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Date: August 25, 1997
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Mr. Benito Garcia
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P.O. Box 26110
Santa Fe, NM 87502

SUBJECT: SUBMITTAL OF THE RFI REPORT FOR TA-49

Dear Mr. Garcia:

Enclosed are two copies of the Los Alamos National Laboratory's Resource Conservation and Recovery Act Facility Investigation Report for Technical Area 49. One report is for your information and the second should go to your technical branch.

If you have any questions, please contact Don Krier at (505) 665-7834 or Mike Gilgosch at (505) 667-5794.

Sincerely,

Jorg Jansen, Program Manager
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Sincerely,

Theodore J. Taylor, Program Manager
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JJ/TT/ss

Enclosures: (1) RFI Report for TA-49
(2) Certification

3980

TC

97-2786

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CERTIFICATION

I certify under penalty of law that these documents and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violation.

Document Title: RFI Report for TA-49

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RFI Report for Technical Area 49 Potential Release Sites (Areas 5, 6, 10, and 11)

(located in former Operable Unit 1144)

Field Unit 5

Environmental Restoration Project

August 1997

A Department of Energy
Environmental Cleanup Program

Los Alamos
NATIONAL LABORATORY

LA-UR-97-2786

EXECUTIVE SUMMARY

Technical Area (TA) 49 (formerly Operable Unit 1144) is part of Field Unit 5 and is located on the southern boundary of Los Alamos National Laboratory (Laboratory). This TA was the site of 60 subsurface hydronuclear experiments conducted during the early 1960s. These experiments helped to identify one-point safety problems associated with some of the nuclear weapons systems of that time. Hydronuclear experiments terminated during the summer of 1961, and since then, TA-49 has been used only occasionally.

TA-49 is divided into ten operational areas. The potential release sites (PRSs) presented in this report are located in Areas 5, 6, 10, and 11. PRSs in each area are presented as a single unit. They are described as follows:

- Area 10 is located at the eastern end of TA-49 and includes an underground calibration chamber unit (49-002) that was in operation during the 1960s and a small landfill [49-005(a)] that received construction debris during decommissioning activities in the 1980s.
- Area 11 is the site of a former radiochemistry laboratory and small-scale containment experiments. PRS 49-003 is the leachfield associated with the laboratory. PRS 49-008(c) comprises the surface soils at Area 11 possibly impacted by the radiochemistry laboratory operations, small-scale shot experiments, and a chemical-container storage site.
- At the western end of Area 6 is a landfill (PRS 49-004) used from late 1959 to mid-1961 for open-pit burning of combustible construction wastes and for burial of uncontaminated residues generated during hydronuclear experiments and related activities. The landfill was reopened for disposal of TA-49 uncontaminated materials during cleanup operations in 1971 and 1984. Area 6 also contains four open trenches of unknown origin.
- Area 5 served as the main control area for the hydronuclear and related experiments. Many experimental support activities also were located in this area. PRS 49-008(a) is the surface soil within Area 5, 49-005(b) is the location of a small construction debris landfill, and 49-006 is a sump possibly used for the disposal of small amounts of photochemical solutions.
- An eastern section of Area 6 was developed as a general support area very early during the hydronuclear program. It included storage and office buildings, crafts structures, and a storage area for lumber, fencing, steel, cables, pipes, and sand for backfilling shafts. PRS 49-008(b) comprises the surface soils at Area 6 that may have been impacted by these support operations.

During 1995, a Phase 1 sampling investigation was conducted to determine if radionuclides and Resource Conservation and Recovery Act (RCRA) chemicals of potential concern (COPCs) were present at these PRSs at levels above background screening values or screening action levels (SALs). Although radionuclides are regulated by the Department of Energy and are not regulated under RCRA, it is more efficient and

cost effective to investigate all types of potential contamination during a single site characterization. Therefore, radiochemical concerns are also addressed in this report.

The results of the investigation are as follows:

- *Area 10.* The objective of the Phase 1 RCRA facility investigation (RFI) at PRSs 49-002 and 49-005(a) was to determine in surface and near surface soils the presence or absence of contamination associated with operations at the underground experimental chamber and at the small landfill. Eighteen inorganic chemicals were identified above background screening values at these PRSs, but no risk-based COPCs were identified. No radionuclides were detected at concentrations exceeding background screening levels, and no organic chemicals were detected. These two PRSs are being recommended for no further action (NFA).
- *Area 11.* The objective of the Phase 1 RFI at PRSs 49-003 and 49-008(c) was to determine the presence or absence of contamination associated with the radiochemical leachfield, interim storage area, and the shallow shafts (12 ft deep) of the small-scale shot area. Sixteen inorganic chemicals, four radionuclides, and two organic chemicals were identified above background screening values or above detection limits. Beryllium and plutonium-239/240 were identified as COPCs in the human health screening assessment but were eliminated as COPCs in a qualitative risk assessment. These two PRSs are recommended for NFA.
- *Area 6 (west).* The objective of the Phase 1 RFI at PRS 49-004 was to determine the presence or absence of contamination associated with the open burning/landfill area and the four open trenches. Fourteen inorganic chemicals, four radionuclides, and one organic chemical were identified above background screening values or above detection limits in the open burning/landfill area, but no risk-based COPCs were identified in the human health screening assessment. Radiological screening and visual observations indicated the open trenches had not been used for waste disposal. This PRS is recommended for NFA.
- *Area 5.* The objective of the Phase 1 RFI at PRSs 49-005(b), 49-006 and 49-008(a) was to determine the presence or absence of contamination associated with the main control area for the hydronuclear experiments. Ten inorganic chemicals and one organic chemical were identified above background screening values at these PRSs. Copper and lead were identified as COPCs in the human health screening assessment but were eliminated as COPCs in a qualitative risk assessment. These three PRSs are recommended for NFA.
- *Area 6 (east).* The objective of the Phase 1 RFI at PRS 49-008(b) was to determine the presence or absence of contamination associated with the general support area for the hydronuclear program. Three inorganic chemicals were identified above background screening values at this PRS, but no risk-based COPCs were identified. This PRS is recommended for NFA.

Table ES-1 summarizes proposed actions for these PRSs.

TABLE ES-1
SUMMARY OF PROPOSED ACTIONS

			PROPOSED ACTION		
PRS	**HSWA[a]**	**Radionuclide Component[b]**	**NFA Criterion**	**Rationale**	**Section**
49-002, 49-005(a)	No X	—	5	RCRA and radionuclide contamination are below SALs.	5.1.11
49-003, 49-008(c)	X No	X X	5	RCRA contamination is below SALs. Radionuclide contamination above SAL but does not present risk, based on future land use.	5.2.11
49-004	X	—	5	RCRA and radionuclide contamination are below SALs.	5.3.11
49-008(a), 49-005(b), 49-006	No No X	—	5	Radionuclide contamination is below SALs. RCRA contamination above SALs but does not present risk based on future land use.	5.4.11
49-008(b)	No	—	5	RCRA and radionuclide contamination are below SALs.	5.5.11

a. An X in this column indicates that the site is listed on the Hazardous and Solid Waste Amendments Module (Module VIII) of the Laboratory's hazardous waste facility permit.
b. An X in this column indicates that the site has a radionuclide component.

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ACRONYMS AND ABBREVIATIONS

AOT	Accelerator Operations and Technology Division
CFR	Code of federal regulations
COPC	Chemical of potential concern
CST	Chemical Science and Technology Division
DOE	Department of Energy
EDL	Estimated detection limits
EPA	Environmental Protection Agency
EQL	Estimated quantitation limits
ER	Environmental restoration
ESG	Environmental Studies Group
ESH	Environment, Safety, and Health Division
FIDLER	Field instrument for detection of low-energy radiation
FIMAD	Facility for Information Management, Analysis, and Display
HE	High explosives
HMX	High melting explosive
HSWA	Hazardous and Solid Waste Amendments
IQR	Interquartile range
IWP	Installation work plan
Laboratory	Los Alamos National Laboratory
LANL	Los Alamos National Laboratory
LRAD	Long-range alpha detector
MDA	Material disposal area
MCE	Multiple chemical evaluation
NFA	No further action
NIS	Nonproliferation and International Security Division
OU	Operable unit
PCB	Polychlorinated biphenyl
PRG	Preliminary remediation goals
PRS	Potential release site
QA	Quality assurance
QC	Quality control
RCRA	Resource Conservation and Recovery Act
RDA	Recommended daily allowance
RDX	Research department explosive
RFI	RCRA facility investigation
RPD	Relative percent difference
SAL	Screening action level
SMO	Sample Management Office

ACRONYMS AND ABBREVIATIONS

SOP	Standard operating procedure
SVOC	Semivolatile organic compound
TA	Technical area
TAL	Target analyte list
TNT	2,4,6-trinitrotoluene
TSCA	Toxic Substances Control Act
UCL	Upper confidence limit
UTL	Upper tolerance limit
VCA	Voluntary corrective action
VOC	Volatile organic compound

1.0 INTRODUCTION

This report presents the results of the Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) of nine surface and near surface soil potential release sites (PRSs) in Technical Area (TA) 49 of the Los Alamos National Laboratory (Laboratory). This report includes site history, environmental setting, the approach to data analysis and assessment, quality assurance (QA)/quality control (QC) results, specific results, conclusions, and recommendations.

1.1 General Site History

TA-49, in former Operable Unit (OU) 1144, is part of Field Unit 5 of the Laboratory's Environmental Restoration (ER) Project and is shown in Figure 1.1-1. The TA, also known as Frijoles Mesa site, occupies approximately 1280 acres along the south-central boundary of the Laboratory. It is bounded by Bandelier National Monument on the south and west and by other TAs on the north and east. Figure 1.1-2 shows the location of TA-49 in relation to regional and perimeter properties and to other TAs.

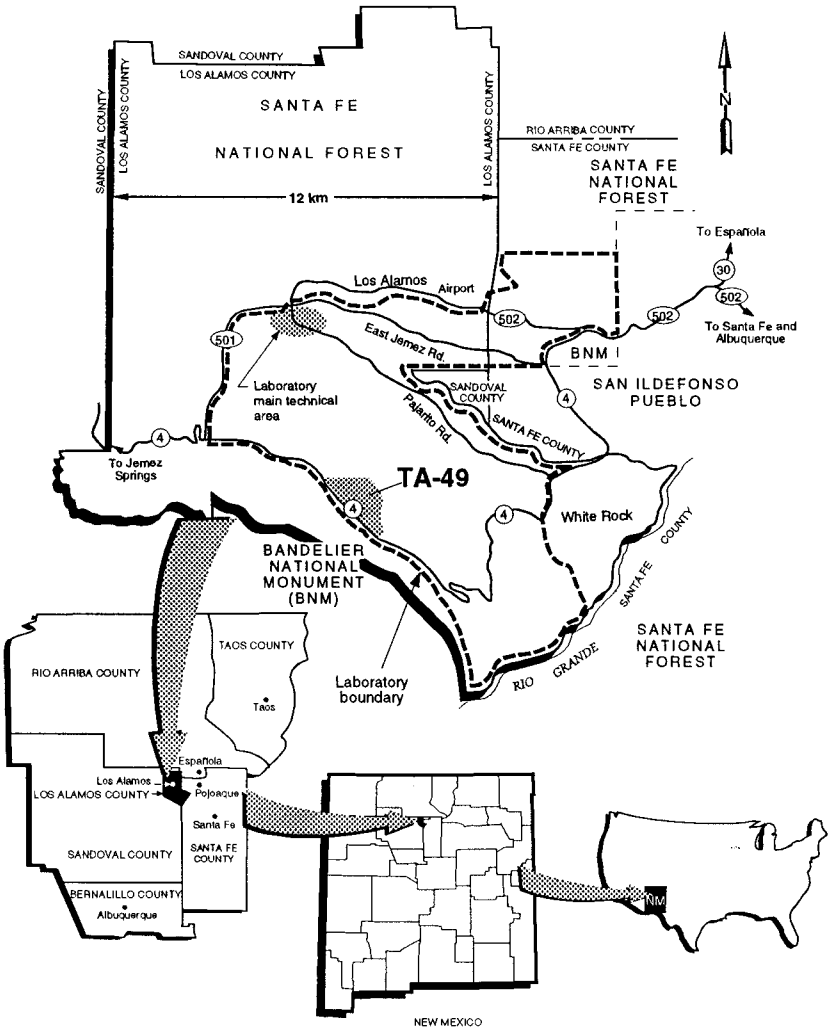

Figure 1.1-1. Location of Los Alamos National Laboratory.

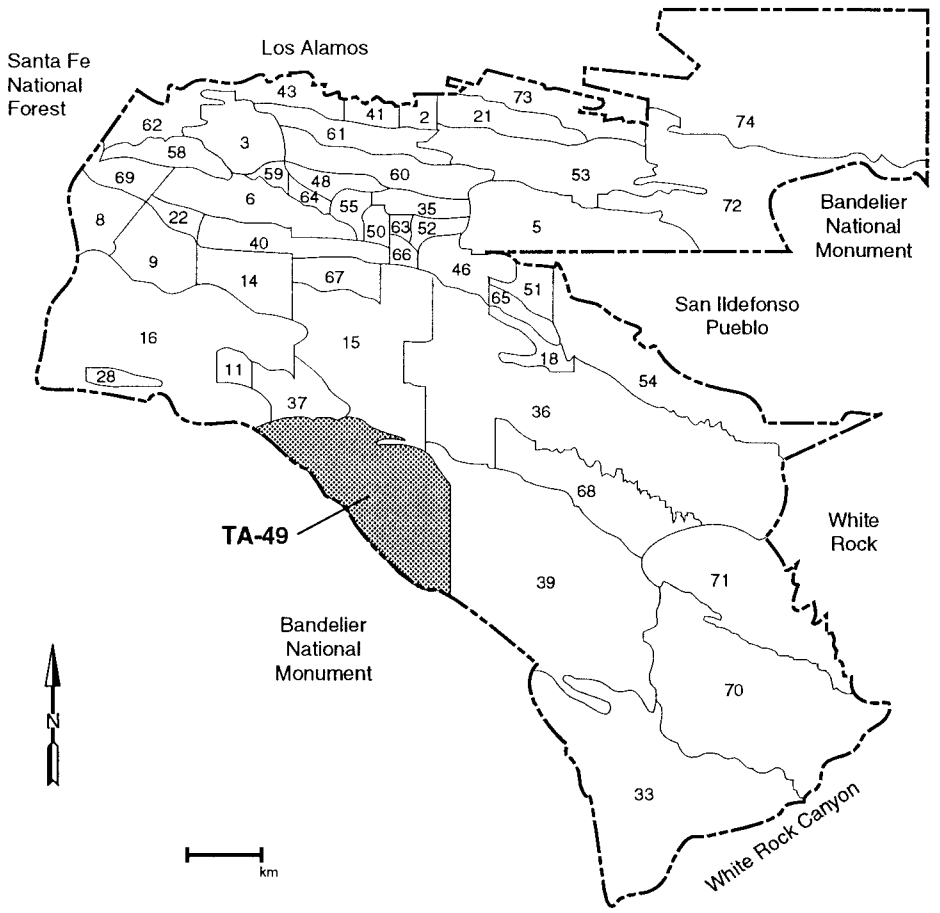

Figure 1.1-2. Location of TA-49 within the Laboratory.

Before 1959, Laboratory scientists had recognized there were potential safety problems with nuclear weapons in the nation's stockpile. These problems were related to the possibility of a significant nuclear yield as a result of accidental detonation of the device's high-explosive (HE) component. The detonation could occur during the assembly stage or while the device was stored in the arsenal. To assess this potential problem, underground hydronuclear and related experiments were designed and conducted. The hydronuclear experiments received the approval in late 1959 from President Eisenhower and in early 1960 from President Kennedy. Historical aspects of the decision to conduct the experiments are contained in a Laboratory report (Thorne and Westervelt 1987, 6672).

The favorable environmental setting of Frijoles Mesa, combined with its relatively remote location and the flat terrain that afforded desirable operational characteristics, led to its selection for the hydronuclear and related experiments. In the fall of 1959, TA-49 was created, and underground experiments were conducted through August 1961. The central portion of TA-49 surrounding Area 5 was devoted to the underground experiments (Figure 1.1-3). Four underground shaft areas (Areas 1–4, later augmented by Areas 2A and 2B) and a central control area (Area 5) were used for this purpose.

These shaft areas are now part of Material Disposal Area (MDA) AB. Supporting activities were carried out in Area 6 (crafts area and open burning/landfill area), Area 7 (security station), Area 10 (underground calibration chamber), Area 11 (radiochemistry facility and small-scale shot area), and Area 12 (Bottle House area). Areas 8 and 9 were never created. This report addresses the PRSs in the TA-49 support areas (5, 6, 10, and 11); however, it is important to understand activities in the main experimental area.

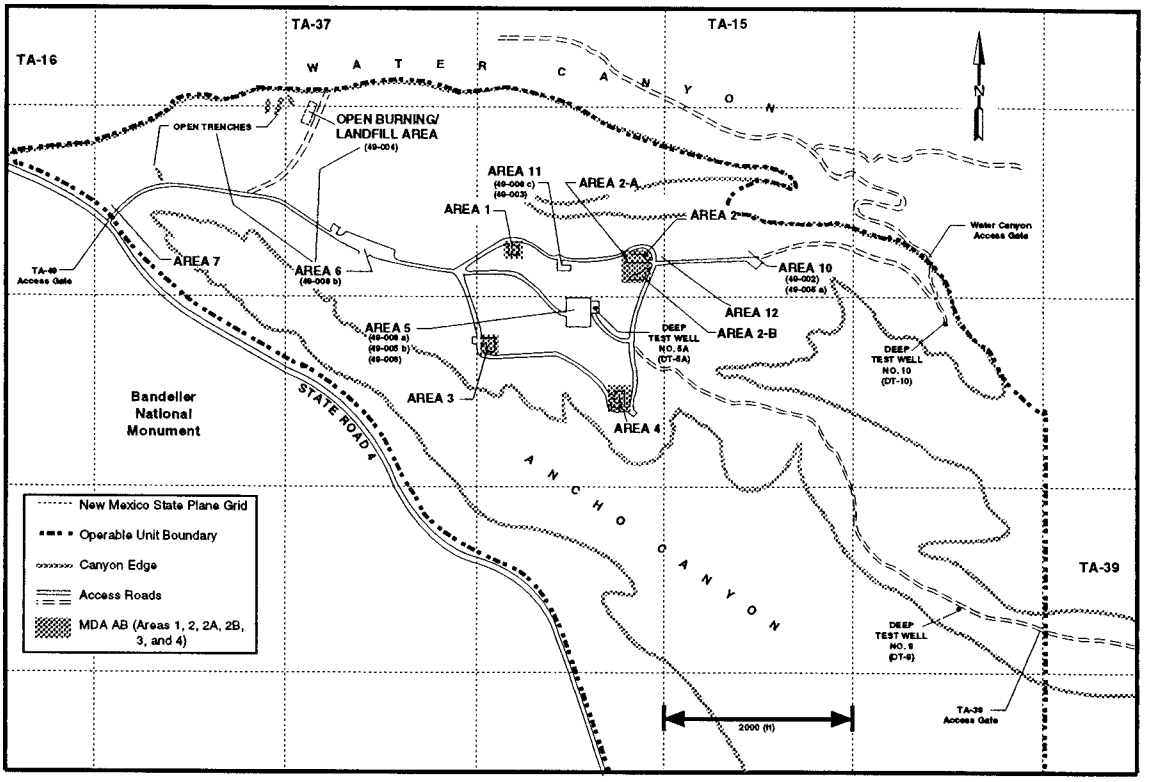

Figure 1.1-3. Locations of areas within TA-49.

