lily and checker lily may occur in OU 1082, but only in moist, shaded areas. If extensive sampling will occur within riparian areas, contact EM-8 to conduct a site-specific survey prior to sampling. These lilies have been found in Los Alamos County but are very rare.

5.3 Wetlands/Flood Plains

There are four areas within OU 1082 that have been classified on the USFWS National Wetlands Inventory maps as possible palustrine wetlands. There are also 28 National Pollutant Discharge Elimination System (NPDES) permitted outfalls within OU 1082 and at least 14 have wetlands vegetation associated with them. These areas may be classified as jurisdictional wetlands. None of the possible jurisdictional wetlands exceeds one acre, and therefore RFI activities within any of these possible jurisdictional wetlands would be permitted under the nationwide permit for such small areas. In addition, flood plain maps developed by McLin (1992, 0825) indicate that flood plains exist in Water Canyon and Cañon de Valle. In compliance with 10 CFR 1022, a flood plain/wetlands involvement notification will be submitted to the Federal Register for public comment. RFI activities are not anticipated to adversely affect the flood plains and wetlands within OU 1082 as long as best management practices outlined in Section 6.0 are adhered to.

6.0 BEST MANAGEMENT PRACTICES

Impacts to non-sensitive species should be avoided when possible. Off-road driving is especially harmful to plants and soil crust. Vehicular travel should be restricted to existing roads whenever possible. Revegetation may be required at some sites. A list of native plants suitable for revegetation for OU 1082 will be included in the final report Biological and Floodplain/ Wetland Assessment for Environmental Restoration Program, Operable

Unit 1082" (Raymer in preparation, 15-16-473). In addition, BRET may be consulted to determine suitable species for seeding.

Additional mitigation measures include the following.

- Avoid unnecessary disturbance (i.e., parking areas, equipment storage areas, off-road travel) to surrounding vegetation during the actual sampling and when traveling into the sampling sites.
- Avoid removal of vegetation along water sources, drainage systems, and stream channels.
- Avoid disturbance to vegetation along canyon slopes and especially to drainages.
- Avoid tree removal. If tree removal is required, contact BRET for evaluation.

In addition to the previously-mentioned mitigation measures, BRET requests notification of additional disturbances prior to their being conducted.

The Biological and Floodplain/Wetland Assessment for Environmental Restoration Program, Operable Unit 1082" (Raymer in preparation, 15-16-473) will be evaluated by the US Fish and Wildlife Service for compliance with the Endangered Species Act (USFWS 1988, 15-16-468). This federal agency may have additional mitigation measures that are required and are not represented in this summary. However, the OU 1082 project leader will be notified of any additional required measures.

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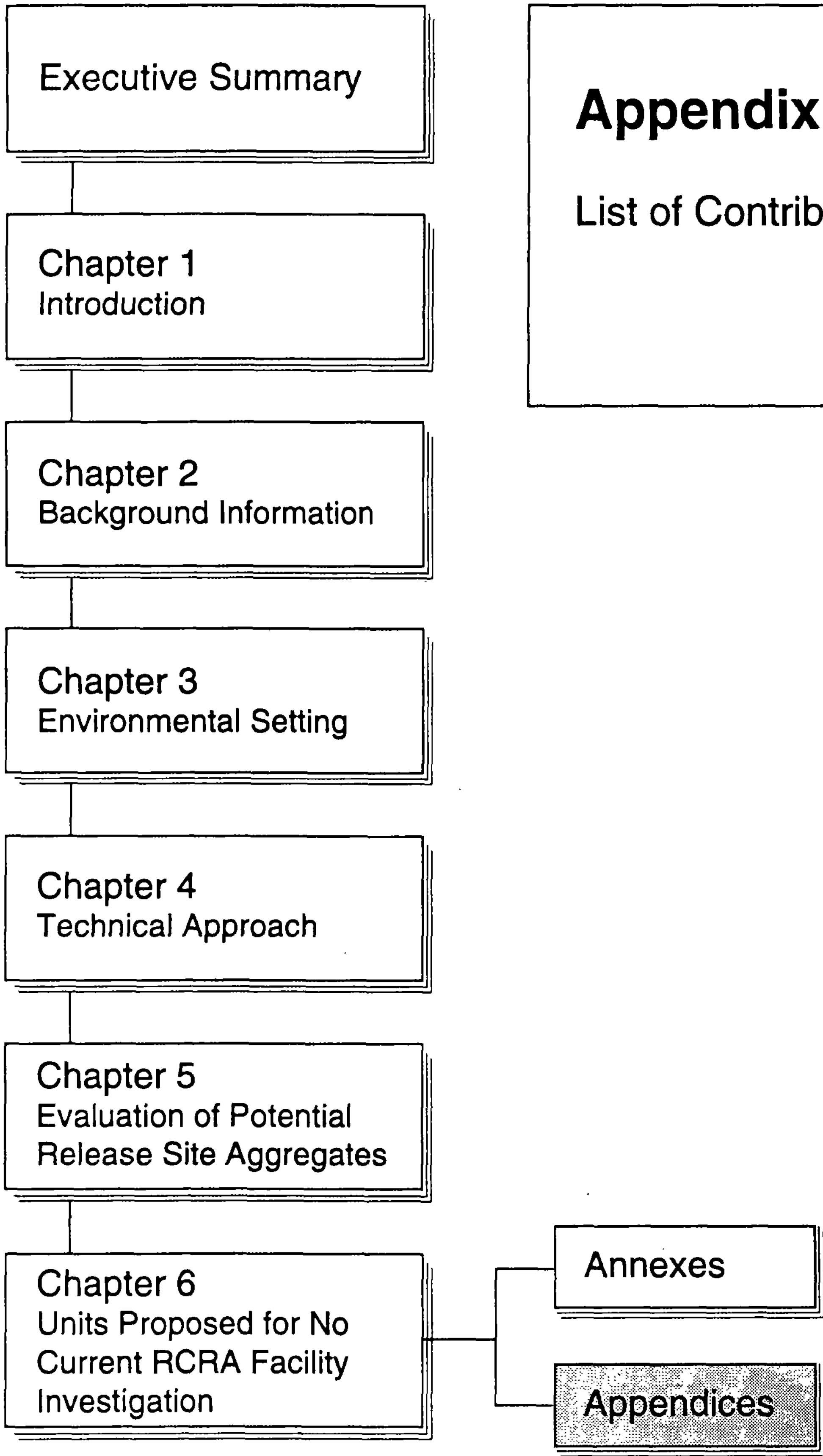
Appendix C