An unusual aspect of the hydronuclear experiments is that the use of special nuclear materials required extremely close accounting of the quantities of uranium, plutonium, and beryllium, which are now the primary contaminants at MDA AB (as well as a large but imprecisely known quantity of lead). The quantities and locations of these contaminants are therefore known with an unusually high degree of precision (Purtymun and Stoker 1987, 6688). Explosives used in the hydronuclear experiments at MDA AB (and at a much smaller scale at Area 11) consisted largely of TNT, RDX, HMX, and barium nitrate. It is highly likely that the explosives, except for the barium component, were essentially completely consumed by the detonations. Based on the detailed historical information available, it is evident that other chemicals, used primarily for photographic and radiochemistry purposes and probably only in Areas 5 and 11, were used only in very limited quantities at TA-49. Lead shielding was used in Areas 5, 10, and 11 and thus may be present in surface soils. A network of buried cables radiating out from the main control area (Area 5) allowed for remote electronic measurements of the hydronuclear experiments. Most of these cables were later removed and disposed of

in landfills at TA-49. Copper, and perhaps other metals, from the cables are present in TA-49 landfills and surface soils.

Since the hydronuclear experiments were terminated in the summer of 1961, TA-49 has been used only lightly and sporadically (DOE 1987, 8663 and 8664). In 1965, a Laboratory group studying atmospheric phenomena conducted lightning observation experiments using the photographic tower that remained in Area 5 after the hydronuclear experiments. During the 1959 and 1961 time frame, nonradioactive TA-49 wastes were burned or buried in trenches northwest of Area 6. This open burning/landfill area also was used for burial of uncontaminated wastes during general site cleanups in 1977 and 1984. As part of the 1984 cleanup, two small areas (one east of Area 10 and one in Area 5) apparently were used as landfills to bury uncontaminated construction debris (DOE 1987, 8663 and 8664; Weston 1989, 11982). Extensive interviews with site personnel and archival searches indicate that all of these landfills [PRSs 49-004, 49-005(a), and 49-005(b)], addressed in Section 6.3 of the OU 1144 work plan, were used for burial of only uncontaminated debris. Wastes buried in the landfills are reported to have been screened with field instruments to ensure the absence of radionuclides (Purtymun and Stoker 1987, 6688; DOE 1987, 8663 and 8664; Eller 1991, 55331; LANL 1992, 7670). All radioactively contaminated surface debris from the various TA-49 cleanup campaigns was transported to the Laboratory's low-level radioactive waste disposal sites at TA-50 and TA-54.

This knowledge significantly reduces the types of chemicals that must be considered during the RFI. Thus, a small set of indicator analytes can be selected for determining the nature and extent of possible contamination at TA-49 PRSs. Although radionuclides are regulated by the Department of Energy (DOE) and are not regulated under RCRA, it is more efficient and cost effective to investigate all types of potential contamination during a single site characterization. Therefore, radiochemical concerns are addressed in this report.

The primary historic use of TA-49 as a buffer zone for activities at adjacent firing sites (TAs 15 and 39) is expected to continue indefinitely. Currently, it is only used for small-scale on-site operations, including high-power microwave experimentation by Group AOT-9 and for Hazardous Devices Team training.

This report addresses the nine PRSs listed in Table 1.1-1. PRSs from each area have been grouped together because of geographical proximity or common past operational activities, processes, and occurrences. All are recommended for no further action (NFA).

1.2 RFI Overview

This RFI report presents the results of Phase I field investigations performed at the nine PRSs. In general, Phase I investigations were conducted to assess whether chemicals were present above background concentrations and/or screening action levels (SALs) at the sites; the investigations focused on biased, worst-case scenario sampling strategies. Decisions depended on risk-based screening level risk assessments performed at each of the PRSs.

The goal of the RFI was to demonstrate and document the suitability of Areas 5 and 11 for unrestricted Laboratory use, subject to site-wide restrictions resulting from the

continuing use of TA-49 as a firing site buffer zone and the additional isolation of Areas 5 and 11 within the MDA AB exclusion fence. Future land use was assumed to remain the same as that at present; that is, these two areas will remain a controlled area within the fence enclosing MDA AB and will be managed with MDA AB for the indefinite future. For Areas 6 and 10, the goal of the RFI was to demonstrate and document the suitability of these PRS areas for unrestricted Laboratory use, subject to site-wide restrictions resulting from the ongoing use of TA-49 as a firing site buffer zone. Indefinite continuation of present use of these areas by the Laboratory was assumed.

TABLE 1.1-1
PRSs ADDRESSED IN THIS REPORT

PRS	Type of Unit	Location
49-002	Calibration Chamber Facility	Area 10
49-003	Leachfield	Area 11
49-004	Open burning/landfill area	Area 6
49-005(a)	Landfill	Area 10
49-005(b)	Landfill	Area 5
49-006	Sump	Area 5
49-008(a)	Surface soil	Area 5
49-008(b)	Surface soil	Area 6
49-008(c)	Surface soil	Area 11

For the PRSs at Areas 5, 6, 10, and 11, the data collected were needed primarily to define the distribution and extent of chemicals in surface and near-surface soils. The principal potential contaminant-migration pathway is erosion (aerial resuspension and surface water runoff). However, the significance of infiltration into buried construction debris at the landfills and the past small radioactive liquid releases at Area 11 were investigated. Although localized contamination above action levels are present at some of the areas, the likelihood of transport of significant levels of contaminants from Areas 5, 6, 10, and 11 in the near term is considered unlikely for the following reasons:

- these areas are located on a relatively flat portion of Frijoles Mesa where runoff and erosion are minimal;
- the depth to the main aquifer is about 1000 to 1200 ft, and there are no perched aquifers known or expected in the area;
- the distance to potential receptors off the Laboratory site is large for the assumed exposure scenarios, and no credible pathways are known;

- access and use of the site is strictly controlled; and
- a relatively low inventory of chemicals were found at these areas.

For these reasons, the likelihood for significant impact to public health or environment from Areas 5, 6, 10, and 11 chemicals is minimal over the assumed institutional time frame of 100 years (LANL 1992, 7670).

Field activities and analytes for each PRS are specified in the work plan (LANL 1992, 7670). The screening level analysis for the results is consistent with the strategies in the work plan and the draft RFI report format.

1.3 Field Activities

During field activities at TA-49, all applicable LANL-ER-SOPs (LANL, 51575) were followed, unless otherwise noted in Chapter 5.

1.3.1 Land Surveys

Field work at these PRSs began in December 1994 when sampling grids were staked out at Areas 5, 6, 10, and 11. The size of the sampling grids was described in the work plan (LANL 1992, 7670). Coordinates for the sampling locations were calculated with a surveying computer program (Leica 1990, 55329) and staked out with a total-station, electronic theodolite. All land surveying was completed in accordance with LANL-ER-SOP-3.01.R1 (LANL, 51575). Sampling locations were entered into the Facility for Information Management, Analysis, and Display (FIMAD) database.

1.3.2 Radiological and Chemical Screening

A radiological survey at each grid point was conducted in late 1994 and 1995 using a field instrument for detection of low-energy radiation (FIDLER) equipped with sodium iodide detectors, in accordance with LANL-ER-SOP 10.04, R1 (LANL, 51575). The purpose of the survey was to detect the presence of low-energy, gamma-emitting radionuclides in the surface soil. As proposed in the work plan (LANL 1992, 7670), a radiologically contaminated area or *hot spot* was defined as having a FIDLER measurement corresponding to an activity of 10 pCi/g or greater. The results of the survey were used in selection of the grid points for sample collection and laboratory analysis (Art 1996, 55332). Background measurements were taken at an area near the TA-49 front gate, away from any known Laboratory past or present activities.

To comply with worker safety requirements and Department of Transportation and Laboratory sample transport requirements, radiological and chemical screenings were conducted before and after sample collection. Before sample collection, each sampling location was screened for radioactivity with an ESP-1 beta/gamma meter equipped with an HP260 pancake probe (following LANL-ER-SOP 10.07, R1) (LANL, 51575) and for organic vapors with a photoionization detector (Environmental Restoration Decommissioning Project 1995, 55423). Soil samples from each location were then dried and screened for gross alpha and gross beta radiation using a Berthold proportional gas counting system (LANL-ER-SOP 14.01.R0) (LANL, 51575).

1.3.3 Surface and Subsurface Sampling

Surface and subsurface soil sampling took place during July and August 1995. Surface samples were collected using dedicated stainless steel scoops to mix the soil in place to a depth of 6 in., following LANL-ER-SOP-6.09 (LANL, 51575). The subsurface samples were collected using a CME 45 hollow-stem auger drill rig and 5-ft core barrel samplers, following LANL-ER-SOP-6.26.R0 (LANL, 51575). All samples were analyzed by gamma spectrometry. Selected samples were also analyzed for specific analytes prescribed in the work plan, including target analyte list (TAL) metals, isotopic plutonium, and total uranium. Unless specified otherwise, samples that received these additional analyses were randomly chosen before the sample collection events. Deviations from the work plan are described in Chapter 5.

2.0 ENVIRONMENTAL SETTING

The environmental setting of the Laboratory is described in Section 2.4 of the "Installation Work Plan for Environmental Restoration" (LANL 1995, 52009). A detailed discussion of the environmental setting for TA-49, including climate, geology, hydrology, and a conceptual hydrogeologic model for the area and its surroundings, is presented in the work plan (LANL 1992, 7670). A summary is presented in the following sections.

2.1 Climate

Los Alamos County has a semiarid, temperate, mountain climate. Summers are generally sunny with moderate, warm days and cool nights. High altitude, light winds, clear skies, and dry atmosphere allow summer temperatures at TA-49 to range between 50° and 90°F. During the winter, temperatures typically range between 15° and 50° F, with occasional lows below 0°. The average annual precipitation at TA-49 is 16 in. Of this total, approximately 50% occurs as brief intense thunderstorms during July and August. Stream flow in canyons and tributaries can occur as a result of these storms. Spring runoff from snow melt may also contribute to stream flow in the area canyons and tributaries.

2.2 Geology

2.2.1 Geologic Setting

A detailed discussion of the geology of the entire Los Alamos area can be found in Section 2.5.1 of the installation work plan (IWP) (LANL 1995, 52009). Stratigraphic detail of TA-49 is described in the work plan (LANL 1992, 7670) and is based on logging information from three deep test holes at the central and eastern portions of the site (DT-5A, -9, and -10) and on four core holes located in the MDA AB area. A summary of that information follows.

TA-49 lies on the east flank of the Jemez Mountains volcanic field and on the west margin of the Española Basin of the Rio Grande rift. The stratigraphy beneath TA-49 consists of 850 to 930 ft of Bandelier Tuff; depth to the main aquifer is about 1000 to 1200 ft. Rocks exposed in the area of TA-49 are entirely of the Tshirege Member of the Bandelier Tuff. Within the upper portion of the Tshirege Member is a widespread pyroclastic surge bed, which exists at a depth of 60 to 80 ft beneath MDA AB. This surge bed provides a useful site-wide geologic marker, but more importantly, it is a potential

migration pathway because of its high permeability relative to the surrounding tuff and because it is very near to, or is intersected by, one or more of the experimental shafts at MDA AB.

TA-49 lies on the western margin of a major regional tectonic feature, which includes the presumed projection of the Guaje Mountain and possibly the Rendija Canyon fault systems. A 140-ft offset in the pre-Bandelier Tuff surface along the projection of the Guaje Mountain fault near well DT-5A at TA-49 could have a significant influence upon the site's vadose- and saturated-zone hydrology and infiltration pathways.

PRSs addressed in this report are all located on the mesa top at an average elevation of approximately 7140 ft.

2.2.2 Soils

A detailed discussion of the soils in the Los Alamos area can be found in Section 2.5.1.3. of the IWP (LANL 1995, 52009). A more detailed description of the soils at TA-49 is presented in the work plan (LANL 1992, 7670).

Soils at TA-49 are primarily associated with mesa tops. However, adjacent canyon bottoms and steep canyon walls have areas where materials eroded from the PRS areas may have been deposited. Soils on the western mesa top are the deep, well-drained Nyjack loam and Typic Eutroboralf fine loam; soil thickness in this area ranges between 37 and 53 in. Near MDA AB, the soils are the Hackroy series intermixed with rock materials and are from 8 to 20 in. thick. The soil in Area 10, east of the MDA AB area, is Frijoles fine sandy loam. Further east, generally beyond the influence of the PRS area, the soil is Seaby loam. Soil thickness in shallow bore holes on the flatter areas of the mesa ranged between 0.5 and 9 ft. A distinct clay layer often is observed at the soil-tuff interface on the Pajarito Plateau. This layer has been described as an effective seal against moisture infiltration into the underlying bedrock. However, this barrier against infiltration may not exist in areas where soils have been removed or disturbed, as in much of the PRS area.

There are no features, such as wetlands, that would trap major amounts of eroded sediment.

2.3 Hydrology

The hydrology of the Pajarito Plateau is summarized in Section 2.5.2 of the IWP (LANL 1995, 52009), and a refined hydrologic model for the site is discussed in the work plan (LANL 1992, 7670). Except for the special conditions associated with MDA AB, there is not likely to be a significant migration pathway to the main ground water aquifer at TA-49 because of the large distance (1170 ft), the absence of liquid discharges, high evapotranspiration, and the generally dry nature of the underlying tuff.

2.3.1 Surface Water

PRSs at TA-49 are located in the center of a mesa that is bounded by canyons on the north, east, and south. Figure 2.3.1-1 shows the general topography for the area. Heavy summer thunderstorms can cause erosion of mesa top materials through small channels into canyons. Serious undercutting because of erosion is evident only near the mesa edges; the soils near the PRSs are quite stable because of the protection by natural

vegetation and engineered diversions. Surface water quality data have been collected for about 30 years at a surface water station in Water Canyon (about 2000 ft north of MDA AB), in Water and Ancho canyons at State Road 4, and in drainages leading from MDA AB following intense rainfall events. The surface water chemistry results over this period have shown that materials potentially released from the site are almost always at detection or background levels and show no evidence of transport from TA-49 (LANL 1992, 7670).

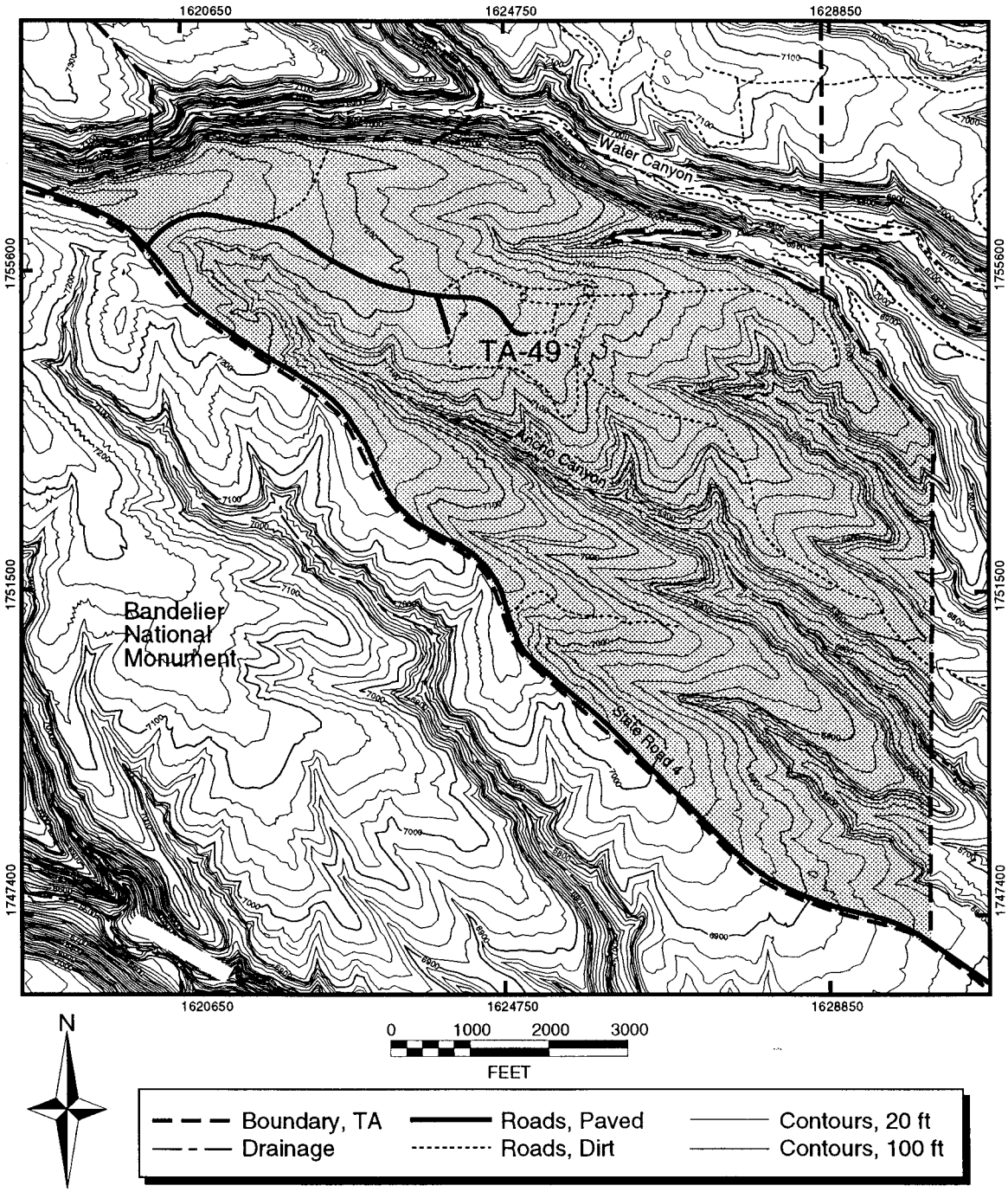

Figure 2.3.1-1. Topography of TA-49 and the surrounding area.

Surface water infiltration provides a potential mechanism for movement of contaminants into the subsurface and to the ground water aquifer. Surface water can infiltrate into the underlying tuff from small catchments, along fractures associated with the local fault system, and from leach fields, open trenches, and sumps, all represented by PRSs evaluated in this report. A number of studies addressing surface water infiltration into the Pajarito Plateau have indicated that infiltration of water through native soils into the tuff bedrock is not significant on the mesa tops (Section 4.4.1.1 of the work plan; LANL 1992, 7670). Infiltration may not be as limited in the disturbed area of MDA AB as evidenced by the appearance of water in one of the core holes. There are no wetlands immediately affected by water runoff from TA-49.

2.3.2 Ground Water

The subsurface hydrology at TA-49 is dominated by unsaturated conditions down to the main ground water aquifer; these conditions were measured in 1995 at a depth of about 1180 ft below the mesa top in test well DT-5A. Two other test wells in TA-49, DT-9 and DT-10, also penetrated the main aquifer and had water depths in 1995 of 1116 ft and 1097 ft. respectively (Environmental Assessments and Resource Evaluations Group 1996, 54769).

Except for evidence of moisture in a core hole within MDA AB, no perched ground water has been observed at TA-49. There are also no springs or seeps in Ancho or Water canyons within the boundaries of TA-49. The extensive thickness of the unsaturated zone minimizes the potential for downward movement of water through the Bandelier Tuff and into the main aquifer.

2.4 Biological Surveys

A biological resource field survey has been conducted at TA-49 (Raymer 1996, 55420) for compliance with the Federal Endangered Species Act of 1973; the New Mexico Wildlife Conservation Act; the New Mexico Endangered Species Act; Executive Order 11990, "Protection of Wetlands"; Executive order 11988, "Floodplain Management"; 10 CFR 1022, "Compliance With Floodplain/Wetlands Environmental Protection Review Requirements" (DOE 1979); and DOE Order 5400.1, General Environmental Protection Program (DOE 1988). The report concludes that there are no floodplain or wetland concerns or adverse impacts to any known critical habitat or sensitive areas as a result of sampling.

The results of this survey and the habitat description for TA-49 will be included in the ecological report prepared by the Ecological Risk Assessment Team for the ecological exposure unit(s) in which these PRSs are located.

2.5 Cultural Surveys

A cultural resource survey (Larson et al., 55328) was conducted in 1991 for TA-49, as required by the National Historic Preservation Act (amended). Thirty-four archaeological sites were identified within the survey area as being eligible for inclusion on the National Register of Historic Places under Criterion D. It was determined that the attributes that make those sites eligible for inclusion would not be affected by any ER sampling activities.

3.0 APPROACH TO DATA ASSESSMENT AND ANALYSES

The approach to data assessment used by the ER Project is described in the policy document, "Risk-Based Corrective Action Process" (Dorries 1996, 55575). The approach includes

- sampling and analysis design,
- field investigation and collection of field and QA samples,
- chemical and radiochemical analyses of samples and reporting of analytical data,
- baseline verification and validation of analytical data,
- organization of field and analytical data into PRS-specific data set(s),
- exploratory data analysis,
- focused validation when necessary to further assess questionable data,
- comparison of validated analytical results with Laboratory background data,
- comparison of validated analytical results with SALs,
- evaluation of sufficiency of data set(s) to support site decisions, and
- assessment of human health risk.

The following subsections provide overviews of the methods used to complete the steps listed above for the PRSs discussed in this report.

3.1 Sample Analyses

Samples were collected in accordance with the sampling design specified in the work plan (LANL 1992, 7670). All samples requiring chemical and radiochemical analyses and chain-of-custody documentation were submitted to the Sample Management Office (SMO), except as noted below.

3.1.1 Analytical Methods

The following analytical suites were used for categorizing the sample analyses in this report: inorganic chemicals, radionuclides, HE, volatile organic compounds (VOCs), and semivolatile organic compounds (SVOCs). A list of the target analytes for which analyses were performed for the purpose of this report can be found in Appendix A.

All samples were analyzed by contract analytical laboratories using methods specified in ER SMO analytical subcontracts (LANL 1995, 49738). The allowed methods are current Environmental Protection Agency (EPA) SW-846 and Contract Laboratory Program methods or an equivalent method for inorganic chemicals, VOCs, SVOCs, polychlorinated biphenyls (PCBs), and HE. Before analysis for inorganic chemicals, solid samples were digested according to EPA SW-846 method 3050 or an equivalent method (EPA 1992, 40070). The subcontracts specify Laboratory-approved methods for radiochemical analyses according to the technologies identified in the subcontract (e.g., americium-241 by alpha spectrometry, tritium by liquid scintillation, or multiple isotopes by gamma spectrometry). Analytical method selection is described in Appendix IV of the

ER Project "Quality Assurance Project Plan Requirements for Sampling and Analysis" (LANL 1996, 54609). For each analyte, quantitation or detection limits are specified as contract-required estimated quantitation limits (EQLs) for organic chemicals and radionuclides and estimated detection limits (EDLs) for inorganic chemicals. These limits are included in Appendix III of the ER Project quality assurance project plan along with the target analytes for each analytical suite.

Samples were not submitted to the mobile radiological analysis laboratory for gross radiation screening. Instead, gross alpha and gross beta radioactivities of aliquots of all soil samples were determined by gas proportional counting on a Berthold counter at the Laboratory ESH-19 TA-59 Counting Facility. The samples were dried and analyzed on individual planchets, each containing 1 g of soil. In this way, a measure of the levels of radioactivity of the samples was obtained before they were shipped to analytical laboratories.

The work plan stated that a field test kit was to be used to field screen soil samples for PCBs. Five samples collected from Area 5, PRS 49-008(b), were instead submitted to and analyzed by a fixed laboratory (LANL Group CST-12). Chain-of-custody procedures were followed. The method used was CST EO-410 (LANL 1993, 31793) in which the samples were sonicated with 10 ml of hexane. A Varian gas chromatograph with an electron capture detector was used to quantitate the concentration of PCBs.

3.1.2 Data Validation

Data verification and baseline validation procedures were used to determine whether data packages received from the analytical laboratory were generated according to specifications and contained the information necessary to determine data sufficiency for decision making. For analytical data used for decisions discussed in this report, baseline data validation under the ER protocol was performed as described in the quality assurance project plan (LANL 1996, 54609).

This process produced validation reports, with data qualifiers (i.e., a marker was attached to the data results) designating potential deficiencies for affected results. Each data qualifier is accompanied by a reason code that provides information about the deficiency that led to qualification of the data. The validation reports were used in the decision-making process and to direct the focused validations required to evaluate the usability of the data for this report. The purpose is not to reject data but rather to ensure that the relative quality of the data is understood so that the data may be used appropriately.

Data qualifiers used in the Laboratory ER Project baseline validation process are

- A — The data required for data review and evaluation are not available.
- U — The analyte was not positively identified in the sample, and the associated value is the sample-specific EQL/EDL.
- J — The analyte was positively identified, and the associated numerical value is estimated to be more uncertain than would normally be expected for that analysis.

- J+ The analyte was positively identified, and the result is likely to be biased high.
- J- The analyte was positively identified, and the result is likely to be biased low.
- UJ The analyte was not positively identified in the sample, and the associated value is an estimate of the sample-specific EQL/EDL.
- RPM Without further review of the raw data, the sample results are unusable because of serious deficiencies in the ability to analyze the sample and meet QC criteria. Presence or absence cannot be verified. NOTE: Any results qualified as RPM must be evaluated for relevance to data use.
- P Professional judgment should be applied to using the data in decision making.
- PM Professional judgment should be applied to using the data in decision making. A manual review of raw data is recommended to determine if the defect impacts data use for decision making.

A focused data validation may be required as a follow-up to the baseline validation. The purpose of a focused validation is to determine the technical adequacy of measurement data when

- the data are qualified as deficient or as requiring professional judgment during the verification/baseline validation process. For example, when holding times are exceeded or interferences are present, a focused validation may be required to assist in determining data adequacy for the intended use.
- the data quality assessment process requires additional information about the
  - variability or uncertainty of the reported data or
  - data quality before making a data-use decision because of anomalies detected in a data set.

Details of QA/QC activities are presented in Chapter 4 of this report. Qualifiers resulting from baseline and focused validation are shown in the analytical results tables included in Chapter 5 of this report. Summaries of data quality evaluations and focused validation of analytical data relevant to this report are given in Appendix B. The RPM, P, and PM qualifiers do not appear in Chapter 5 data tables, nor in Appendix B, because they are replaced during focused validation according to the data use.

3.2 Process for the Identification of Chemicals of Potential Concern

3.2.1 Inorganic Chemicals

Detected inorganic chemicals are compared with natural background distributions to determine if they should be retained as chemicals of potential concern (COPCs) or eliminated from further consideration. The inorganic background data used in this report are from soil and tuff samples collected throughout Los Alamos County for which chemical analyses were performed for certain inorganic (metal) chemicals (Longmire et al. 1995, 55115 and 52227).

The data in this report are for surface and subsurface samples; these samples were analyzed for inorganics. Surface samples and some subsurface samples were collected from material that was not identified as a specific geologic unit. The remainder of the subsurface samples were collected from Unit 3 of the Tshirege Member of the Bandelier Tuff. In accordance with ER Project policy, the most geologically relevant subset of Laboratory-wide background data were selected for each of these materials.

Comparisons between site data and background data are initially performed by comparing each observed concentration datum with a chemical-specific background screening value that is the upper tolerance limit (UTL), or the maximum reported concentration, or the detection limit of a nondetected chemical. These background screening values are derived from Laboratory-wide soil and tuff background data, and details on the calculation of these values are presented in Longmire et al. (1995, 52227). Certain inorganic chemicals in certain media have no Laboratory-wide background data. For these exceptions, PRS sample-specific detection limits are used as nominal background screening values. In this report, chemicals that lack background data in at least one geologic unit include mercury and silver.

If a chemical has a reported concentration that exceeds its background screening value or fails other statistical background comparison tests (i.e., the site data are statistically greater than background data), then that chemical is carried forward through the screening assessment process. If a chemical does not have a reported concentration that exceeds the background screening value, then that chemical is removed from further consideration.

Further statistical tests are used for background comparisons when sufficient data are available. When site data contain several nondetects and/or do not appear to satisfy normality assumptions, nonparametric tests are used for further background comparisons. The Gehan modification to the Wilcoxon Rank Sum test and the Quantile test, both of which account for nondetects, were used for these evaluations. The Gehan test is best suited for assessing complete shifts in distribution, whereas the Quantile test is better suited for assessing partial shifts of a subset of the data. These two tests can detect most types of differences between distributions. Detailed information on selecting statistical tests is presented in the guidance document, "Application of LANL Background Data to ER Project Decision Making, Part I: Inorganics," EM/ER:96-PCT-010 (Project Consistency Team, undated). Observed significance levels (p-values) for these tests are presented in Sections 5.1.5, 5.2.5, 5.3.5, 5.4.5, and 5.5.5 of this report. If a p-value is less than some small probability, specifically 0.05, for at least one of the statistical tests then there is reason to suspect that the site distribution is statistically greater than the background distribution; otherwise no difference is indicated. The results of these statistical tests are used in addition to the results of the comparison with background screening values to determine if a chemical appears to be elevated above background.

3.2.2 Radionuclides

Comparing reported radiochemical results with minimum detectable activities and background data is necessary to determine the presence of radionuclides and to distinguish concentrations of radionuclides associated with Laboratory operations from those attributable to global fallout and/or to natural sources.

The Laboratory ER Project requires that radiochemical data be reported by a laboratory on the basis of a detection test. Therefore, as part of the data validation/data assessment, reported results must be evaluated to ensure that only those results that represent detections be used to classify a radionuclide as a COPC. This is typically done by comparing the reported value with the associated minimum detectable activity if one is reported. When the minimum detectable activity is not available or does not meet the data quality needs of the ER Project, the reported value will be tested against an estimated minimum detectable activity. This estimated value is based on instrument counting error. The counting error is typically reported as the analytical uncertainty at a value of 1-sigma (i.e., one standard deviation), and the estimated minimum detectable activity is computed as 3-sigma.

Detected radionuclides are retained as COPCs or eliminated from further consideration based on a comparison with natural or anthropogenic background distributions. The radionuclide background data used in this report are from the following sources:

- soil and tuff samples collected throughout Los Alamos County for which chemical analyses were performed for certain naturally occurring radioactive chemicals (Longmire et al. 1995, 55115 and 52227).
- background concentrations of radioactive chemicals associated with global fallout from atmospheric nuclear testing (e.g., plutonium, cesium, strontium, and tritium) reported in Laboratory environmental surveillance reports (Purtymun et al. 1987, 6687; ESG 1988, 6877; ESG 1989, 6894; Environmental Protection Group 1990, 6995; Environmental Protection Group 1992, 7004).

Comparisons between site data and background data are initially performed by comparing each observed concentration datum with a radionuclide-specific background screening value that is either the UTL or the maximum reported activity. These background screening values are derived from Laboratory-wide soil and tuff background data, and details on the calculation of these values are presented in Longmire et al. (1995, 52227). Certain radionuclides in certain media have no Laboratory-wide background data. For these exceptions, PRS sample-specific minimum detectable activities are used as nominal background screening values.

3.2.3 Organic Chemicals

Background data are not available for organic chemicals. Organic chemicals positively identified in one or more samples have been carried forward in the screening assessment process for the PRSs in this report. Chemicals not detected in any sample have been removed from further consideration.

3.2.4 Risk-Based Screening Assessment

Inorganic chemicals and radionuclides that exceed background and organic chemicals positively identified in one or more samples require further evaluation if they also exceed SALs. SALs for nonradioactive chemicals are based on EPA Region 9 preliminary remediation goals (PRGs) for residential soil and tap water. Where appropriate, certain EPA Region 9 water PRGs are replaced by Native American pueblo, state, or federal water quality standards. Soil and water media have separate SALs for each chemical. The decision to identify a chemical as a COPC when a SAL is not available is made on a

case-by-case basis, taking into account the availability of process knowledge and toxicological information.

If more than one COPC is present at the site, a multiple chemical evaluation (MCE) is performed to determine if the potentially additive effect of chemicals detected below SALs warrants additional investigation. The method for performing an MCE is summarized in the policy document, "Risk-Based Corrective Action Process" (Dorries 1996, 55575). These comparisons are the last quantitative steps in the screening assessment process for human health concerns. If COPCs remain after this step, then further evaluation is required. If no COPCs remain after this step and the data set is sufficient to support the decision, an NFA recommendation may be proposed based on human health concerns.

If COPCs remain after the screening assessment, several options exist for the PRS. A further site-specific evaluation may lead to eliminating a COPC without going into a formal risk assessment. The site may be proposed for further sampling to more completely characterize the site or for remediation if it is cost effective to proceed without a risk assessment. A risk assessment may be conducted to determine if the remaining COPCs present an unacceptable human health risk.

3.3 Human Health Assessment

3.3.1 Risk Due to Naturally Occurring Inorganic Chemicals in Soils (Background)

Risk is associated with exposure to inorganic chemicals naturally occurring in soil. Calculation of background risks using the same methodology as site risk estimates provides a frame of reference for risk levels calculated at a site. This information provides a basis for determining risk-based remediation goals, which in some circumstances may be set at target risks comparable to background rather than default values, i.e., a cancer risk of 10^{-6} or a hazard index of 1. Background risks can also affect decisions at sites that have chemicals for which there is a toxicity threshold. For some inorganic chemicals, background intakes may be near a toxicity threshold such that incremental intakes associated with contamination may be unacceptable.

Background risk estimates provided in Table 3.3-1 were calculated using the same exposure assumptions by which SALs are calculated. SALs are based on health-protective assumptions for a residential scenario (EPA 1995, 53970). For soil exposure, the pathways include incidental soil ingestion, inhalation of resuspended dust, and dermal contact with soil. The background soil data used for these calculations were collected from several soil horizons at geographically diverse locations. Background risks are estimated for two statistics. One statistic is the median, which represents the midpoint in the concentration range (technically, the median is the concentration value that divides the results into two equal groups or where half of the data are above and half are below this value). The second statistic represents the upper range on background concentration values and is either a calculated UTL or a maximum concentration value.[1]

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[1] UTLs and maximum concentration values are identical to those described in Section 3.2.1 (Inorganic Chemicals).

The background risks based on the Laboratory SAL residential exposure model are provided in Table 3.3-1. Risks due to background concentration are presented for both noncarcinogenic and carcinogenic outcomes. The potential for adverse noncarcinogenic health effects is estimated by a hazard quotient. A chemical intake leading to a hazard quotient of up to 1 is not associated with adverse health effects. None of the median background concentrations result in hazard quotients greater than 1. The hazard quotient of the UTL concentration for manganese exceeds 1 (1.9). However, exposure to naturally occurring manganese is not expected to have significant health consequences because of the unlikely occurrence of the UTL concentration over an entire exposure area, the conservative assumptions used in the exposure assessment, and the margin of safety incorporated into the reference dose.

TABLE 3.3-1

RISK DUE TO BACKGROUND CONCENTRATIONS OF INORGANIC CHEMICALS IN SOIL ASSUMING A RESIDENTIAL SCENARIO[a]

Inorganic Chemical	Background Soil Concentration[b] (mg/kg)		Hazard Quotient		Lifetime Cancer Risk	
	Median	UTL	Median	UTL	Median	UTL
Aluminum	10 000	38 700	0.1	0.5	NC[c]	NC
Antimony	0.6	1[d]	0.02	0.03	NC	NC
Arsenic	4	7.82	0.2	0.4	1×10^{-5}	2×10^{-5}
Barium	130	315	0.03	0.06	NC	NC
Beryllium	0.895	1.95	0.003	0.006	6×10^{-6}	1×10^{-5}
Cadmium[e]	0.2	2.6[d]	0.005	0.07	1×10^{-10}	2×10^{-9}
Chromium[f]	8.6	19.3	0.00009	0.0002	NC	NC
Cobalt	6	19.2	0.001	0.004	NC	NC
Copper	5.75	15.5	0.002	0.01	NC	NC
Lead[g]	12	23.3	0.03	0.06	NC	NC
Manganese	320	714	0.8	1.9	NC	NC
Mercury	0.05	0.1[d]	0.002	0.004	NC	NC
Nickel	7	15.2	0.005	0.01	NC	NC
Selenium	0.3	1.7[d]	0.0008	0.005	NC	NC
Thallium	0.2	1[d]	0.03	0.2	NC	NC
Uranium	0.9	1.87	0.004	0.008	NC	NC
Vanadium	21	41.9	0.04	0.08	NC	NC
Zinc	30.7	50.8	0.001	0.002	NC	NC

a. Risk estimates are based on reference doses, slope factors, and EPA Region 9 default exposure assumptions effective April 1996.
b. Background concentrations taken from the all soil horizons data set (Longmire et al. 1995, 55115).
c. NC = noncarcinogen
d. Maximum detected background value.
e. Cancer risks for cadmium are based solely on inhalation of resuspended dust.
f. Naturally occurring chromium is assumed to exist in a trivalent state.
g. Hazard quotient based on biokinetic uptake model.