List of Contributors



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Appendix D

Introduction to High Explosives

Executive Summary

Chapter 1
Introduction

Chapter 2
Background Information

Chapter 3
Environmental Setting

Chapter 4
Technical Approach

Chapter 5
Evaluation of Potential Release Site Aggregates

Chapter 6
Units Proposed for No Current RCRA Facility Investigation

Annexes

Appendices

1.0 INTRODUCTION TO HIGH EXPLOSIVES USED AT THE S-SITE COMPLEX

There are several types of explosives and associated co-constituents that may be present in soils and/or sediments at sites where explosives were or are currently processed, assembled, machined, stored, tested (i.e., detonated), or disposed. Potential contaminants from these operations may consist of the residual parent explosive and other co-constituents, such as inorganic metals, production impurities, degradation products, or products of detonation and/or combustion. The migration and dispersal characteristics of these potential contaminants in the environment are governed by the physical and chemical properties of the constituents, as well as by the physical characteristics of the sediments and soils on site. Some of these potential contaminants are carcinogens or systemic toxicants and may pose a health hazard upon exposure through inhalation, incidental ingestion, and dermal contact.

Explosives used at the Los Alamos National Laboratory (LANL) may be divided into three classes: 1) primary or initiating, 2) boostering, and 3) secondary (bursting charge) or high explosives (LANL 1986, 15-16-315). High explosives (HE) that contain HMX (cyclotetramethylenetetranitramine), RDX (cyclonitrite, cyclotrimethylenetrinitramine), or TNT (trinitrotoluene) as explosive components represent the vast majority of explosives that have been processed at Technical Area (TA) 16.

Primary explosives are not currently processed at the Laboratory but are used in squibs, low-energy detonators, fuses, explosive bolts and fasteners, and are assembled into test devices. Primary explosives are extremely sensitive to friction, heat, and impact, and some are sensitive to an electrical discharge. When exposed to flame, these explosives can be expected to detonate without burning. Lead azide and lead styphnate are examples of primary explosives. These and other detonator materials were used, processed, and disposed of at S-Site during the 1940s and 1950s.

The majority of detonators handled and assembled into test devices at these locations are the exploding bridge wire type which contain boostering explosives. High-energy exploding bridge wire detonators approved for use at LANL may be found in the Fabrication and Assembly Group's (WX-3) Standard Operating Procedure (SOP) 1.1.0, Explosives (LANL 1986, 15-16-315). Boostering explosives are less sensitive to explosion initiators than primary explosives, but may be set off by heat, friction, or impact. These explosives may detonate when burned in large quantities. Examples of boostering explosives include HMX, PETN (pentaerythritol tetranitrate), RDX, and tetryl (trinitrophenyl methylnitramine).

HMX, PETN, and RDX are also processed in the first steps of making molding powders for secondary or high explosives such as plastic-bonded explosives (PBX) and extrudable explosives [e.g., Extex (XTX)].

Most of the explosives processed at S-Site are secondary or high explosives (LANL 1986, 15-16-315). These explosives require more energy for initiation than either primary or boostering explosives. All will detonate if they receive a strong shock from an impact or from a boostering explosive. Unless confined, secondary explosives will burn without detonating. Examples of high explosives include baratol, the cyclotols, TNT, several PBXs, and extrudable explosives.

The types of secondary or high explosives that may be processed at TA-16 fall into the categories of established explosives, developmental explosives, and detonators. Table D-1 lists the nominal compositions of established secondary explosives that contain HMX, RDX, or TNT; these include the explosives most commonly used at TA-16. Table D-2 lists the nominal compositions of established secondary explosives used at TA-16 that do not contain HMX, RDX, or TNT. The type of bonding materials used in these explosives (e.g., plasticizers, polystyrenes, waxes, etc.) are not considered to be of human health or environmental concern and are not included in these tables. Developmental explosives contain the same types of chemicals that compose the established explosives; however, they are generally used in extremely small quantities (<100 lbs) in a limited number of TA-16 facilities (TA-16-340 and TA-16-460). However, there are some additions to this list. These are included in Table D-3. A complete listing of each of these explosives may be found in WX-3 Standard Operating Procedure (SOP) 1.1.0, Explosives (LANL 1986, 15-16-315). Table D-4 summarizes the explosives components of concern from Tables D-1 through D-3, with estimates of the total quantities of each that have been processed at TA-16 over the past 50 years. These estimates were made by Mr. L. Hatler of

TABLE D-1

NOMINAL COMPOSITION OF ESTABLISHED EXPLOSIVES THAT CONTAIN HMX, RDX, OR TNT (LANL 1986, 15-16-315)