Three of the background inorganic chemicals provided in Table 3.3-1 are also carcinogens. Applying the default exposure assumptions used for SALs, the lifetime cancer risks due to residential soil exposure to background concentrations (UTL column) are estimated at approximately 1 excess case of cancer in 100,000 people for beryllium, 2 in 100,000 for arsenic, and 2 in 1,000,000,000 for cadmium (carcinogenic only by inhalation). EPA uses a range of 1 excess case of cancer in 10,000 people to 1 in 1,000,000 as a guidance for an acceptable range of cancer risk (EPA 1990).

These background risk estimates provide a frame of reference for a risk-based screening assessment and site decisions. If a site-specific risk assessment is necessary to further evaluate risks, background risks can also be calculated using site-/scenario-specific assumptions to assist in any remedial action decisions for the site.

3.3.2 Risk Assessment

No human health risk assessments were performed for these PRSs.

3.4 Ecological Assessment

In cooperation with the New Mexico Environment Department and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further discussion of ecological risk assessment methodology will be deferred until the ecological exposure unit methodology being developed has been approved.

4.0 RESULTS OF QA/QC ACTIVITIES

All samples and the chain-of-custody documentation were submitted to the SMO for off-site fixed analytical laboratory analyses.

EPA SW-846 methods (EPA 1992, 40070) were used to analyze samples for TAL metals; they included flame atomic absorption, method 7420; electrothermal vapor atomic absorption, method 7041; cold vaporization atomic absorption, method 7471; and inductively coupled plasma emission spectroscopy, method 6010. TAL metals include aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, and thallium.

EPA SW-846 methods (EPA 1992, 40070) were used to analyze samples for SVOCs, PCBs, and HE. Methods included gas chromatography/mass spectroscopy, method 8270, for SVOCs; gas chromatography, method 8081, for PCBs; and high-performance liquid chromatography, method 8330, for HE.

Methods used to analyze samples for radionuclides were alpha spectrometry for isotopic uranium and plutonium, kinetic phosphorescence or delayed neutron activation for total uranium, and gamma spectrometry. Americium-241 was among the radionuclides analyzed for by gamma spectrometry. The methods used for radiological analyses varied from laboratory to laboratory.

Data validation was performed on all data from the analytical laboratories. If data did not meet QC standards or nonstandard analysis methods were used, data were qualified according to the following subset of codes discussed in Chapter 3.

- J The associated numerical value is an estimated quantity.

- J- The associated numerical value is an estimated quantity biased low.
- J+ The associated numerical value is an estimated quantity biased high.
- R The data are unusable (compound may or may not be present). Resampling and reanalysis are necessary for verification.
- UJ The material was analyzed for but was not detected. The quantitation limit is an estimated quantity.

4.1 Inorganic Analyses

PRSs 49-002 and 49-005(a), Area 10. Seventeen samples were collected at these sites, and 11 soil samples were analyzed for TAL metals. Table B-1, Appendix B, summarizes the QC deviations for these PRSs.

Under request 719 (two samples), QC criteria were not met for the matrix spike sample analyses. The percent recovery of antimony, selenium, and manganese was below the lower control limit. Data for antimony and selenium were qualified UJ for both samples. Data for manganese were qualified J- for both samples. The corresponding sample results for these analytes may be biased low, but the magnitudes of the bias should have a minimal effect on the screening assessments in Chapter 5. Therefore, all sample data are considered valid and usable for site characterization.

Under request 727 (two samples), QC criteria were not met for the matrix spike sample analyses. The percent recovery of antimony was below the lower control limit; therefore, data for antimony were qualified UJ in both samples. The corresponding sample results for these analytes may be biased low, but the magnitudes of the bias should have a minimal effect on the screening assessments in Chapter 5. Therefore, all sample data are considered valid and usable.

Under request 794 (seven samples), QC criteria were not met for the matrix spike and duplicate sample analyses. The percent recoveries of lead, arsenic, and selenium were below the lower control limit in the matrix spike sample. The relative percent difference (RPD) for lead was above the acceptance criteria in the duplicate sample analyses. Data for arsenic and selenium were qualified UJ in all seven samples. Data for lead were qualified J in all seven samples. The differences in duplicate analyses are most likely caused by soil sample inhomogeneity. When duplicate analyses were reported, the larger of the two values was used in the screening assessment in Chapter 5. As for the low percent recovery, the corresponding sample results for these analytes may be biased low, but the magnitude of the bias should have a minimal effect on the outcome of the screening assessments in Chapter 5. Therefore, all sample data are considered valid and usable.

PRSs 49-003 and 49-008(c), Area 11. Fifty-one samples were collected at these sites, and 27 soil samples were analyzed for TAL metals; 3 were field duplicate samples. Table B-1, Appendix B, summarizes the QC results for these PRSs.

Under request 656 (17 samples), QC criteria were not met for the matrix spike and duplicate sample analyses. The percent recovery of selenium was below the lower control limit in the matrix spike sample; therefore, data for selenium were qualified UJ in all 17 samples. The corresponding sample results for these analytes may be biased low,

but the magnitudes of the bias should have a minimal effect on the screening assessments in Chapter 5. The RPD for beryllium was above the acceptance criteria in the duplicate sample analysis. Data for beryllium were qualified J for all 17 samples. The differences in duplicate analyses are most likely caused by soil sample inhomogeneity. When duplicate analyses were reported, the larger of the two values was used in the screening assessment in Chapter 5. Therefore, all sample data are considered valid and usable.

Under request 679 (10 samples), QC criteria were not met for the matrix spike analyses. The percent recovery of manganese was above the upper control limit in the matrix spike sample; therefore, data for manganese were qualified J+ in all 10 samples. The percent recovery of antimony was below the lower control limit in the matrix spike sample; therefore, data for antimony were qualified UJ in all 10 samples. The corresponding sample results for manganese may be biased high, and the antimony may be biased low. The magnitudes of these biases should have a minimal effect on the outcomes of the screening assessments in Chapter 5. Therefore, all sample data are considered valid and usable.

PRS 49-004, Area 6. Fifty-five samples were collected at this site. Twenty-eight soil samples were analyzed for TAL metals, and one of the samples is a field duplicate. Table B-1, Appendix B, summarizes the QC results for this PRS.

Under request 683 (nine samples), QC criteria were not met for the matrix spike and duplicate sample analyses. The percent recovery of antimony, selenium, arsenic, and barium was below the lower control limit in the matrix spike sample. Data for antimony and selenium were qualified UJ for all nine samples. Data for arsenic were qualified J- in three samples and UJ in the remaining six samples. Data for barium were qualified J- in seven samples and UJ in the remaining two samples. The RPD for manganese was above the acceptance criteria in the duplicate sample analyses. Data for manganese were qualified J for all nine samples. The differences in duplicate analyses are most likely caused by soil sample inhomogeneity. When duplicate analyses were reported, the larger of the two values was used in the screening assessment in Chapter 5. As for the low percent recovery, the corresponding sample results for these analytes may be biased low, but the magnitude of the bias had a minimal effect on the outcome of the screening assessments in Chapter 5. Therefore, all sample data are considered valid and usable.

Under request 727 (one sample), QC criteria were not met for the matrix spike sample analyses. The percent recovery of antimony was below the lower control limit in the matrix spike sample. Data for antimony were qualified UJ. However, all sample data are considered valid and usable.

Because of the large number of samples associated with request 783 (18 samples), the laboratory divided the samples into two analytical batches. Each batch contained its own set of QC samples. For both batches, QC criteria were not met for the matrix spike sample analyses. The percent recovery of antimony was <30% in both matrix spike samples; therefore, data for antimony were rejected (qualified R) in all 18 samples. The percent recovery of manganese was below the lower control limit in only one of the matrix spike samples. Therefore, only sample data associated with the noncompliant

matrix spike sample were qualified J- for manganese. Manganese data may be biased low, but the magnitude of the possible bias should not affect the outcome of the screening assessment in Chapter 5. Ten of the samples analyzed for selenium were qualified R for low-percent recovery in a matrix spike sample. For one of the two matrix spike samples, the laboratory was unable to recover selenium. It may have been present in that batch of samples but at a concentration that was undetectable. With the exception of antimony in all 18 samples and selenium in 10 of the 18 samples, sample data are considered valid and usable.

PRSs 49-005(b), 49-006, and 49-008(a), Area 5. Sixty-four samples were collected at these sites, and 21 soil samples collected at this site were analyzed for TAL metals; 1 of the samples was a field duplicate. Table B-1, Appendix B, summarizes the QC results for these PRSs.

Under request 719 (12 samples), QC criteria were not met for the matrix spike sample analyses. The percent recovery of antimony, selenium, and manganese was below the lower control limit. Data for antimony were qualified UJ for 11 of 12 samples, and data for selenium were qualified UJ for all 12 samples. The antimony datum for sample 0549-95-0130 was qualified J-. Data for manganese were qualified J- for all 12 samples. The corresponding sample results for these analytes may be biased low, but the magnitudes of the bias should have a minimal effect on the screening assessments in Chapter 5. Therefore, all sample data are considered valid and usable.

Under request 727 (nine samples), QC criteria were not met for the matrix spike sample analyses. The percent recovery of antimony was below the lower control limit; therefore, data for antimony were qualified UJ in all nine samples. Antimony data may be biased low, but the magnitude of the possible bias should not affect the outcome of the screening assessment in Chapter 5. Therefore, all sample data are considered valid and usable.

PRS 49-008(b), Area 6. Twenty-one samples were collected at this site, and 12 were analyzed for TAL metals; 1 of the samples was a field duplicate. Table B-1, Appendix B, summarizes the QC results for this PRS.

Under request 783 (12 samples), QC criteria were not met for the matrix spike sample analyses. The percent recovery of antimony was <30% in both matrix spike samples; therefore, data for antimony were rejected or qualified R in all 12 samples. The percent recovery for manganese was below the lower control limit. Data for manganese were qualified J- for all 12 samples. Manganese data may be biased low, but the magnitude of the possible bias should not affect the outcome of the screening assessment in Chapter 5. Therefore, with the exception of antimony, sample data are considered valid and usable.

4.2 Radiochemical Analyses

PRSs 49-002 and 49-005(a), Area 10. Seventeen samples were collected at these sites, and 17 were analyzed for radionuclides.

Under request number 795, 13 samples were analyzed using gamma spectrometry, and 7 samples were analyzed for plutonium isotopes and total uranium. QC criteria associated with the three analyses were met. All sample data are valid and usable.

Under request number 720, two samples were analyzed for plutonium isotopes and total uranium and also by gamma spectrometry. QC criteria associated with the three analyses were met. All sample data are valid and usable.

Under request number 728, two samples were analyzed for plutonium isotopes and total uranium and also by gamma spectrometry. QC criteria associated with the three analyses were met. All sample data are valid and usable.

PRSs 49-003 and 49-008(c), Area 11. Fifty-one samples were collected at these sites, and 51 were analyzed for radionuclides, 3 were field duplicates. Table B-1, Appendix B, summarizes the QC results for these PRSs.

Under request 657, 35 soil samples were analyzed using gamma spectrometry, and 17 samples were analyzed for plutonium isotopes and total uranium. QC criteria associated with the three analyses were met. All sample data are valid and usable.

Under request 680, 16 soil samples were analyzed using gamma spectrometry, and 10 samples were analyzed for plutonium isotopes and total uranium. QC criteria associated with the gamma spectrometry and plutonium isotopes analyses were met. Therefore, data for gamma spectrometry and plutonium isotope analyses are valid and usable. For the total uranium by kinetic phosphorescence analysis, samples 0549-95-0065 and 0549-95-0072 indicated lifetime decay values of 197 µsec and 198 µsec, respectively. These values are below the acceptable value of 200 µsec. Therefore, the total uranium data for these samples are qualified J. The results for these two samples may be biased low, but the magnitude of the biases should not affect the outcome of the assessments discussed in Chapter 5. For the remaining samples, total uranium QC criteria were met. However, all data for total uranium are considered valid and usable.

PRS 49-004, Area 6. Fifty-five samples were collected at this site, and 55 samples were analyzed for radionuclides; 2 were field duplicates.

Under request 687, 17 soil samples were analyzed using gamma spectrometry, and 9 samples were analyzed for plutonium isotopes and total uranium. QC criteria associated with the three analyses were met. All sample data are valid and usable.

Under request 728, two soil samples were analyzed using gamma spectrometry, and one sample was analyzed for plutonium isotopes and total uranium. QC criteria associated with the three analyses were met. All sample data are valid and usable.

Under request 786, 36 soil samples were analyzed using gamma spectrometry, and 18 samples were analyzed for plutonium isotopes and total uranium. QC criteria associated with the three analyses were met. All sample data are valid and usable.

PRSs 49-005(b), 49-006, and 49-008(a), Area 5. Sixty-four samples were collected at these sites, and 64 were analyzed for radionuclides; 4 were field duplicates.

Under request 720, 35 soil samples were analyzed using gamma spectrometry, and 12 samples were analyzed for plutonium isotopes and total uranium. All QC criteria associated with the three analyses were met. All sample data are valid and usable.

Under request 728, 29 soil samples were analyzed using gamma spectrometry, and 10 samples were analyzed for plutonium isotopes and total uranium. QC criteria associated with the three analyses were met. All sample data are valid and usable.

49-008(b), Area 6. Twenty-one samples were collected at this site, and 21 were analyzed for radionuclides; 2 were field duplicates.

Under request 786, 21 soil samples were analyzed using gamma spectrometry, and 12 samples were analyzed for plutonium isotopes and total uranium. QC criteria associated with the three analyses were met. All sample data are valid and usable.

4.3 Organic Analyses

PRSs 49-002 and 49-005(a), Area 10. Seventeen samples were collected at these sites, and five were analyzed for SVOCs; one was analyzed for PCBs.

Under request 793, one soil sample was analyzed for SVOCs and PCBs. QC criteria associated with the two analyses were met. All sample data are valid and usable.

Under request 718, two soil samples were analyzed for SVOCs. QC criteria were met, and all sample data are valid and usable.

Under request 726, two soil samples were analyzed for SVOCs. QC criteria were met, and all sample data are valid and usable.

PRSs 49-003 and 49-008(c), Area 11. Fifty-one samples were collected at these sites. Under request 678, three soil samples were analyzed for SVOCs, and two were analyzed for HE. The QC criteria for both analyses were met. All sample data are valid and usable.

PRS 49-004, Area 6. Fifty-five samples were collected at this site, and 10 were analyzed for organics.

Under request 682, nine soil samples were analyzed for SVOCs. QC criteria were met, and all sample data are valid and usable.

Under request 726, one soil sample was analyzed for SVOCs. QC criteria were met, and all sample data are valid and usable.

PRSs 49-005(b), 49-006, and 49-008(a), Area 5. Sixty-four samples were collected at these sites. Under request 726, four soil samples were analyzed for SVOCs. QC criteria were met, and all sample data are valid and usable.

PRS 49-008(b), Area 6. No organic analyses were performed at this site.

5.0 SPECIFIC RESULTS, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Area 10: PRSs 49-002, Calibration Chamber Facility, and 49-005(a), Landfill

Area 10 is the location of two PRSs included in this investigation. PRS 49-002 is an underground calibration chamber facility that was used for experimental measurements and calibration during the hydronuclear experiments (Figure 5.1-1); the facility consists of two vertical shafts and an underground room. This PRS also includes an area on the surface believed to be the location of a hydraulic fluid reservoir used to supply hydraulic equipment in the shafts. PRS 49-005(a) is a small landfill used to dispose of debris

during a 1984 cleanup effort (Figure 5.1-1). Metals were detected at concentrations above background but below health risk-based standards. These PRSs are recommended for NFA.

Figure 5.1-1. Sampling locations, facilities, and features at PRS 49-002, calibration chamber facility, and PRS 49-005(a), small landfill.

5.1.1 History

PRSs 49-002 and 49-005(a) are discussed in detail in Sections 6.3 and 6.5 of the work plan (LANL 1992, 7670).

The calibration chamber facility was used primarily during the hydronuclear and related experiments in 1960 and 1961; the underground room was used for experimental measurements and calibration. Potential contaminants were small radioactive sources used for instrument calibration, canisters containing lead shielding bricks, and very small

amounts of enriched uranium. It is believed that all contaminants were removed when experimental operations ended. Surface soils in this area may contain elevated levels of metals from the weathering of lead shielding and small spills of materials. Leakage of hydraulic oil is not known to have occurred, but the potential for such release existed. Chemicals of concern are TAL metals and radionuclides around the shafts and structure locations and also SVOCs and PCBs at the presumed hydraulic fluid reservoir location.

Use after 1961 was minor, unconnected with the hydronuclear experiments, and apparently did not involve radioactive or hazardous materials, with the possible exception of small radioactive sources for radiochemical counting.

During the 1984 cleanup, a small landfill [PRS 49-005(a)] was created; it is located 50 to 100 ft northeast of PRS 49-002. The location of the landfill was identified with the best available information, but the exact location is not certain. Available information, primarily from employee interviews, indicates that this small landfill was used solely to dispose of uncontaminated debris from the 1984 cleanup operations (LANL 1992, 7670; Weston 1989, 11982; Maes and Purtymun 1996, 55327). Because buried debris was uncontaminated, the chemicals of concern (radionuclides and TAL metals) are presumed to be those that were used in other areas of TA-49.

5.1.2 Description

Chapter 2 contains a detailed site-specific description including geology, soils, wildlife habitat, and cultural resources.

5.1.3 Previous Investigation(s)

No previous investigations have been performed at these sites.

5.1.4 Field Investigation

The objective of this field investigation was to determine if chemicals of concern exist above SALs or background levels in surface soils near PRS 49-002 and in surface and subsurface soils at the landfill [PRS 49-005(a)]. The investigation included soil sampling and a radiological survey conducted with a FIDLER portable gamma spectrometry meter.

5.1.4.1 FIDLER Radiological Survey

PRS 49-002. The radiological survey for this site was performed on a 25-ft grid (18 locations); Figure 5.1-1 shows survey locations. Results from two locations were at or above three standard deviations of the average background. No results exceeded the radioactivity screening level, and no further investigation was conducted for the radiological survey.