CHEMICAL	Al	BA	BDNPA/ BDNPF	BN	CEP	DEHS	DOP	FO or MO	HMX	$NaNO_3$	NC	PETN	RDX	TATB	TNT	TOP	OTHER
EXPLOSIVE																	
Baratol *				76%											24%		
Boracitol		60%													40%		
Composition A-3													91%				9%
Composition A-4													97%				3%
Composition A-5													98.5%				1.5%
Composition B *													60%		40%		
Composition B-3													60%		40%		
Composition C-3													88%				12%
Composition C-4						5.3%		1.6%					91%				
Cyclotol, 75/25													75%		25%		
Cyclotol, 70/30													70%		30%		
DBA-1										X					X		X
EDC-8												76%					24%
EDC-28													94%				6%
EDC-32									85%								15%
EDC-37											1%		91%				8%
EDC-38									94.5%								5.5%
HBX-1	17%												40%		38%		5%
HMX									100%								
LX-04									85%								15%
LX-07									90%								10%
LX-14									95.5%								4.5%
Octol									75%						25%		
PBX-9001							1.5%						90%				8.5%
PBX-9007							0.5%						90%				9.5%
PBX-9010													90%				10%
PBX-9011									90%								10%
PBX-9205							2%						92%				6%
PBX-9206									92%								8%
PBX-9401													94.2%			2.2%	3.6%
PBX-9404 *					3%						3%		94%				
PBX-9405					3%						3%		94%				
PBX-9407													94%				6%
PBX-9501 *			2.5%						95%								2.5%
PBX-9503									15%					80%			5%
PBXW-113									88%								12%
Pentolite												50%			50%		
RDX													100%				
TNT															100%		
TNT/NC											20%				80%		
Tritonal	20%														80%		
XTX													80%				20%

* These explosives represent those processed in the largest quantities.
All percentages are wt %.

Legend

- Al: Aluminum powder
- BA: Boric Acid
- BDNPA: Bis(dinitropropyl) acetal
- BDNPF: Bis(dinitropropyl) formal
- BN: Barium nitrate
- CEP: Chloroethyl phosphate
- DEHS: Di(2-ethylhexyl)sebacate
- DOP: Dioctyl phthalate
- FO: Fuel Oil
- HMX: Cyclotetramethylenetetranitramine
- MO: Motor Oil
- $NaNO_3$: Sodium Nitrate
- NC: Nitrocellulose, cellulose nitrate
- Other: Binders
- PETN: Pentaerythritol tetranitrate
- RDX: Cyclonite, cyclotrimethylenetrinitramine
- TATB: Triaminotrinitrobenzene
- TNT: Trinitrotoluene
- TOP: Trioctyl phosphate
- X: Constituent present (% not available)

TABLE D-2

COMPOSITION OF ESTABLISHED SECONDARY EXPLOSIVES THAT DO NOT CONTAIN HMX, RDX, OR TNT (all percentages in wt %) (LANL 1986, 15-16-315)

EXPLOSIVE	COMPOSITION
AL ANFO	Aluminum powder (AL)/ammonium nitrate (AN)/fuel oil (FO)
AN	100% ammonium nitrate (AN)
ANFO	Ammonium nitrate (AN)/fuel oil (FO)
BDNPA	100% Bis(dinitropropyl) acetal (BDNPA)
Black powder	74% Potassium nitrate/10.4% sulfur, 14.6% other
BTX	5,7-Dinitro-1-picrylbenzotriazole
DATB	100% Diaminotrinitrobenzene
Datasheet C	63% Pentaerythritol tetranitrate (PETN)/8% nitrocellulose (NC), 29% other
Datasheet D	75% Pentaerythritol tetranitrate (PETN), 25 % other
DINGU	100% Dinitroglycoluril
DNPA	100% 2,2-Dinitropropyl acrylate polymer (DNPA)
EDC-8	76% Pentaerythritol tetranitrate (PETN), 14 % other
High energy propellants	100% Solid propellants
HNS	100% Hexanitrostilbene
K-10	65.3% Dinitroethylbenzene/34.7% trinitroethylbenzene
NC	100% Nitrocellulose
Nitromethane	100% Nitromethane
NQ	100% Nitroguanidine
NT0	100% 1,2,4-nitro-triazole-5-one
PBX-9502	95% Triaminotrinitrobenzene (TATB), 5% other
PETN	100% Pentaerythritol tetranitrate
PYX	100% 2,6-Bis(picrylamino)-3,5-dinitropyridine
Smokeless powder (single base)	Nitrocellulose (NC), inorganic nitrates
Smokeless powder (double base)	Nitrocellulose (NC), inorganic nitrates,nitroglycerin or nitroglycol
STRATABLAST C	Slurry blasting explosive
TAGN	100% Triaminoguanidine nitrate
TAL-1005E	Slurry blasting explosive
TATB	100% Triaminotrinitrobenzene
Tetryl	100% 2,4,6-Trinitrophenylmethylnitramine
TNS	100% Trinitrostilbene
TPM	100% Tripicrylmelamine
XTX-8003	80% Pentaerythritol tetranitrate (PETN), 20% other

TABLE D-3

ADDITIONAL CHEMICALS THAT ARE COMPONENTS OF DEVELOPMENTAL SECONDARY EXPLOSIVES (all percentages in wt %) (LANL 1986, 15-16-315)

EXPLOSIVE	CHEMICAL	EXPLOSIVE	CHEMICAL
X-0231	40 - 90% Tungsten	X-0302	100% FKM
X-0232	40 - 90% Tungsten	X-0364	52.4% ADNT
X-0233	40 - 90% Tungsten	X-0365	39.0% EDD
X-0239	40 - 90% Tungsten	X-0366	50% EDD
X-0249	0 -70% Barium carbonate	X-0367	50% EDD
X-0250	0 -70% Cyanuric acid	X-0368	7.5% Potassium nitrate
X-0251	0 -70% Barium carbonate	X-0369	40.3% Potassium nitrate
X-0252	0 - 70% Cyanuric acid	X-0370	36.2% Potassium nitrate
X-0254	Barium carbonate	X-0382	3.75% Potassium nitrate
X-0256	Less than 44.9% Barium carbonate	X-0386	6.4% Potassium nitrate
X-0258	Less than 46.8% Barium carbonate	X-0387	7.4% Potassium nitrate
X-0260	Less than 47.1% Barium carbonate	X-0388	4.9% Potassium nitrate
X-0262	Less than 46.7% Barium carbonate	X-0389	85.24% Tungsten
X-0264	Less than 45.2% Barium carbonate	X-0390	85.36% Tungsten
X-0266	Less than 47.1% Barium carbonate	X-0415	40% EAK
X-0268	Less than 27.4% Barium carbonate	X-0416	60% EAK
X-0271	Approximately 0.5% Decylgallophenone	X-0417	80% EAK
X-0276	35.9% Copper	X-0421	80% EAK
X-0277	33.0% Iron	X-0460	11.5% TCP/18% CT
X-0279	40.8% Cesium nitrate	X-0466	Less than 30% cyanuric acid
X-0284	0 - 70% Potassium nitrate	X-0467	Less than 30% zinc oxide
X-0294	Approximately 15% MAN	X-0515	50% Cyanuric acid
X-0295	Approximately 30% MAN	X-0516	50% Zinc oxide

ADNT – 3,5-dinitro-1,2,4-triazole
CT – calcium tartrate
EAK – mixture of ethylene diamine dinitrate, ammonium nitrate, and potassium nitrate
EDD – ethylene diamine dinitrate
FKM – mixture of HMX, nitrate, esters, oxidizers, and binders
MAN – methyl amine nitrate
TEP – tricresyl phosphate

TABLE D-4

SUMMARY OF HE COMPONENTS USED AT TA-16
THAT ARE POTENTIAL CONTAMINANTS OF CONCERN

HE COMPONENT	AMOUNT (lbs)	NOTES
ADNT		
Ammonium nitrate	<2 500	
Barium nitrate	>500 000	
BDNPA	2 500	Plasticizing agent
BDNPF	2 500	Plasticizing agent
BTX	<100	
CT		
Cyanuric acid	25 000 - 50 000	Mock HE component
DATB	10 000 - 25 000	
Decyclgallophenone	<100	Cast HE additive, viscosity
Di(2-ethyl) sebacate	<100	Cast HE additive, viscosity
Dinitroethylbenzene	<10	
Dinitroglycolutil	<500	
DNPA	6 000	Plastic
EAK	<2 500	
EDD	<2 500	
FKM	<1 000	
Hexanitrostilbene	<100	
HMX	>500 000	
MAN	<1 000	
Nitrocellulose	2 000 - 5 000	
Nitroguanadine	50 000 - 100 000	
Nitromethane	<50 000	Liquid HE
NTO	500 - 1 000	
PETN	10 000 - 15 000	
PYX	<1 000	
RDX	>500 000	
TAGN	<100	
TATB	100 000 - 500 000	
TCP	<100	
Tetryl	1 000 - 5 000	
TNT	>500 000	
Trinitroethylbenzene	<10	
Trinitrostilbene	<100	
Trioctyl phosphate	<1 000	
Tripicrylmelamine	<1 000	

Note: Abbreviations are identical to those in Tables D-1 through D-3.

Group WX-3, who has worked at TA-16 since 1968 (Hickmott and Martin 1993, 15-16-448).

2.0 POTENTIAL CONTAMINANTS OF CONCERN FROM EXPLOSIVES

The type of potential contaminants present at a particular site is directly dependent upon the type of operation conducted at the site (i.e., processing, assembly, machining, storage, testing, and/or disposal) and the type of explosive and test device used in the operation. Products of environmental degradation (e.g., photolysis and/or microbial degradation) of the potential contaminants located at each site may also be present. Table D-5 presents the type of potential contaminants of concern (PCOCs) associated with various explosive operations conducted at the Laboratory. Table D-6 presents the potential explosive impurities and environmental degradation products likely to be of concern in the environment that are associated with explosives that contain HMX, RDX, TNT, PETN, and tetryl.

TABLE D-5

CONSTITUENTS OF POTENTIAL CONCERN ASSOCIATED WITH EXPLOSIVE OPERATIONS AT THE LABORATORY

CONSTITUENTS OF POTENTIAL CONCERN	OPERATION			
	PROCESSING OPERATIONS	ASSEMBLY AND STORAGE	MACHINING	TESTING AND OPEN-AIR BURNING
Parent explosive (explosive, inorganic metal co-consituents, production impurities)	X	X	X	X
Inorganic metals (that compose the explosive device)			X	X
Products of incomplete detonation (PIDs) and/or incomplete combustion (PICs) (nitroaromatics, lead, friable asbestos, polynuclear aromatic hydrocarbons)				X
Products of environmental degradation	X	X	X	X

Although Table D-6 lists a large number of potential co-contaminants of HE that may be detected in the environment, most have only been observed in laboratory experiments. The following HE impurities and degradation products have been observed in field investigations: in TNT - 2,4 DNT,