PRS 49-005(a). The radiological survey for the landfill area was performed on a 10-ft grid; Figure 5.1-1 shows survey locations. No results exceeded three standard deviations of the average background or the radioactivity screening level.

Detailed information on the radiological survey conducted at both sites in 1995 can be found in the report, "TA-49 FIDLER Survey" (Art 1996, 55332).

5.1.4.2 Soil Sampling

PRS 49-002. The surface soil investigation focused on the area near the tops of the shafts. As proposed by the work plan, a 25-ft grid was established over the area above the shafts, around the concrete pads covering the shafts, and around structure locations (Leica 1990, 55329). The grid spacing and placement were derived, as discussed in the work plan (LANL 1992, 7670). The total surface area covered by the grid was about 13,000 sq. ft.

Before sample collection, beta/gamma screening was conducted using an ESP-1 portable radiological meter at each sample location. The range of measurements was 186 to 305 cpm, with the average being 239 cpm. None of these values are considered elevated; the normal Laboratory background is from 150 to 250 cpm.

On August 3, 1995, 13 surface soil samples were collected at a depth of 0–6 in. The samples were collected at 12 locations in the middle part of the grid, around the concrete pads covering the shafts. Six of these samples were analyzed for TAL metals; all 12 were analyzed for radionuclides. Table 5.1.4-1 summarizes the sample locations and requested analyses. The thirteenth sample (location 49-7560) was collected at the location of the hydraulic fluid (Figure 5.1-1). This sample was analyzed for TAL metals, radionuclides, SVOCs, and PCBs. Gamma spectrometry was performed on all samples.

TABLE 5.1.4-1
SUMMARY OF SAMPLES TAKEN AT PRS 49-002, CALIBRATION CHAMBER

Location ID	Sample ID	Depth (ft)	Matrix	SVOCs[a]	PCBs[a]	Inorganic Chemicals[a]	Radionuclides[a]
49-7536	0549-95-0252	0–0.5	Soil	—[b]	—	794	795[c]
49-7537	0549-95-0253	0–0.5	Soil	—	—	794	795[c]
49-7538	0549-95-0254	0–0.5	Soil	—	—	—	795
49-7539	0549-95-0255	0–0.5	Soil	—	—	794	795[c]
49-7542	0549-95-0256	0–0.5	Soil	—	—	794	795[c]
49-7543	0549-95-0257	0–0.5	Soil	—	—	—	795
49-7544	0549-95-0258	0–0.5	Soil	—	—	794	795[c]
49-7545	0549-95-0259	0–0.5	Soil	—	—	—	795
49-7548	0549-95-0260	0–0.5	Soil	—	—	794	795[c]
49-7549	0549-95-0261	0–0.5	Soil	—	—	—	795
49-7550	0549-95-0262	0–0.5	Soil	—	—	—	795
49-7551	0549-95-0263	0–0.5	Soil	—	—	—	795
49-7560	0549-95-0264	0–0.5	Soil	793	793	794	795[c]

a. Request numbers.
b. A dash indicates that analysis was not requested.
c. Samples under this request number were analyzed for isotopic plutonium and total uranium, in addition to gamma spectrometry analysis.

All samples were screened for gross alpha/beta before shipment to the analytical laboratory. Minimum, average, and maximum radioactivities of the 13 samples were 0.0, 2.0, and 10.0 pCi/g gross alpha and 8.0, 20.0, and 33.0 pCi/g gross beta. No Laboratory background UTL has been established for gross alpha or beta activity; however, these data can be compared to TA-49 background data. At nine on-site monitoring locations, the minimum, average, and maximum gross alpha activities were 0.0, 3.0, and 6.0 pCi/g, and gross beta activities were 3.0, 12.0, and 20.0 pCi/g. The gross alpha and beta activities present in the screened samples appear to be slightly higher than the background data, but the values indicate no significant radionuclide contamination at the site.

The following were deviations from the work plan:

- Concrete pads covering the shafts were to be removed before the sampling operation; the pads were not removed because of safety concerns. It was also determined that the surface sampling scheme would provide sufficient indication of the presence of contaminants; if any contaminants were found, further sampling would be conducted after the concrete covers are removed.
- Samples were to be taken at the bottom of the 60-ft-deep elevator shaft, if the floor was exposed and sampling could be conducted in a safe manner. After discussions with Laboratory safety personnel, it was determined that the site conditions could not be made safe for the prescribed sampling operation.

PRS 49-005(a). This PRS is a small landfill located approximately 50 ft northeast of PRS 49-002 (Figure 5.1-1). As recommended by the work plan, two boreholes were drilled at the landfill.

Before sample collection, beta/gamma screening was conducted using an ESP-1 portable radiological meter at each sample location. The range of measurements was 194 to 244 cpm, with the average being 212 cpm. None of these values are considered elevated; the normal Laboratory background range is between 150 and 250 cpm.

Surface soil samples were collected on July 19, 1996, at locations 49-7512 and 49-7527 (Figure 5.1-1). Core samples were collected on July 20, 1996, at both locations. Analysis for radionuclides, isotopic plutonium, total uranium, TAL metals, and SVOCs was performed on the core samples and surface samples. Table 5.1.4-2 summarizes sampled locations and requested analyses. Gamma spectrometry was performed on all samples.

All samples were screened for gross alpha/beta before shipment to the analytical laboratory. Minimum, average, and maximum radioactivities of the four samples were 1.0, 7.0, and 8.0 pCi/g gross alpha and 9.0, 11.0, and 14.0 pCi/g gross beta. No Laboratory background UTL has been established for gross alpha or beta activity; however, these data can be compared to TA-49 background data. At nine on-site monitoring locations, the minimum, average, and maximum gross alpha activities were 0.0, 3.0, and 6.0 pCi/g, and gross beta activities were 3.0, 12.0, and 20.0 pCi/g. The beta/gamma and gross alpha/beta screening results indicate no significant concentrations of radionuclides at this site.

TABLE 5.1.4-2
SUMMARY OF SAMPLES TAKEN AT PRS 49-005(a), SMALL LANDFILL

Location ID	Sample ID	Depth (ft)	Matrix	SVOCs[a]	Inorganic Chemicals[a]	Radionuclides[a,b]
49-7512	0549-95-0141	0–0.5	Soil	718	719	720
49-7527	0549-95-0143	0–0.5	Soil	718	719	720
49-7512	0549-95-0140	4.0–9.0	Soil	726	727	728
49-7527	0549-95-0142	7.25–10	Soil	726	727	728

a. Request numbers.
b. Samples analyzed for isotopic plutonium and total uranium, in addition to gamma spectrometry analysis.

There was only one deviation from the work plan: no geophysical survey was conducted because the type of material (wood, small pieces of metal) buried would not be detected by normal geophysical methods.

5.1.5 Evaluation of Inorganic Chemicals

Seven soil samples collected at PRS 49-002 and four soil samples collected at PRS 49-005(a) were analyzed for TAL metals and total uranium. Of the 11 samples, 9 were collected from mesa top soil and 2 were collected from Unit 3 Tshirege Member of the Bandelier Tuff. Each inorganic result was compared to the geologically appropriate background screening value (Longmire et al. 1995, 55115 and 52227).

Fourteen inorganic chemicals (aluminum, barium, beryllium, calcium, chromium, cobalt, copper, iron, lead, magnesium, nickel, potassium, uranium, and vanadium) were detected in Unit 3 samples at concentrations above their respective background screening values. Because Unit 3 site data for these metals are inadequate to support statistical tests, these metals are carried forward to the screening assessment. Four additional inorganic chemicals (antimony, mercury, silver, and zinc) were detected in mesa top soil samples at concentrations above their respective background screening values. Antimony, mercury, and silver were not subjected to further background comparisons because the mesa top soil background data for these metals are inadequate to support the prescribed statistical tests. Further background comparisons were performed for zinc. The Gehan modification to the Wilcoxon Rank Sum test and the Quantile test were used for these evaluations (Section 3.2.1). The Gehan test p-value for zinc was 0.0144, and the Quantile test p-value was 0.0164. The results are indicative of site concentrations greater than background.

Based on the background comparisons and further statistical tests, aluminum, antimony, barium, beryllium, calcium, chromium, cobalt, copper, iron, lead, magnesium, mercury, nickel, potassium, silver, uranium, vanadium, and zinc are carried forward to the screening assessment. The data for each sample that had at least one concentration

above its background screening value are presented in Table 5.1.5-1. The locations of these samples are shown in Figure 5.1.5-1.

5.1.6 Evaluation of Radionuclides

Seventeen soil samples were analyzed by gamma spectrometry. Of these, seven samples collected at PRS 49-002 and four samples collected at PRS 49-005(a) were analyzed for isotopic plutonium and total uranium.

Uranium, which is carried forward to the screening assessment (Section 5.1.8), will be evaluated as both a noncarcinogen and a radionuclide during the screening assessment.

Twenty-two radionuclides were reported by the gamma spectrometry analysis. Analyses of radionuclides by gamma spectrometry often leads to the reporting of concentrations (for certain radionuclides) that are inappropriate to evaluate as potential site contaminants. These include short-lived activation/fission products, naturally occurring background radionuclides, and daughter radionuclides. These three classes of radionuclides are generally not considered site contaminants for the reasons discussed below.

- Seven short-lived activation/fission products reported at PRSs 49-002 and 49-005(a) (barium-140, cesium-134, cobalt-57, europium-152, manganese-54, ruthenium-106, and sodium-22) have half-lives ranging between a few days and 13.6 years. Several of these radionuclides are used as internal standards to measure equipment performance and laboratory background (or contamination). Because activation/fission products with short half-lives are routinely reported for reasons not related to RFI investigations and are not expected to occur at these PRSs, these short-lived activation/fission products are eliminated as potential radionuclide contaminants.
- Potassium-40 is a naturally occurring radionuclide that is routinely reported because it is used as an internal standard to measure such things as equipment performance and laboratory background (or contamination). There are no known processes at these PRSs that used this radionuclide, and reported concentrations are generally within known background ranges for potassium-40 (Longmire et al. 1995, 55115 and 52227), including the range of TA-49 background data. Potassium-40 will not be considered a potential radionuclide contaminant at these sites.
- Daughters of naturally occurring radionuclides (uranium and thorium) are also reported in gamma spectrometry analyses. These daughters (e.g., isotopes of actinium, bismuth, lead, protactinium, radium, radon, thallium, and thorium) are normally present in secular equilibrium concentrations and are not directly evaluated as potential radionuclide contaminants. Daughter radionuclide activities can be attributed to background concentrations of the parent and thus were not retained as potential contaminants.

TABLE 5.1.5-1

INORGANICS WITH CONCENTRATIONS[a] EXCEEDING BACKGROUND SCREENING VALUES AT PRSs 49-002 AND 49-005(a)

Analyte	SAL	All Soil Data UTL	Location 49-7536, Sample 0549-95-0252	Location 49-7539, Sample 0549-95-0255	Location 49-7542, Sample 0549-95-0256	Unit 3 UTL	Location 49-7512, Sample 0549-95-0140	Location 49-7527, Sample 0549-95-0142
Aluminum	77000	38700	5380	4240	7120	3700	**12000**	**21900**
Antimony	31	1[b]	5.7(U)	5.6(U)	**13.9**[c]	0.4	0.75(UJ)	0.81(UJ)
Barium	5300	315	76	114	118	28	**85.6**	**112**
Beryllium	n/a[d]	1.95	0.53	0.52	0.78	1.53	1.2	**1.9**
Calcium	n/a	6120	4000	3190	3690	1520	**2340**	**3320**
Chromium	210	19.3	6.6	5.4	7.3	2.1	**8.4**	**11.4**
Cobalt	4600	19.2	5.7	3.5	4.6	1.39	**2.6**	**2.1**
Copper	2800	15.5	13	**20**	12	2	**6.7**	**8.2**
Iron	n/a	21300	8280	5990	9350	9040	**10500**	**12400**
Lead	400	23.3	**48(J)**	**27(J)**	14(J)	16.2	6.3	10.1
Magnesium	n/a	4610	1380	1130	1750	628	**2530**	**3720**
Mercury	23	0.1[b]	0.72(U)	**0.11**	0.05(U)	n/a	0.1(U)	0.12(U)
Nickel	1500	15.2	5.3	5	5.3	2.6	**9**	**12.1**
Potassium	n/a	3410	936(U)	995(U)	1620(U)	735	**2260**	**4090**
Silver	380	n/a[e]	**0.67**	0.51(U)	0.51(U)	1.9	0.25	0.36
Uranium	230	5.45	3.2	3.9	3.5	1.64	**2.13**	**4.09**
Vanadium	540	41.9	12	11	14	4.01	**13**	**16.4**
Zinc	23000	50.8	**99**	**79**	43	59	29.2	30.9

a. Units are mg/kg.
b. Value represents the maximum reported background concentration in soil.
c. Bold, enlarged values indicate concentrations above background screening values.
d. n/a = not available.
e. For silver, the detection limit (0.51 mg/kg) is used as a background screening value.

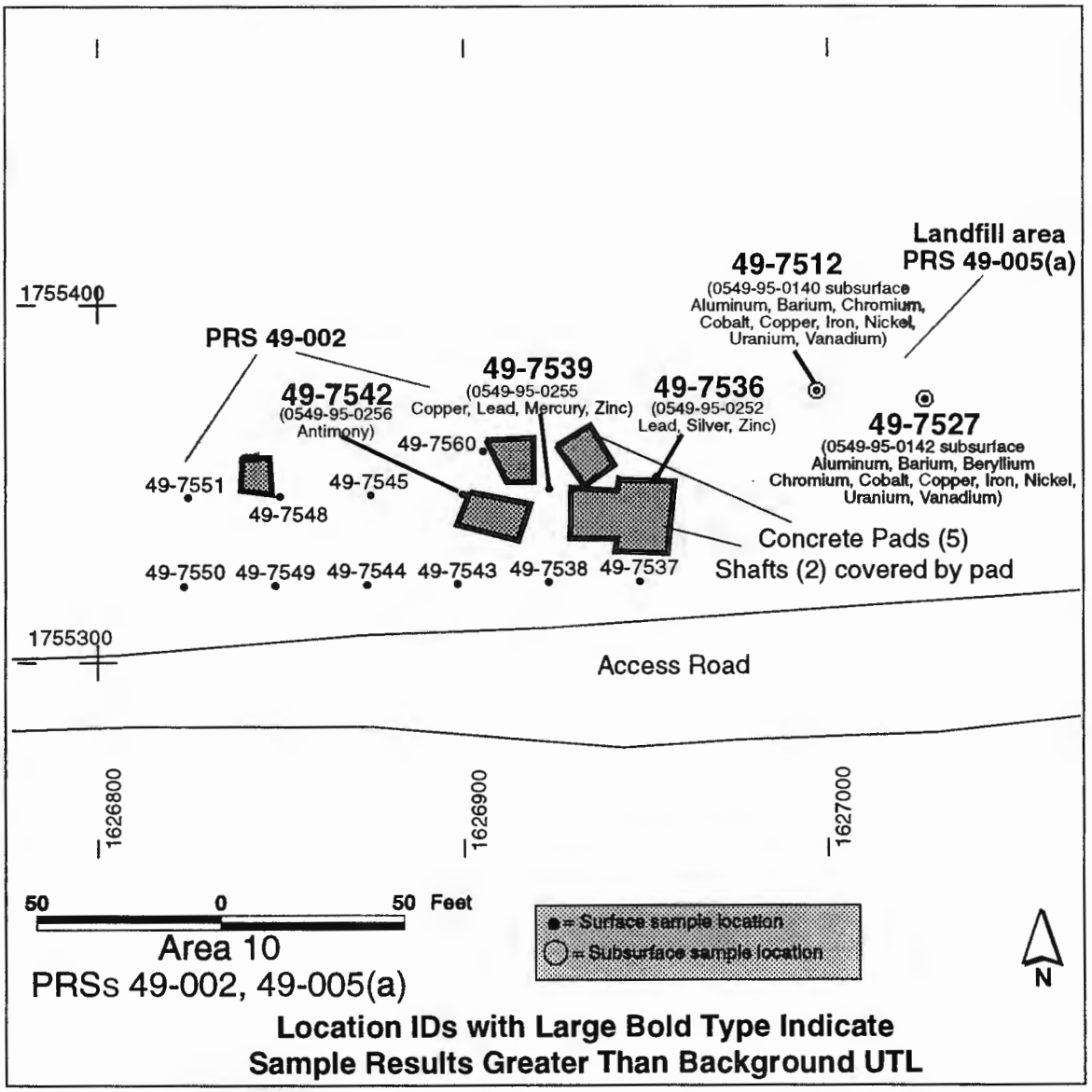


Figure 5.1.5-1. Locations of samples with inorganic concentrations above background screening values.

EQLs and minimum detectable activities are often not available for those radionuclides reported in gamma spectrometry analysis. A value of three times the measurement uncertainty (3-sigma or three standard deviations) is used to calculate a sample-specific minimum detectable activity, which is then used in the same manner as a detection limit. This methodology is similar to Currie's method of determining radionuclide maximum detectable activity (Currie 1988, 55422). The 3-sigma screening value takes into account variability because of counting statistics but does not account for spectral peak identification problems. Thus, 3-sigma screening is conservative and may include radionuclides whose presence is spuriously reported because of spectral interferences or misidentifications. Americium-241, cerium-144, cobalt-60, neptunium-237, plutonium-238, and uranium-235 were eliminated from further consideration based on this criterion.

Cesium-137 and plutonium-239/240 are the remaining radionuclides that were detected. They were eliminated from further consideration based on a comparison to background screening values. Therefore, no radionuclides (except uranium as an inorganic) are carried forward to the screening assessment.

5.1.7 Evaluation of Organic Chemicals

One soil sample from 49-7560 collected at PRS 49-002 and four soil samples collected at PRS 49-005(a) were analyzed for SVOCs. The sample collected at location 49-7560 was also analyzed for PCBs. No organics were detected in these samples. Therefore, no organics are carried forward to the screening assessment.

5.1.8 Risk-Based Screening Assessment

Eighteen inorganic chemicals detected at concentrations greater than background screening values or having no background data for comparison were carried forward to the screening assessment. Uranium was the sole radionuclide detected at concentrations exceeding background screening values and is carried forward to the screening assessment. Uranium is evaluated both as a noncarcinogen (inorganic) and as a radionuclide. No organics are carried forward to the screening assessment. The screening assessment includes a comparison to SALs and an MCE, as described in "Risk-Based Corrective Action Process" (Dorries 1996, 55575).