TABLE D-6

EXPLOSIVE CONSTITUENTS OF POTENTIAL CONCERN IN THE ENVIRONMENT

PRINCIPAL TYPE OF EXPLOSIVE	PARENT EXPLOSIVE (explosive, metal co-consituents)	(production impurities)	INORGANIC METALS (that compose the explosive device)	PIDs and/or PICs	PRODUCTS OF ENVIRONMENTAL DEGRADATION	CONSTITUENTS DETECTED IN THE ENVIRONMENT
HMX	See Tables D-1, D-2, and D-3	RDX, aliphatic and cyclic nitro compounds (a)	See Table D-11	Barium, lead, friable asbestos, polycyclic aromatic hydrocarbons (PAHs) (b)	Nitrate ions, nitrite ions, ammonia, formaldehyde, organic nitro-compounds, hydrogen cyanide (a), mono-, di-, and trinitroso-RDX analogues, hydrazine, 1,1-dimethylhydrazine, 1,2-dimethylhydrazine, methanol (a)	Parent explosive (HMX, RDX, aliphatic and cyclic nitro-compounds), inorganic metals, PIDs and PICs (lead, friable asbestos, PAHs) (a)
RDX	See Tables D-1, D-2, and D-3	HMX, aliphatic and cyclic nitro compounds (a)	See Table D-11	Barium, lead, friable asbestos, PAHs (b)	Similar to those of HMX (a)	Parent explosive (RDX, HMX, aliphatic and cyclic nitro compounds), inorganic metals, PIDs and PICs (lead, friable asbestos, PAHs) (a)
TNT	See Tables D-1, D-2, and D-3	2,4-DNT, 2,6-DNT, 1,3-DNB, 1,3,5-TNB (a)	See Table D-11	Barium, TNT, 2,4-DNT, 2,6-DNT, 1,3,5-TNB, 1,3-DNB, lead, friable asbestos, PAHs (b)	1,3,5-TNB, TNBOH, TNBAL, TNBA, anthranils (e.g., 2,6-dinitroanthranil), nitriles (e.g., 2,4,6-trinitrobenzonitrile), amines (2-amino-4,6-DNT, 4-amino-2,6-DNT), 3,5-dinitrophenol, 2-amino-4,6-dinitrobenzoic acid) (a)	Parent explosive (TNT, 2,4-DNT, 2,6-DNT, 1,3-DNB, 1,3,5-TNB), inorganic metals, PIDs and PICs (lead, friable asbestos, PAHs), environmental degradation products (2-amino-4-6-DNT, 4-amino-2,6-DNT) (a)
PETN	See Tables D-1, D-2, and D-3	PE-tri-N, dipentaerythritol hexanitrate, tripentaerythritol acetonitrate (a)	See Table D-11	Lead, friable asbestos, PAHs (b)	Pentaerythritol (PE or Pe-tri-N) (a)	Parent explosive, inorganic metals, PIDs and PICs (lead, friable asbestos, PAHs), environmental degradation products (a)
Tetryl	See Tables D-1, D-2, and D-3	No production impurities of consequence (a)	See Table D-11	Lead, friable asbestos, PAHs (b)	N-methylpicramide, picric acid, methylnitramine (a)	Parent explosive, inorganic metals, PIDs and PICs (lead, friable asbestos, PAHs) (a)

Legend:

2-amino-4,6-DNT: 2-amino-4,6-dinitrotoluene
4-amino-2,6-DNT: 4-amino-2,6-dinitrotoluene
1,3-DNB: 1,3-dinitrobenzene
2,4- DNT: 2,4-dinitrotoluene
2,6-DNT: 2,6-dinitrotoluene
1,3,5-TNB: 1,3,5-trinitrobenzene
HMX: cyclotetramethylenetetranitramine
PE-tri-N: pentaerythritol
PETN: pentaerythritol tetranitrate
PIC: product of incomplete combustion
PID: product of incomplete detonation
RDX: cyclonitrite, cyclotrimethylenetrinitramine
TNBA: 2,4,6-trinitrobenzoic acid
TNBAL: 2,4,6-trinitrobenzaldehyde
TNBOH: 2,4,6-trinitrobenzyl alcohol
TNT: 2,4,6-trinitrotoluene

Footnotes:

(a) Layton et al. 1987, 15-16-447
(b) U S ATHMA 1986, 15-16-457

2,6 DNT, TNB, DNB; in RDX - HMX, nitrate; and in HMX - RDX. Thus, at TA-16 we will focus our investigation of HE co-contaminants on DNT, TNB, and DNB.

WX Division SOPs describe components of both standard and developmental explosives. The principal constituents of the explosives are generally the explosive components themselves, such as HMX, RDX, and TNT. However, subsidiary contaminants present in the explosive formulations may include: polycyclic aromatic hydrocarbons (PAH), metals, cyanide, and asbestos. Each of these co-contaminant types is described below. Inorganic metals that may compose the explosive device include, but are not limited to: lead, uranium, copper, or iron.

2.1 Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons have been detected at firing sites and burning grounds. They may be the product of incomplete detonation or combustion of those explosive that contain motor or fuel oil or may be the product of incomplete combustion of fuels used to ignite explosives at disposal areas. At TA-16, these contaminants are most likely to be found at open burn/open detonation sites and at firing sites, rather than in association with process buildings.

The manner in which individual PAHs behave in the environment is linked directly to the molecular weight of each potential contaminant. For example, low molecular weight PAHs (e.g., acenaphthylene, anthracene, flourene, and phenanthrene) are associated with significant volatilization compared to high molecular weight PAHs (e.g., benz[a]anthracene, benzo[b]flouranthene, benzo[k]flouranthene, benzo[a]pyrene, chrysene, dibenz[a,h]anthracene, and indeno[1,2,3-cd]pyrene) (Clement International Corporation 1990, 0873). Thus, it is likely that high molecular weight PAHs will be found in the soils and sediments.

In addition, sorption of PAHs to soil and sediments increases with increasing soil organic carbon content. The higher molecular weight PAHs have K_{oc} values in the range of 10^{+5} to 10^{+6}, indicating a stronger tendency to adsorb to organic carbon (Clement International Corporation 1990, 0873). This tendency for sorption also governs the manner in which the individual

PAHs will move in surface or groundwater. The high molecular weight PAHs will be transported in water adsorbed to particulates, whereas the lower molecular PAHs will tend to volatilize. Microbial metabolism is the major process for degradation of PAHs in the soil environment. Photooxidation, chemical oxidation, and biodegradation are only of importance in water environments. Hydrolysis is not considered to be an important degradation process for PAHs (Clement International Corporation 1990, 0873).