No chemicals were detected at concentrations exceeding their respective SALs at PRSs 49-002 and 49-005(a). Five of the inorganic chemicals carried forward from the background comparisons have no SALs for comparison. These include beryllium, calcium, iron, magnesium, and potassium. Beryllium was detected in 1 of 11 samples at a concentration (1.9 mg/kg) exceeding its background screening value (1.53 mg/kg). Beryllium concentrations in all other samples were within background screening values. Beryllium is retained as a COPC and is discussed in a qualitative human health risk assessment in Section 5.1.9. Calcium, iron, magnesium, and potassium are essential nutrients that can be eliminated as COPCs on the basis of best professional judgment (EPA 1989, 8021). Although none of these chemicals have a SAL, as essential nutrients they may be compared to the recommended daily allowance (RDA) for children and adults.

The calcium RDA is 800 mg/day for a child and 1200 mg/day for an adult. The highest detected concentration of calcium that exceeds background screening values was 3320 mg/kg. At the EPA default child soil ingestion rate of 200 mg/day, a child would ingest about 0.6 mg of calcium per day. At the EPA default adult soil ingestion rate of 100 mg/day, an adult would ingest about 0.3 mg of calcium per day. Because both amounts are considerably less than the RDAs, calcium is eliminated as a COPC.

The iron RDA is 10 mg/day for a child and 15 mg/day for an adult female. The highest detected concentration of iron that exceeds background screening values was 12,400 mg/kg. At the EPA default child soil ingestion rate of 200 mg/day, a child would ingest about 2.5 mg of iron per day. At the EPA default adult soil ingestion rate of 100 mg/day, an adult female would ingest about 1.2 mg of iron per day. Because both amounts are considerably less than the RDAs, iron is eliminated as a COPC.

The magnesium RDA is 80 mg/day for a 1- to 3-year-old child and 280 mg/day for an adult female. The highest detected concentration of magnesium that exceeds background screening values was 3720 mg/kg. At the EPA default child soil ingestion rate of 200 mg/day, a child would ingest about 0.7 mg of magnesium per day. At the EPA default adult soil ingestion rate of 100 mg/day, an adult female would ingest about 0.4 mg of magnesium per day. Because both amounts are considerably less than the RDAs, magnesium is eliminated as a COPC.

The estimated minimum requirement for potassium is 1600 to 2000 mg/day. The highest detected concentration of potassium that exceeds background screening values was 4090 mg/kg. At the EPA default child soil ingestion rate of 200 mg/day, a child would ingest about 0.8 mg of potassium per day. At the EPA default adult soil ingestion rate of 100 mg/day, an adult would ingest about 0.4 mg of potassium per day. Because both amounts are considerably less than the estimated minimum requirement, potassium is eliminated as a COPC.

The thirteen remaining chemicals were detected at maximum concentrations below their respective SALs. These remaining chemicals were divided into three classes (carcinogens, noncarcinogens, and radionuclides), and an MCE was performed to evaluate possible additive effects within each class (Dorries 1996, 55575). Chromium was the only carcinogen detected at a concentration below SAL, so an MCE was not performed for this class. Chromium was detected at a maximum concentration of 11.4 mg/kg, which is well below its SAL of 210 mg/kg, indicating little potential for adverse human health effects. Chromium is eliminated as a COPC. Uranium was the only radionuclide carried forward from the background comparison, so an MCE was not performed for radionuclides. Uranium was detected at a maximum concentration (4.09 mg/kg), which is well below its SAL (29 mg/kg), indicating little potential for adverse human health effects. Uranium is eliminated as a radionuclide COPC; however, it will be further evaluated for its noncarcinogenic effects. The MCE for noncarcinogens is presented in Table 5.1.8-1. The sum (0.9) of the normalized values in this MCE is less than unity, indicating that the potential for adverse human health effects from exposure is unlikely. Therefore, all chemicals listed in Table 5.1.8-1 are eliminated as COPCs. Only beryllium is retained as a COPC.

5.1.9 Human Health Risk Assessment

Beryllium was the only COPC identified by the screening assessment for PRSs 49-002 and 49-005(a). A quantitative human health risk assessment was not performed for these PRSs; however, a qualitative evaluation of this COPC is presented below.

Beryllium was detected in one sample collected from Unit 3 of the Bandelier Tuff; the sample was 7.25 to 10 ft below ground surface and had a concentration of 1.9 mg/kg, which exceeded the Unit 3 UTL (1.53 mg/kg). Beryllium was detected in all units of the Bandelier Tuff at naturally occurring concentrations ranging between 0.15 and 3.4 mg/kg (Longmire et al. 1995, 52227). It is likely, therefore, that this detected concentration is indicative of background concentrations in this area rather than a release to the tuff 7.25 to 10 ft below the ground surface. In addition, although the Unit 3 UTL is exceeded, the surface soil UTL (1.95 mg/kg) is not exceeded, and the subsurface concentration

represents no more risk to receptors than surface soil concentrations. Therefore, beryllium is eliminated as a COPC.

TABLE 5.1.8-1
MCE FOR NONCARCINOGENS AT PRSs 49-002 AND 49-005(a)

Chemical	Location ID	Sample Number	Maximum Concentration*	SAL*	Normalized Value
Aluminum	49-7527	0549-95-0142	21900	77000	0.3
Antimony	49-7542	0549-95-0256	13.9	31	0.4
Barium	49-7527	0549-95-0142	112	5300	0.02
Cobalt	49-7512	0549-95-0140	2.6	4600	0.0006
Copper	49-7539	0549-95-0255	20	2800	0.007
Lead	49-7536	0549-95-0252	48	400	0.1
Mercury	49-7539	0549-95-0255	0.11	23	0.005
Nickel	49-7527	0549-95-0142	12.1	1500	0.008
Silver	49-7536	0549-95-0252	0.67	380	0.002
Uranium	49-7527	0549-95-0142	4.09	230	0.02
Vanadium	49-7527	0549-95-0142	16.4	540	0.03
Zinc	49-7536	0549-95-0252	99	23000	0.004
			Sum	**=**	**0.9**

* Units in mg/kg.

5.1.9.1 Review of COPCs and Extent of Contamination

Although eighteen inorganic chemicals were identified above background screening values at these PRSs, no COPCs were identified. No radionuclides were detected at concentrations exceeding background screening values, and no organic chemicals were detected. As described in Section 5.1.4, the sampling activities were biased toward areas where contamination would be expected. The grid size and sampling locations described in Section 5.1.4 are adequate to determine the nature of contamination at these PRSs, as described in the work plan (LANL 1992, 7670). Because no COPCs were identified, determination of the extent of contamination is irrelevant.

5.1.10 Preliminary Ecological Assessment

An ecological risk evaluation was not performed because the Laboratory ER Project, in cooperation with the New Mexico Environment Department and EPA Region 6, is developing an approach for ecological risk assessment. This site will be evaluated for

ecological concerns as soon as the ecological risk screening assessment methodology can be conducted for this ecological unit.

5.1.11 Conclusions and Recommendations

The objective of the Phase 1 RFI at PRSs 49-002 and 49-005(a) was to determine the presence of contamination associated with operations at the former underground experimental chamber and at the small landfill. Beryllium was identified as a COPC in the human health screening assessment but was eliminated as a COPC in a qualitative risk assessment.

Soil samples were collected from the area with the highest potential for contamination (in the immediate vicinity of the tops of the shafts and in the landfill). Because no COPCs were identified, the evidence suggests that widespread contamination at concentrations of human health concern has not occurred.

These sites are proposed for NFA, based on NFA Criterion 5. A Class III permit modification will be requested to remove these sites from the Hazardous and Solid Waste Amendments Module of the Laboratory's hazardous waste facility permit.

5.2 Area 11: PRSs 49-003, Leachfield, and 49-008(c), Surface Soils

Area 11 is the location of PRS 49-003, a leachfield and drain lines that received liquid from Building 49-15, and PRS 49-008(c), possible surface soil contamination in the small-scale shot area, the storage area, and the surface soils overlying the leachfield (Figure 5.2-1). Plutonium-239/240 was found above SAL in one surface soil sample. However, a qualitative human health risk assessment indicated that the risk posed should be within acceptable limits, and these PRSs are recommended for NFA.

5.2.1 History

PRSs 49-003 and 49-008(c) are discussed in detail in Section 6.2 of the work plan (LANL 1992, 7670).

From 1959 to 1961, significant Laboratory use of Area 11 was limited to activities related to the hydronuclear program (Purtymun and Stoker 1987, 6688). Activities during that period consisted exclusively of limited radiochemistry operations and small-scale containment experiments involving HE detonations in shallow shafts. Waste solutions from the laboratory were drained into containers; sometimes these containers were temporarily stored in a steel box (an interim waste storage box) until taken to the disposal facility. Building 49-15, which housed the radiochemistry operations, and the steel box were removed in 1971 (Eller 1992, 26489). The leachfield and drain lines remain in place. Some small-scale experiments in the radiochemistry building involved the use of uranium-238 tracers, neptunium-239, and small quantities of lead.

Currently, Area 11 is within the interior locked exclusion fence that surrounds Areas 1, 2, 2A, 2B, and 4 of MDA AB. Access also is limited by the locked gate at State Road 4, and security personnel routinely patrol the area. The chemicals of concern at these PRSs are TAL metals, radionuclides, SVOCs, and HE.

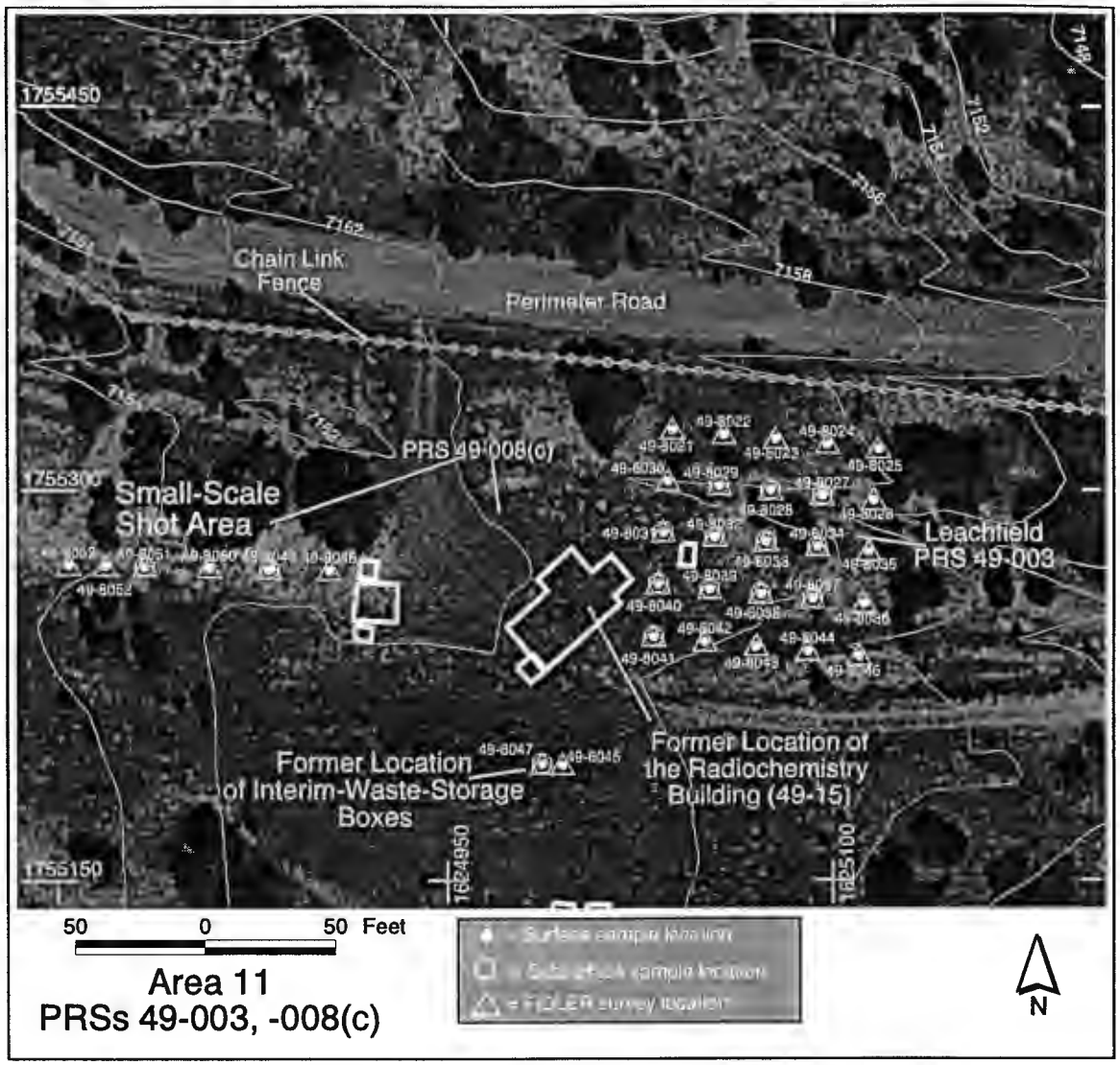


Figure 5.2-1. Sampling locations, facilities, and features at PRS 49-003, leachfield, and PRS 49-008(c), surface soils.

5.2.2 Description

Chapter 2 contains a detailed site-specific description including geology, soils, wildlife habitat, and cultural resources.

5.2.3 Previous Investigations

As part of DOE's management of MDAs containing buried radioactive waste, an intensive study of surface soils and vegetation at several areas, including Area 11, of TA-49 was conducted in 1987 (Soholt 1990, 7510). This study is referred to as the A411 Survey. As part of this survey, 22 soil samples and 20 vegetation samples were collected around the general area of the radiochemistry building and were analyzed for radionuclides. Radionuclide levels were near background in most samples, but activities of total uranium, plutonium-238, plutonium-239/240, and americium-241 were above background for a few samples. The most elevated radioactivity was in a sample taken

near the east edge of the radiochemistry building location, possibly where the sink drain was located. Levels at this sampling point were 121 pCi/g for plutonium-239/240, 22 pCi/g for americium-241, and 2.4 pCi/g for plutonium-238. The A411 report results are discussed extensively in Chapters 6 and 7 of the work plan (LANL 1992, 7670).

In May 1991, a geophysical survey was performed using magnetometry, as well as electromagnetic and ground-penetrating radar techniques (Geophex 1991, 8887). In the leachfield, the survey results suggested near-surface piping and electrically conductive areas, possibly related to subsurface chemical contamination or elevated moisture levels. The survey also confirmed the location of some buried metal in the small-scale shot area. Other portions of the area appeared to be entirely free of objects. This geophysical survey is discussed in detail in Chapter 6 and Appendix D of the work plan (LANL 1992, 7670).

On May 17 through May 19, 1994, NIS-6 personnel used long-range alpha detector (LRAD) surface soil-monitoring technology to determine the extent of alpha contamination in surface soils at Areas 1 and 11. A grid (25 ft by 25 ft over an area of 100 ft by 100 ft) was established over Area 11, and LRAD measurements were taken at each point of the grid. There was a slightly higher than normal grouping of measurements in the north-central part of the grid and a more elevated measurement in the southeastern corner. The measurement in the southeastem corner indicated low-level contamination (twice background). More detailed results of the LRAD study can be obtained from a Laboratory memorandum dated June 2, 1994 (Bounds 1994, 55330).

5.2.4 Field Investigation

The objective of this field investigation was to determine if chemicals of concern exist above SALs or background levels in surface soils near PRS 49-008(c) and in the leachfield (PRS 49-003). The investigation included a radiological survey conducted with a FIDLER portable gamma spectrometry meter and soil sampling.

5.2.4.1 FIDLER Radiological Survey

The radiological survey was performed on a 25-ft grid over the leachfield and at the sample locations of the small-scale shot holes and the location of the storage containers (Figure 5.2-1). FIDLER measurements did not indicate any radiologically contaminated areas. Location 49-8040 was just above three standard deviations of mean background. This location corresponds geographically to the east edge of the radiochemistry building, possibly where the sink drain was located. This was the approximate location of the most elevated radioactivity found in the A411 Survey. Despite the results of the LRAD study, location 49-8045 was within three standard deviations of the average background.

Detailed information on the radiological survey conducted at all sites can be found in the TA-49 FIDLER survey report (Art 1996, 55332).

5.2.4.2 Soil Sampling

Surface and subsurface samples were collected at the leachfield, interim storage area, and small-scale shot area. Tables 5.2.4-1, 5.2.4-2, and 5.2.4-3 summarize the locations sampled and analyses requested. Before sample collection, beta/gamma screening was conducted using an ESP-1 portable radiological meter at each sample location. The

range of measurements was 198 to 288 cpm, with the mean being 232 cpm. None of these values are considered elevated; the normal Laboratory background is from 150 to 250 cpm.

TABLE 5.2.4-1
SUMMARY OF SAMPLES TAKEN AT PRS 49-003, LEACHFIELD SUBSURFACE, AND PRS 49-008(c), LEACHFIELD SURFACE

Location ID	Sample ID	Depth (ft)	Matrix	Inorganic Chemicals[a]	Radionuclides[a]
49-8027	0549-95-0059	1.0–1.5	Soil	—[b]	680
49-8028	0549-95-0062	2.5–3.5	Soil	—	680
49-8029	0549-95-0065	0.8–2.0	Soil	679	680[c]
49-8029R[d]	0549-95-0066	0.8–2.0	Soil	679	680[c]
49-8031	0549-95-0072	3.3–4.3	Soil	679	680[c]
49-8032	0549-95-0075	3.3–4.3	Soil	679	680[c]
49-8033	0549-95-0078	3.0–3.5	Soil	679	680[c]
49-8034	0549-95-0081	2.5–3.5	Soil	—	680
49-8037	0549-95-0084	2.5–3.5	Soil	—	680
49-8038	0549-95-0087	2.5–3.5	Soil	679	680[c]
49-8039	0549-95-0090	2.8–3.8	Soil	—	680
49-8040	0549-95-0093	3.0–4.0	Soil	679	680[c]
49-8041	0549-95-0069	2.3–3.3	Soil	—	680
49-8021	0549-95-0024	0–0.5	Soil	656	657[c]
49-8022	0549-95-0025	0–0.5	Soil	—	657
49-8023	0549-95-0026	0–0.5	Soil	656	657[c]
49-8024	0549-95-0027	0–0.5	Soil	—	657
49-8025	0549-95-0028	0–0.5	Soil	—	657
49-8026	0549-95-0029	0–0.5	Soil	656	657[c]
49-8027	0549-95-0030	0–0.5	Soil	—	657
49-8028	0549-95-0031	0–0.5	Soil	656	657[c]

a. Request numbers.
b. A dash indicates that analysis was not requested.
c. Samples under this request number were analyzed for isotopic plutonium and total uranium, in addition to gamma spectrometry analysis.
d. R indicates field replicates.

TABLE 5.2.4-1 (concluded)

Location ID	Sample ID	Depth (ft)	Matrix	Inorganic Chemicals	Radionuclides
49-8029	0549-95-0032	0–0.5	Soil	—	657
49-8030	0549-95-0033	0–0.5	Soil	—	657
49-8031	0549-95-0034	0–0.5	Soil	656	657
49-8032	0549-95-0035	0–0.5	Soil	—	657[c]
49-8033	0549-95-0036	0–0.5	Soil	656	657[c]
49-8034	0549-95-0037	0–0.5	Soil	656	657[c]
49-8035	0549-95-0038	0–0.5	Soil	656	657[c]
49-8036	0549-95-0039	0–0.5	Soil	—	657
49-8037	0549-95-0040	0–0.5	Soil	—	657
49-8038	0549-95-0041	0–0.5	Soil	—	657
49-8038R	0549-95-0042	0–0.5	Soil	—	657
49-8039	0549-95-0043	0–0.5	Soil	656	657[c]
49-8040	0549-95-0044	0–0.5	Soil	656	657[c]
49-8041	0549-95-0045	0–0.5	Soil	—	657
49-8042	0549-95-0046	0–0.5	Soil	656	657[c]
49-8042R	0549-95-0047	0–0.5	Soil	656	657[c]
49-8043	0549-95-0048	0–0.5	Soil	—	657
49-8044	0549-95-0049	0–0.5	Soil	656	657[c]
49-8045	0549-95-0050	0–0.5	Soil	656	657[c]

c. Samples under this request number were analyzed for isotopic plutonium and total uranium, in addition to gamma spectrometry analysis.

Leachfield Area. A 25-ft grid was established over the leachfield area, as was proposed in the work plan (LANL 1992, 7670). On July 6, 1995, 25 surface soil samples (0–0.5 ft) were collected from points on the grid. Surface samples were collected at locations 49-8021 to 49-8045 (Table 5.2.4-1). On July 11, 1995, 13 subsurface soil samples (0.8–4.3 ft) were collected from cores drilled at 12 locations on the leachfield grid. Subsurface samples were collected at locations 49-8027 to 49-8029, 49-8031 to 49-8034, and 49-8037 to 49-8041. Figure 5-2.1 shows the site and all sample locations. The location for the drilling and the depths of the borehole were specified in the work plan and were expected to bound the conductive zone identified by the geophysical survey. The work plan specified a depth of 9 ft for boreholes in the leachfield; however, this depth was not reached because tuff was encountered at shallower depths than expected. The soil-tuff

interface was identified in the recovered core. This soil-tuff interface and the intervals immediately above and below it (Table 5.2.4-1) were included in the collected sample.

TABLE 5.2.4-2
SUMMARY OF SAMPLES TAKEN AT PRS 49-008(c), INTERIM STORAGE AREA

Location ID	Sample ID	Depth (ft)	Matrix	SVOCs[a]	Inorganic Chemicals[a]	Radionuclides[a]
49-8046	0549-95-0051	0–0.5	Soil	—[b]	656	657[c]
49-8047	0549-95-0052	0–0.5	Soil	—	—	657
49-8047	0549-95-0096	0–3	Soil	678	679	680[c]

a. Request numbers.
b. A dash indicates that analysis was not requested.
c. Samples under this request number were analyzed for isotopic plutonium and total uranium, in addition to gamma spectrometry analysis.

TABLE 5.2.4-3
SUMMARY OF SAMPLES TAKEN AT PRS 49-008(c), SMALL-SCALE SHOT AREA

Location ID	Sample ID	Depth (ft)	Matrix	HE[a]	SVOCs[a]	Inorganic Chemicals[a]	Radionuclides[a]
49-8048	0549-95-0053	0–0.5	Soil	—[b]	—	—	657
49-8049	0549-95-0054	0–0.5	Soil	—	—	—	657
49-8049	0549-95-0099	7–12	Soil	678	678	679	680[c]
49-8050	0549-95-0055	0–0.5	Soil	—	—	656	657[c]
49-8051	0549-95-0056	0–0.5	Soil	—	—	—	657
49-8051	0549-95-0100	7–12	Soil	678	678	679	680[c]
49-8052	0549-95-0057	0–0.5	Soil	—	—	—	657
49-8053	0549-95-0058	0–0.5	Soil	—	—	656	657[c]

a. Request numbers.
b. A dash indicates that analysis was not requested.
c. Samples under this request number were analyzed for isotopic plutonium and total uranium, in addition to gamma spectrometry analysis.

Interim Storage Container Area. On July 6 and 7, 1995, two surface samples and one subsurface sample were collected in this area (Figure 5.2-1). Table 5.2.4-2 summarizes sample locations and requested analyses. The work plan specified a depth of 6 ft for the borehole at the interim storage area. However, as with the leachfield boreholes, tuff was encountered at a shallower depth than expected. Only one subsurface sample was collected; the entire interval (0–3 ft) was included in the collected sample.

Small-Scale Shot Area. On July 6, 1995, surface samples were collected at six locations, and on July 11, 1995, subsurface samples were collected at two of the six locations; locations were randomly selected. During experiments, explosive charges had been set off at the bottom of 10-in.-diameter vertical holes that were 12 ft deep. The core intervals of 7 to 12 ft were included in the collected samples. This was the depth at which the highest amount of chemicals from the explosive charges was expected. Figure 5.2-1 shows sample locations. Table 5.2.4-3 summarizes sampled locations and requested analyses.

All samples from these areas were screened for gross alpha/beta and were then packaged and promptly submitted through chain-of-custody procedures to the SMO for shipment to analytical laboratories. Minimum, average, and maximum radioactivities of the 51 samples from PRSs 49-003 and 49-008(c) were 0.6, 9.0, and 62.0 pCi/g gross alpha and 0.0, 11.0, and 24.0 pCi/g gross beta. The maximum gross alpha activity of 62.0 pCi/g is from location 49-8040, which is near the area identified by the A411 study discussed in Section 5.2.3. No Laboratory background UTL has been established for gross alpha or beta activity; however, these data can be compared to TA-49 background data. At nine on-site monitoring locations, the minimum, average, and maximum gross alpha activities were 0.0, 3.0, and 6.0 pCi/g, and gross beta activities were 3.0, 12.0, and 20.0 pCi/g. At the analytical laboratory, all samples were analyzed for radionuclides by gamma spectrometry, and half were analyzed for TAL metals, isotopic plutonium, and total uranium. The subsurface samples collected at the interim container storage area and the small-scale shot area were analyzed for SVOCs and HE (in addition to the previous mentioned analyses).

The following are deviations from the work plan.

- The work plan discussed conducting voluntary corrective actions (VCAs). Specifically, possible drain lines inferred from the 1991 geophysical survey were to be excavated. It was decided to complete the Phase 1 surface and subsurface soil sampling and evaluate the results before proceeding with any VCAs. This decision was made because of a change in approach to VCAs by the ER Project with its accelerated RFI decision logic (Project Consistency Team, undated).
- The sampling plan specified that subsurface samples at the leachfield be analyzed for SVOCs. Because of an oversight, SVOCs were not requested. However, the lack of SVOC data does not invalidate the recommendations made in Section 5.2.11. The primary contaminants from laboratory operations at this site would have been radionuclides. Long-lived radionuclides, such as plutonium, are far more environmentally persistent than organic chemicals. If there was a widespread presence of radionuclides in the subsurface samples collected from the leachfield, it would indicate that waste liquids were discharged to the leachfield rather than collected and stored in containment vessels. In that event, resampling for organic chemicals would have been necessary. However, as discussed in Section 5.2.6, only one radionuclide, americium-241, in one subsurface sample was found at a concentration slightly above the background screening levels. This would indicate that, at most, only small amounts of waste liquids were discharged to the subsurface. Therefore, the inorganic and

radiochemical data are sufficient, to characterize potential releases of laboratory chemicals to the leachfield.

5.2.5 Evaluation of Inorganic Chemicals

Twenty-seven soil samples collected at PRSs 49-003 and 49-008(c) were analyzed for TAL metals and total uranium. Of the 27 samples, 20 were collected from mesa top soil, and 7 were collected from Unit 3 Tshirege Member of the Bandelier Tuff. Each inorganic result was compared to the geologically appropriate background screening value (Longmire et al. 1995, 55115 and 52227).

Fifteen inorganic chemicals (aluminum, barium, beryllium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, uranium, and vanadium) were detected in Unit 3 samples at concentrations above their respective background screening values. Because Unit 3 site data for these metals are inadequate to support statistical tests, these inorganic chemicals are carried forward to the screening assessment. Silver was detected in mesa top soil at a concentration above its background screening value. Silver was not subjected to further background comparisons because the mesa top soil background data for silver are inadequate to support the prescribed statistical tests. Silver is, therefore, carried forward to the screening assessment.

Based on the background comparisons, 16 inorganic chemicals are carried forward to the screening assessment. The data for each sample that had at least one concentration above its background screening value are presented in Table 5.2.5-1. The locations of these samples are shown in Figure 5.2.5-1.

Qualifiers shown in Table 5.2.5-1 were assigned during baseline validation. However, the data are usable for site-specific decisions. As discussed in Section 4.1, beryllium data were qualified J because, in the duplicate sample analysis, the RPD was above acceptance criteria. The beryllium datum for the 1 sample that is qualified J is below the all soil data UTL for beryllium, and the qualifier indicates that the concentration has greater uncertainty than usual. Manganese data were qualified J+ in 10 samples because, in the matrix spike sample, the percent recovery of manganese was above the upper control limit. These qualifiers indicate a possible high bias, and the concentrations in these samples are all below their respective UTLs for manganese. Uranium data were qualified J for 2 samples because the indicated lifetime phosphorescence decay values are slightly below the acceptable value. This might cause a very slight low bias in the reported results that does not affect the outcome of the risk-based screening assessment conducted in Section 5.2.8.

5.2.6 Evaluation of Radionuclides

Twenty-seven soil samples collected at PRSs 49-003 and 49-008(c) were analyzed for isotopic plutonium and total uranium. Twenty-three of these samples and an additional 27 samples were also analyzed by gamma spectrometry.

Uranium, which is carried forward to the screening assessment in Section 5.2.8, will be evaluated as both a noncarcinogen and a radionuclide during the screening assessment.

TABLE 5.2.5-1
INORGANICS WITH CONCENTRATIONS[a] EXCEEDING BACKGROUND SCREENING VALUES IN SOILS AT PRSs 49-003 AND 49-008(c)

Analyte	SAL	All Soil Data UTL	Location 49-8035, Sample 0549-95-0038	Location 49-8053, Sample 0549-95-0058	Location 49-8029, Sample 0549-95-0065[b]	Location 49-8029, Sample 0549-95-0066	Location 49-8047, Sample 0549-95-0096
Surface Soils							
Aluminum	**77000**	**38700**	6470	6180	9770	8460	7400
Barium	**5300**	**315**	87.3	124	121	115	122
Beryllium	**n/a[c]**	**1.95**	0.526(UJ)	0.884(J)	0.8(U)	0.76(U)	0.75(U)
Calcium	**n/a**	**6120**	1240	1170	2340	2400	1740
Chromium	**210**	**19.3**	6.41	6.22	8.54	**7.9**	8.1
Cobalt	**4600**	**19.2**	6.01	11.3	6.57(U)	6.1(U)	7.9(U)
Copper	**2800**	**15.5**	5.99	5.22	5.87	5.6	6
Iron	**n/a**	**21300**	8390	8640	12400	11700	12100
Lead	**400**	**23.3**	11.2	13.2	15.5	15.5	13
Magnesium	**n/a**	**4610**	1270	1210	1880	1690	1400
Manganese	**3200**	**714**	457	**828[d]**	392(J+)	375(J+)	486(J+)
Nickel	**1500**	**15.2**	4.72	4.64	7.48(U)	7.4(U)	7(U)
Potassium	**n/a**	**3410**	1160	1180	1120(U)	1060(U)	1130
Silver	**380**	**n/a[e]**	0.526(U)	0.517(U)	**0.108**	**0.11**	**0.11**
Uranium	**230**	**5.45**	**8.36**	2.55	2.42	2.37	2.47
Vanadium	**540**	**41.9**	20.2	22.6	22.4	21	24

Subsurface Soils

Analyte	SAL	Unit 3 UTL	Location 49-8031, Sample 0549-95-0072	Location 49-8032, Sample 0549-95-0075	Location 49-8033, Sample 0549-95-0078	Location 49-8038, Sample 0549-95-0087	Location 49-8040, Sample 0549-95-0093	Location 49-8051, Sample 0549-95-0100
Aluminum	**77000**	**3700**	**14900**	**9060**	**14200**	**23100**	**15500**	1590
Barium	**5300**	**28**	**175**	**72.2**	**147**	**431**	**407**	16.9(U)
Beryllium	**n/a**	**1.53**	1.1(U)	0.82(U)	1.5	**1.7**	1.3	0.61(U)
Calcium	**n/a**	**1520**	**4380**	**2980**	**3510**	**5950**	**6330**	**2720**
Chromium	**210**	**2.1**	**8**	**7**	**9.3**	**11.8**	**8.6**	**2.3**

a. Units are mg/kg.
b. Value represents the maximum of a sample concentration and its laboratory duplicate.
c. n/a = not available.
d. Bold, enlarged values indicate concentrations above background screening values.
e. For silver, the detection limit is used as a background screening value.

TABLE 5.2.5-1 (concluded)

Analyte	SAL	Unit 3 UTL	Location 49-8031, Sample 0549-95-0072	Location 49-8032, Sample 0549-95-0075	Location 49-8033, Sample 0549-95-0078	Location 49-8038, Sample 0549-95-0087	Location 49-8040, Sample 0549-95-0093	Location 49-8051, Sample 0549-95-0100
Subsurface Soils								
Cobalt	4600	1.39	**12.2**	1.9(U)	3.3(U)	3.9(U)	3.6(U)	1.3(U)
Copper	2800	2	3.8(U)	4.6(U)	**6.8**	**7.5**	**6.8**	**2.2**
Iron	n/a	9040	**12500**	8850	**12300**	**16600**	**13200**	3280
Lead	400	16.2	**22.6**	9.4	15.4	**23.5**	12.4	2
Magnesium	n/a	628	**2340**	**2270**	**3260**	**4250**	**2680(J+)**	809(U)
Manganese	3200	426	**497(J+)**	97.4(J+)	134(J+)	107(J+)	120(J+)	176(J+)
Nickel	1500	2.6	7.8(U)	5.6(U)	**10**	**11.9**	**9.6**	2.9(U)
Potassium	n/a	735	**1190**	**1150**	**1690**	**2030**	**1350**	519(U)
Silver	380	1.9	0.11	0.11	0.11	0.11	0.12	0.11
Uranium	230	1.64	1.8(J)	1.7(J)	**1.79**	**2.1**	**1.85**	1.2
Vanadium	540	4.01	**17.3**	10.3(U)	**16.1**	**20.7**	**16.6**	2(U)

Eleven radionuclides were reported by the gamma spectrometry analysis. Analyses of radionuclides by gamma spectrometry often leads to the reporting of concentrations (for certain radionuclides) that are inappropriate to evaluate as potential site contaminants. These include short-lived activation/fission products and naturally occurring background radionuclides. These classes of radionuclides are generally not considered site contaminants for the reasons discussed below.

Five short-lived activation/fission products reported at PRSs 49-003 and 49-008(c) (barium-140, cobalt-57, europium-152, ruthenium-106, and sodium-22) have half-lives ranging between a few days and 13.6 years. Several of these radionuclides are used as internal standards to measure equipment performance and laboratory background (or contamination). Because activation/fission products with short half-lives are routinely reported for reasons not related to RFI investigations and are not expected to occur at these PRSs, these short-lived activation/fission products are eliminated as potential radionuclide contaminants.

Potassium-40 is a naturally occurring radionuclide that is routinely reported because it is used as an internal standard to measure such things as equipment performance and laboratory background (or contamination). There are no known processes at these PRSs that used this radionuclide, and reported concentrations are generally within known Laboratory background ranges (Longmire et al. 1995, 55115 and 52227) and specifically within TA-49 background ranges. Potassium-40 will not be considered a potential radionuclide contaminant at these sites.

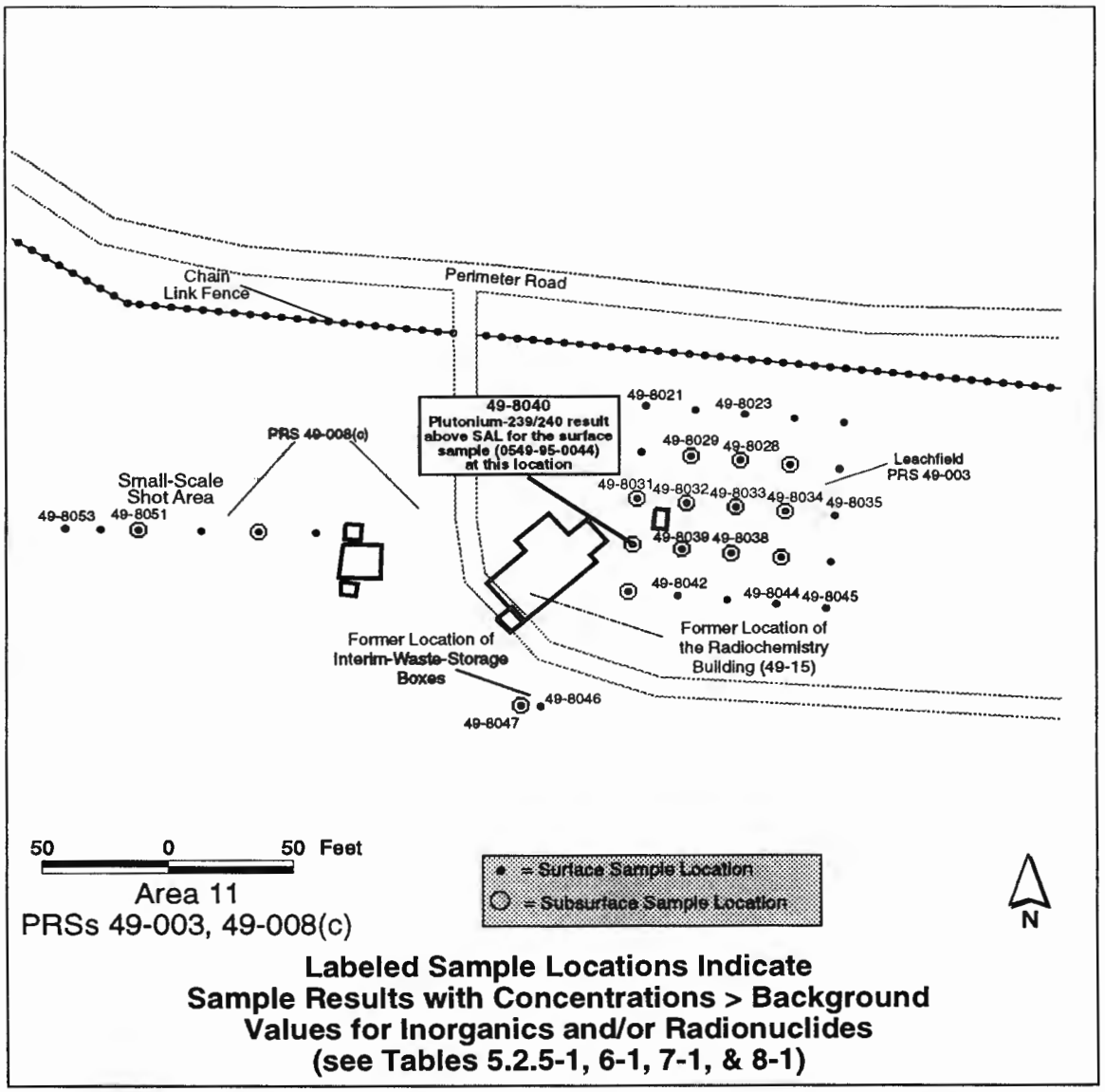


Figure 5.2.5-1. Locations of samples with inorganic and radionuclide concentrations above background screening values.