2.2 Potential Metal Contaminants

Metals used in processing operations and in assembly and storage locations may be co-constituents of the parent explosive (see Tables D-1, D-2, and D-3). Metals may be co-constituents of parent explosives or may have composed the device that housed the explosive. Such metals may include barium, beryllium, lead, uranium, copper, and iron. These metals will be found in largest quantities at open burn/open detonation sites at TA-16. They will also be present at firing sites. Those that are components of the explosives themselves will be found associated with process buildings.

The primary factor governing the distribution of potential metal contaminants in the environment is soil pH. With the exception of lead, the potential metal contaminants will tend to be more mobile in acidic soils. Lead is mobile in soils under both alkaline and acidic conditions. Two metals of particular concern at TA-16 are barium and beryllium.

Barium exhibits low mobility in soil. Barium mobility is limited by adsorption in soils with high cation exchange capacity (Clement International Corporation 1992, 0874). Thus, in fine soils or soils with high organic content, barium is expected to be located near the soil surface.

Beryllium is also expected to have limited mobility in most soil types. Beryllium tightly adsorbs to soils by displacing divalent cations that share common sorption sites (Syracuse Research Corporation 1992, 0872).

2.3 Cyanide

Cyanuric acid, a co-constituent of some developmental secondary explosives and a component of mock HE (see Table D-3), contains cyanide. Upon heating, cyanuric acid evolves hydrogen cyanate (CHNO), which is soluble in water, decomposing to carbon dioxide and ammonia (Budavari et al. 1989, 15-16-454). Thus, cyanide may be detected at processing areas for developmental secondary explosives and mock HE. AT TA-16, outfalls associated with the 300-Line are most likely to be contaminated with cyanuric acid. However, it is unlikely that cyanide will be detected at testing or disposal sites.

The fate of cyanide in soils and/or sediments is pH dependent. Cyanide may adsorb to suspended solids and sediments, although adsorption is probably insignificant when compared to volatilization. The adsorption of cyanides increases with increasing iron oxide, clay, and organic material. However, instead of being more mobile in acidic environments, cyanide adsorption increases with increasing acidity (ATSDR 1991, 15-16-451).

In the soil, cyanide may be present as hydrogen cyanide, soluble alkali metal salts, or as immobile metallocyanide complexes. Under aerobic conditions, low concentrations of cyanide undergo biodegradation with the formation of ammonia followed by nitrate. Under anaerobic conditions in the subsurface environment cyanides denitrify to gaseous nitrogen (Clement International Corporation 1991, 15-16-451).

2.4 Asbestos

Asbestos is nonvolatile and insoluble. Thus, its fate is primarily controlled by deposition after airborne transport. However, some fibers are sufficiently small that they may remain suspended in the atmosphere or water and be transported long distances. Asbestos is not known to undergo significant transformation or degradation in the environment (Clement International Corporation 1990b, 15-16-450). Asbestos is most likely to occur at firing sites and WW II waste disposal sites at TA-16.

3.0 FATE AND TRANSPORT OF EXPLOSIVES AND EXPLOSIVES BY-PRODUCTS

In addition to environmental degradation, other factors affect the potential fate and migration of PCOCs in the environment. These include the physical and chemical properties of the constituents and their degradation products as well as the physical and geochemical characteristics of the sediments and soils on site. Factors such as soil pH, soil cation-exchange-capacity (CEC), water infiltration rate, soil porosity, along with chemical-specific factors [e.g., water partition coefficient (K_{oc}), and soil retention factors (K_d)] are key to understanding the potential migration patterns of these constituents. A summary of aspects of the environmental fate of explosives is presented in Table D-7.

Layton et al. (1987, 15-16-447) provide a detailed discussion of the distribution of HE in environmental media. They calculate the distribution of a number of HE, including TNT, HMX, RDX, and HE by-products including DNT and DNB, in reference landscapes using the program GEOTOX. They also summarize existing data confirming HE and HE by-products at open burn/open detonation sites nationwide.

The most important result of the modeling is that all of the HE and HE by-products are calculated to be distributed into both surface soils (A soil horizons) and subsurface soils (B soil horizons). In the western ecoregion models TNT, DNT, and RDX were all predicted to favor subsurface over surface soils. This modeling may not be directly relevant to TA-16 because a near-surface groundwater reservoir was included in the models.

The compiled data on concentrations of HE and HE by-products for a wide variety of facilities also suggest that HE is distributed in surface and subsurface soils (Layton et al. 1987, 15-16-447). In general, the actual field data suggest greater concentrations of HE in surface soils than predicted by the GEOTOX modeling.

The implication for TA-16 of these data is that subsurface sampling for HE will be necessary at those sites where HE contamination is likely, such as at TA-16-260 and sump outfalls. However, the lack of evidence for decoupling of surface and subsurface HE suggests that surface screening can be used to locate subsurface HE contamination.

4.0 TOXICITY OF HE CONSTITUENTS

Several of the explosives, co-constituents, degradation products of the explosives, and associated experimental materials are carcinogens and/or systemic toxicants. Nearly all of the potential contaminants may exert their

TABLE D-7

ENVIRONMENTAL FATE OF EXPLOSIVES AND HE BY-PRODUCTS

CONSTITUENT OF POTENTIAL CONCERN	WATER SOLUBILITY (mg/L)	Log K_{OC}	HENRY'S CONSTANT (atm-m^3/mol)	ENVIRONMENTAL FATE	PRIMARY LOCATION IN ENVIRONMENT
2-amino-4,6-DNT	2 800 (a)	0.15 (a)	~4 E-9 (a)	Gradual movement through soils and groundwater, should bind to humic acids and other organic matter (a)	Subsurface soils and groundwater (a)
4-amino-2,6-DNT	2 800 (a)	0.26 (a)	~1 E-9 (a)	Gradual movement through soils and groundwater, should bind to humic acids and other organic matter (a)	Subsurface soils and groundwater (a)
1,3-DNB	533 (b)	1.56 (b)	1.8 E-7 (b)	Gradual movement through soils and groundwater (a)	Subsurface soils and groundwater (a)
2,4-DNT	280 (b)	2.4 (b)	1.86 E-7 (b)	Gradual movement through soils and groundwater(a), diffusion of both vapor and aqueous phases through soil in soils receiving limited water infiltration (a)	Subsurface soils and groundwater (a)
2,6-DNT	206 (b)	1.89 (b)	4.86 E-7 (b)	Gradual movement through soils and groundwater (a), diffusion of both vapor and aqueous phases through soil in soils receiving limited water infiltration (a)	Subsurface soils and groundwater (a)
HMX	2.6(a) or 5.0(a)	2.11(a)	1 E-16 (a)	Leaching through soils (a)	Subsurface soils and groundwater (a)
PETN	2(a) or 32(a)	1.83 (a)	4 E-10 (a)	Leaching through soils (a)	Subsurface soils and groundwater (a)
PE-tri-N	Very soluble (a)	Not available	Not available	Very stable in sunlight, resistant to microbial degradation (a)	Subsurface soils and groundwater (a)
RDX	42.2 (a)	0.89 to 2.43 (a)	6.58 E-12 (a)	RDX does not strongly adsorb to soils and sediments, soil adsorption affects RDX migration only in soils with an organic content >0.25 wt% (a)	Subsurface soils and groundwater (a)
Tetryl	75 (a)	2.43 (a)	2.0 E-12 (a)	Leaching through soils (a)	Subsurface soils and groundwater (a)
1,3,5-TNB	385 (b)	2.82 (b)	9 E-8 (b)	Gradual movement through soils and groundwater (a)	Subsurface soils and groundwater (a)
TNT	123 (a)	2.67 to 3.2 (a)	2.6 E-9 (a)	Migration of TNT is affected in soils with a cation-exchange-capacity (CEC) > 10 meg/100 g, vapor-phase diffusion only important in soils where water infiltration is low (a)	Subsurface soils and groundwater (a)

Footnotes
(a) Layton et al. 1987, 15-16-447
(b) Burrows et al. 1989, 15-16-455

toxic effect (i.e., either carcinogenic and/or systemic effect) through any of the direct routes of exposure (i.e., inhalation, incidental soil ingestion, ingestion of water, and dermal exposure). The exceptions to this include the carcinogenic metals (cadmium, chromium VI, and nickel) and the carcinogenic mineral asbestos, which are considered by the US Environmental Protection Agency (EPA) to be carcinogenic only through the inhalation route of exposure.

Table D-8 lists the potential inorganic contaminants considered by the EPA to be carcinogenic only through the inhalation route of exposure (EPA 1992, 0830). They are placed in order of highest carcinogenicity to lowest carcinogenicity. The class of carcinogen refers to the evidence used to support the carcinogenic classification. For example, the evidence supporting the carcinogenic classification of A for a potential contaminant is stronger than that for a constituent with a carcinogenic classification of B.

TABLE D-8

CARCINOGENIC INORGANICS VIA INHALATION – HE DEVICE CONSTITUENTS

CONSTITUENT	CLASS OF CARCINOGEN	TARGET ORGAN
Chromium VI	A	Lung
Asbestos	A	Lung
Cadmium	B1	Respiratory tract

Table D-9 lists the potential inorganic and organic contaminants that are explosives' components considered by the EPA to be carcinogenic through all direct routes of exposure (EPA 1992, 0830). The target organs identified are for the oral route of exposure. These potential contaminants are placed in decreasing order of carcinogenicity within each class of chemical (i.e., inorganics and organics).

All of the aforementioned constituents have the potential to exert a systemic toxic effect through all direct routes of exposure. However, systemic health criteria have not been developed for all of these constituents. Tables D-10 and D-11 list the constituents, oral target organ designation, and oral reference criteria [i.e., reference dose (RfD) in mg/kg-day] available from

TABLE D-9

CARCINOGENIC CONSTITUENTS VIA ALL ROUTES OF EXPOSURE – HE AND BY-PRODUCTS

CONSTITUENT	CLASS OF CARCINOGEN	TARGET ORGAN FOR ORAL ROUTE
Inorganics		
Beryllium	B2	Multiple organs
Organics		
PAHs (i.e., benzo[a]pyrene)	B2	Stomach
2,4-DNT	B2	Liver
2,6-DNT	B2	Liver
RDX	C	Liver
TNT	C	Bladder

TABLE D-10

ORGANIC SYSTEMIC TOXICS – HE AND BY-PRODUCTS

CONSTITUENT	ORAL RfD (mg/kg/DAY)	TARGET ORGAN OR EFFECT
1,3,5-TNB	5.00E-5	Spleen
1,3-DNB	1.00E-4	Spleen weight
Nitrobenzene	5.00E-4	Liver, kidney
2,4,6-TNT	5.00E-4	Liver
2,4-DNT	2.00E-3	Neurotoxic
RDX	3.00E-3	Prostate
Tetryl	1.00E-2	Liver, kidney, spleen
HMX	5.00E-2	Liver

the EPA. An RfD is the highest dose that an individual may receive throughout his lifetime without experiencing an adverse health effect. The more toxic systemic constituents have the lowest RfDs. These constituents are placed in decreasing order of systemic toxicity within each class of chemical (i.e., inorganics and organics).

TABLE D-11

INORGANIC SYSTEMIC TOXICS – HE DEVICE COMPONENTS

CONSTITUENT	ORAL RfD (mg/kg/DAY)	TARGET ORGAN OR EFFECT
Lead	10 ug/dl (blood) [a]	Central nervous system
Cadmium	5.00E-4	Kidney
Uranium	3.00E-3	Kidney
Beryllium	5.00E-3	Not available
Chromium VI	5.00E-3	Central nervous system
Vanadium	7.00E-3	Not available
Cyanide	2.00E-2	Myelin degradation
Nickel	2.00E-2	Decreased body weight
Barium	7.00E-2	Blood pressure
Boron	9.00E-2	Testicular effects
Manganese	1.00E-1	Central nervous system
Nitrite	1.00E-1	Methemoglobemia
Zinc	2.00E-1	Anemia
Copper	1.30E+0	GI irritation
Nitrate	1.60E+0	Methemoglobemia

[a] The blood lead level of 10 ug/dl has been selected as a cutoff for intervention. Lead does not have an RfD because lead does not have a known threshold for the induction of systemic effects (EPA 1990, 15-16-456).

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OU-1082, West

Chapter 5 PRS's

LEGEND

- Boundary, LANL
- Boundary, OU
- Boundary, TA
- Contours, 10 foot
- Contours, 100 foot
- Roads, Paved
- Road/Trail
- SWMU, Present
- SWMU, Probable
- SWMU, Possible
- Permanent Structure
- Temporary Structure

NORTH, NM State Plane

Grid provides NMSP coordinates, in feet

Grid interval, in feet: 2000

0 300 600 900 ft

NOTICE: Information on this map is provisional and has not been checked for accuracy

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Earth & Environmental Sciences Division
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OU-1082, East

Chapter 5 PRS's

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G100558 28 May 93

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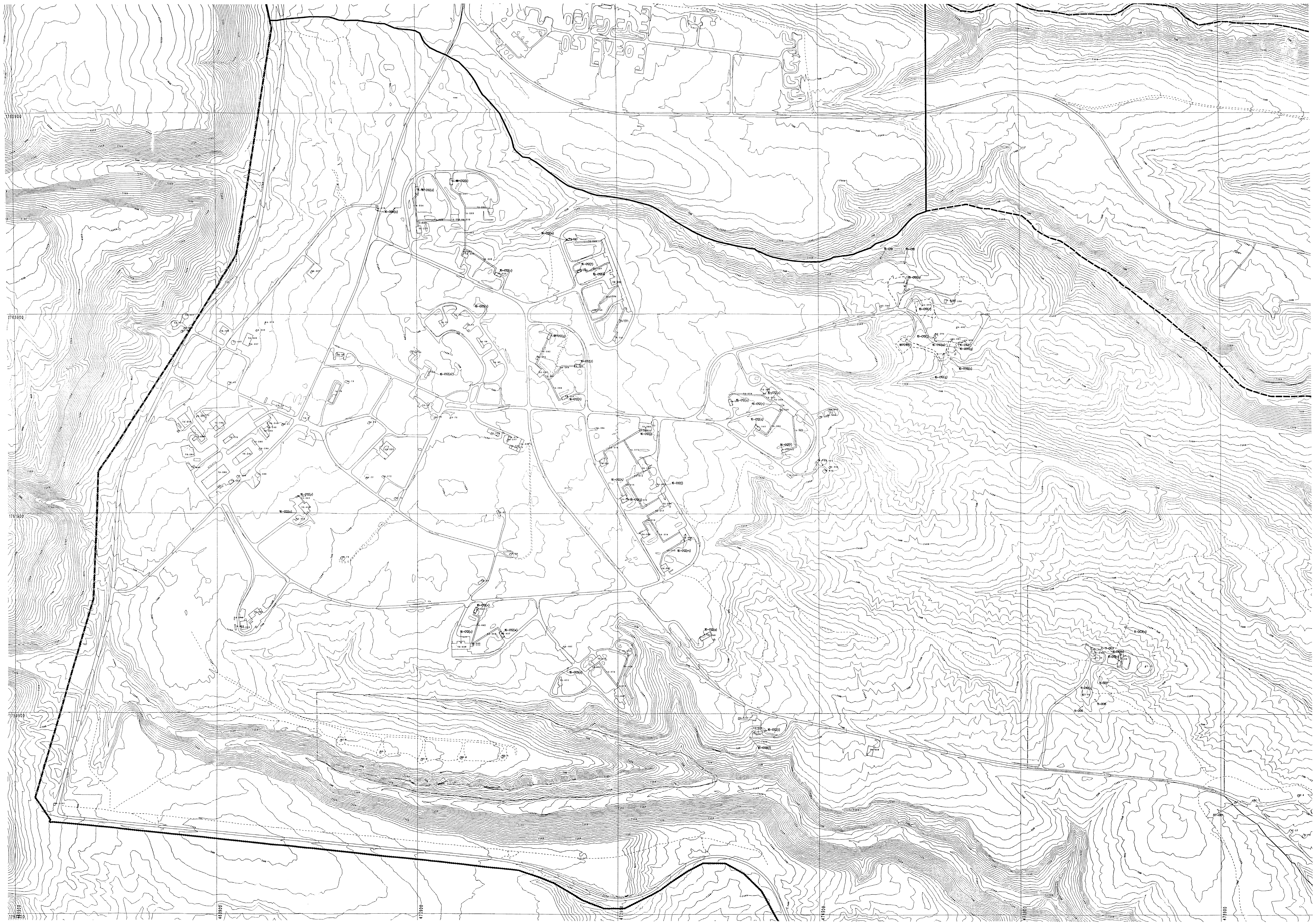
NFA (arrow only) and DA PRS's



G100559 28 May 93

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