EQLs and minimum detectable activities are often not available for those radionuclides reported in gamma spectrometry analysis. A value of three times the measurement uncertainty (3-sigma or three standard deviations) is used to calculate a sample-specific minimum detectable activity, which is then used in the same manner as a detection limit. This methodology is similar to Currie's method of determining radionuclide maximum detectable activity (Currie 1988, 55422). The 3-sigma screening value takes into account variability because of counting statistics but does not account for spectral peak identification problems. Thus, 3-sigma screening is conservative and may include radionuclides whose presence is spuriously reported because of spectral interferences or misidentifications. Cerium-144, cobalt-60, and neptunium-237 were eliminated from further consideration based on this criterion.

Americium-241, cesium-137, plutonium-238, and plutonium-239/240 are the remaining radionuclides that were detected. Cesium-137 was eliminated from further consideration based on comparison to background screening values. Americium-241, plutonium-238, and plutonium-239/240 are carried forward to the screening assessment. The data for each sample that had at least one concentration above its background screening value for these three radionuclides are presented in Table 5.2.6-1. The locations of these samples are shown in Figure 5.2.5-1.

TABLE 5.2.6-1
RADIONUCLIDES WITH CONCENTRATIONS[a] EXCEEDING BACKGROUND SCREENING VALUES AT PRSs 49-003 AND 49-008(c)

Location ID	Sample ID	Americium-241	Plutonium-238	Plutonium-239/240
UTL	—	**0.336[b]**	**0.104[b]**	**0.092[b]**
SAL	—	**22**	**27**	**24**
49-8021	0549-95-0024	-0.539 (U)	0.01	**0.2[c]**
49-8023	0549-95-0026	-0.018 (U)	0.01	**0.3**
49-8028	0549-95-0031	0.165 (U)	0.02	**0.1**
49-8031	0549-95-0034	0.549 (U)	0.08	**5.4**
49-8032	0549-95-0035	**0.613**	NR[d]	NR
49-8033	0549-95-0036	0.041 (U)	0.02	**0.8**
49-8034	0549-95-0037	0.221 (U)	0.01	**0.3**
49-8035	0549-95-0038	-0.131 (U)	0.01	**0.3**
49-8039	0549-95-0043	**1.74**	0.09	**5.1**
49-8040	0549-95-0044	**9.30**	**1.1**	**66.1**
49-8042	0549-95-0046	**1.39**	0.01	**8.5**
49-8042	0549-95-0047	**2.1**	**0.2**	**8.5**
49-8044	0549-95-0049	0.453 (U)	0.04	**2**
49-8045	0549-95-0050	0.799 (U)	0.01	**0.7**
49-8046	0549-95-0051	0.22 (U)	0.01	**0.2**
49-8029	0549-95-0065	**0.442**	0.006 (U)[e]	0.014[e]

a. Units are pCi/g
b. Value represents the maximum reported background concentration from the environmental surveillance reports.
c. Bold, enlarged values indicate concentrations above background screening value.
d. NR = analysis not requested
e. Value represents the maximum of a sample concentration and its laboratory duplicate.

5.2.7 Evaluation of Organic Chemicals

Three soil samples collected at PRSs 49-003 and 49-008(c) were analyzed for SVOCs. Two of these samples were also analyzed for HE. Two organics, bis(2-ethylhexyl)phthalate and di-n-octylphthalate, were detected in these samples. The data for these detected organic chemicals are presented in Table 5.2.7-1.

TABLE 5.2.7-1
DETECTED ORGANIC CHEMICAL CONCENTRATIONS[a] AT PRSs 49-003 and 49-008(c)

Location ID	Sample ID	Bis(2-ethylhexyl)phthalate	Di-n-octylphthalate
SAL		32	1300
49-8047	0549-95-0096	**0.1[b]**	**0.15**
49-8049	0549-95-0099	**0.07**	0.35 (U)

a. Concentrations in (mg/kg).
b. Bold, enlarged values indicate detected concentrations.

5.2.8 Risk-Based Screening Assessment

Sixteen inorganic chemicals detected at concentrations greater than background screening values or having no background data for comparison were carried forward to the screening assessment. Three radionuclides (in addition to total uranium) were detected at concentrations exceeding background screening values and are carried forward to the screening assessment. Two organic chemicals were detected and are carried forward to the screening assessment. The screening assessment includes a comparison to SALs and an MCE, as described in "Risk-Based Corrective Action Process" (Dorries 1996, 55575).

Plutonium-239/240 (sample 0549-95-0044) was detected at location 49-8040 at a concentration of 66.1 pCi/g, which exceeded its SAL of 24 pCi/g.

Five of the inorganic chemicals carried forward from the background comparisons have no SALs for comparison. These include beryllium, calcium, iron, magnesium, and potassium. Beryllium was detected in one Unit 3 sample at a concentration (1.7 mg/kg) exceeding its background screening value (1.53 mg/kg). All other sample concentrations were below background screening values. Beryllium is retained as a COPC and is discussed in a qualitative human health risk assessment in Section 5.2.9. Calcium, iron, magnesium, and potassium are essential nutrients that can be eliminated as COPCs on the basis of best professional judgment (EPA 1989, 8021). Although none of these chemicals have a SAL, as essential nutrients they may be compared to the RDA for children and adults.

The calcium RDA is 800 mg/day for a child and 1200 mg/day for an adult. The highest detected concentration of calcium that exceeds background screening values was 6330 mg/kg. At the EPA default child soil ingestion rate of 200 mg/day, a child would ingest about 1.3 mg of calcium per day. At the EPA default adult soil ingestion rate of 100 mg/day, an adult would ingest about 0.6 mg of calcium per day. Because both amounts are considerably less than the RDAs, calcium is eliminated as a COPC.

The iron RDA is 10 mg/day for a child and 15 mg/day for an adult female. The highest detected concentration of iron that exceeds background screening values was 16,600 mg/kg. At the EPA default child soil ingestion rate of 200 mg/day, a child would ingest

about 3.3 mg of iron per day. At the EPA default adult soil ingestion rate of 100 mg/day, an adult female would ingest about 1.7 mg of iron per day. Because both amounts are considerably less than the RDAs, iron is eliminated as a COPC.

The magnesium RDA is 80 mg/day for a 1- to 3-year-old child and 280 mg/day for an adult female. The highest detected concentration of magnesium that exceeds background screening values was 4250 mg/kg. At the EPA default child soil ingestion rate of 200 mg/day, a child would ingest about 0.9 mg of magnesium per day. At the EPA default adult soil ingestion rate of 100 mg/day, an adult female would ingest about 0.4 mg of magnesium per day. Because both amounts are considerably less than the RDAs, magnesium is eliminated as a COPC.

The estimated minimum requirement for potassium is 1600 to 2000 mg/day. The highest detected concentration of potassium that exceeds background screening values was 2030 mg/kg. At the EPA default child soil ingestion rate of 200 mg/day, a child would ingest about 0.4 mg of potassium per day. At the EPA default adult soil ingestion rate of 100 mg/day, an adult would ingest about 0.2 mg of potassium per day. Because both amounts are considerably less than the estimated minimum requirement, potassium is eliminated as a COPC.

The 15 remaining chemicals were detected at concentrations below their respective SALs. These remaining chemicals are divided into three classes (carcinogens, noncarcinogens, and radionuclides) to evaluate possible additive effects within each class of chemicals in an MCE (Dorries 1996, 55575). Uranium is evaluated as a radionuclide, as well as for its noncarcinogenic effects. The MCE for PRS 49-003 and 49-008(c) is presented in Table 5.2.8-1.

The sums of the normalized values for carcinogens (0.06), noncarcinogens (0.8), and radionuclides (0.7) are each less than unity, indicating that the potential for adverse human health effects from exposure is unlikely. Therefore, all carcinogens, noncarcinogens, and radionuclides at concentrations below SAL are eliminated as COPCs. Only beryllium and plutonium-239/240 are retained as COPCs.

5.2.9 Human Health Risk Assessment

Beryllium and plutonium-239/240 were identified as COPCs by the screening assessment for PRSs 49-003 and 49-008(c). A quantitative human health risk assessment was not performed for these PRSs; however, a qualitative evaluation of these COPCs is presented below.

Beryllium was detected in one sample collected from Unit 3 of the Bandelier Tuff; the sample was 2.5 to 3.5 ft below ground surface and had a concentration of 1.7 mg/kg, which exceeded the Unit 3 UTL (1.53 mg/kg). Beryllium was detected in all units of the Bandelier Tuff at naturally occurring concentrations ranging between 0.15 and 3.4 mg/kg (Longmire et al. 1995, 52227). It is likely, therefore, that this detected concentration is indicative of background concentrations in this area rather than a release to the tuff 2.5 to 3.5 ft below the ground surface. In addition, although the Unit 3 UTL is exceeded, the surface soil UTL (1.95 mg/kg) is not exceeded, and the subsurface concentration represents a lower risk to receptors than surface soil. Therefore, beryllium is eliminated as a COPC.

TABLE 5.2.8-1
MCE FOR PRSs 49-003 AND 49-008(c)*

Analyte	Location ID	Sample Number	Maximum Concentration	SAL	Normalized Value
Carcinogens					
Bis(2-ethylhexyl)phthalate	49-8047	0549-95-0096	0.1	32	0.003
Chromium	49-8038	0549-95-0087	11.8	210	0.06
			Sum	**=**	**0.06**
Noncarcinogens					
Aluminum	49-8038	0549-95-0087	23100	77000	0.3
Barium	49-8038	0549-95-0087	431	5300	0.08
Cobalt	49-8031	0549-95-0072	12.2	4600	0.003
Copper	49-8038	0549-95-0087	7.5	2800	0.003
Di-n-octylphthalate	49-8047	0549-95-0096	0.15	1300	0.0001
Lead	49-8038	0549-95-0087	23.5	400	0.06
Manganese	49-8053	0549-95-0058	828	3200	0.3
Nickel	49-8038	0549-95-0087	11.9	1500	0.008
Silver	49-8040	0549-95-0093	0.12	380	0.0003
Uranium	49-8035	0549-95-0038	8.36	230	0.04
Vanadium	49-8038	0549-95-0087	20.7	540	0.04
			Sum	**=**	**0.8**
Radionuclides					
Americium-241	49-8040	0549-95-0044	9.3	22	0.4
Plutonium-238	49-8040	0549-95-0044	1.1	27	0.04
Uranium	49-8035	0549-95-0038	8.36 (mg/kg)	29 (mg/kg)	0.3
			Sum	**=**	**0.7**

* Units for carcinogens and noncarcinogens are in mg/kg, and units for radionuclides are in pCi/g, except as noted.

Plutonium-239/240 was detected in the surface soil at one location (49-8040) in the leachfield at a concentration of 66.1 pCi/g, which exceeded its SAL of 24 pCi/g. This area is near the east edge of the location of the radiochemistry building, possibly where a sink drain was located (Figure 5.2.5-1). Elevated concentrations (above background but well below SALs) decrease as one moves away in any direction from this location (Table 5.2.6-1 and Figure 5.2.5-1). Plutonium-239/240 concentrations did not exceed background screening value in any subsurface samples. The elevated concentration is

thus bounded vertically and laterally. If the leachfield area is assumed to represent an exposure unit, the lognormal mean concentration of plutonium-239/240 across the exposure unit is 3.28 pCi/g, and the 95th upper confidence limit (UCL) calculated on this mean is 8.46 pCi/g. This UCL is well below the residential SAL (24 pCi/g); therefore, no adverse human health effects would be expected from exposure to plutonium-239/240 in this exposure unit. Plutonium-239/240 is therefore eliminated as a COPC.

5.2.9.1 Review of COPCs and Extent of Contamination

Although 16 inorganic chemicals, 4 radionuclides, and 2 organic chemicals were identified above background screening values or above detection limits at these PRSs, no risk-based COPCs were identified. As described in Section 5.2.4, the sampling activities were biased toward areas where contamination would be expected. The grid size and sampling locations described in Section 5.2.4 are adequate to determine the nature of contamination from these PRSs, as described in the work plan (LANL 1992, 7670). The lateral and vertical extent of contamination are defined well enough for plutonium-239/240 to determine that potential adverse human health effects are unlikely.

5.2.10 Preliminary Ecological Assessment

An ecological risk evaluation was not performed because the Laboratory ER Project, in cooperation with the New Mexico Environment Department and EPA Region 6, is developing an approach for ecological risk assessment. This site will be evaluated for ecological concerns as soon as the ecological risk screening assessment methodology can be conducted for this ecological unit.

5.2.11 Conclusions and Recommendations

The objective of the Phase 1 RFI at PRSs 49-003 and 49-008(c) was to determine the presence or absence of contamination associated with the radiochemical leachfield, interim storage area, and the small-scale shot area. Beryllium and plutonium-239/240 were identified as COPCs in the human health screening assessment but were eliminated as COPCs in a qualitative risk assessment.

Soil samples were collected from the area with the highest potential for contamination (surface and subsurface samples within the leachfield, interim storage area, and small-scale shot area). Because no COPCs were identified, the evidence suggests that widespread contamination at concentrations of human health concern has not occurred.

These sites are proposed for NFA, based on NFA Criterion 5. A Class III permit modification will be requested to remove these sites from the Hazardous and Solid Waste Amendments Module of the Laboratory's hazardous waste facility permit.

5.3 Area 6: PRS 49-004, Open Burning/Landfill Area

PRS 49-004 is an open burning/landfill area (Figure 5.3-1). Four open trenches west and southwest of PRS 49-004 were also investigated (Figure 1.1-3). Metals and radionuclides were detected above background screening levels in samples from the open burning/landfill area but were below health risk-based standards. This PRS is recommended for NFA.

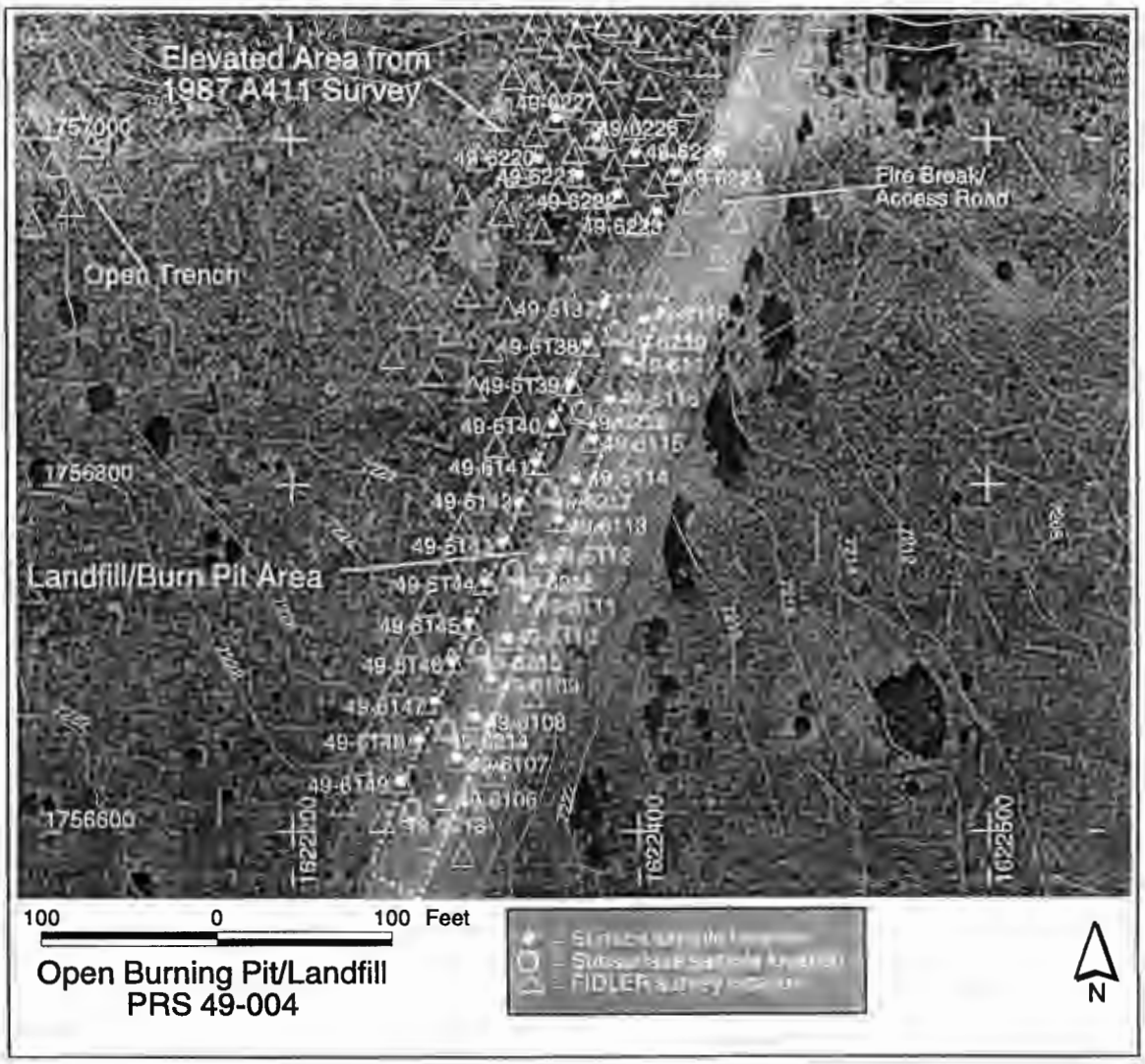


Figure 5.3-1. Sampling locations, facilities, and features at PRS 49-004, open burning/landfill area.

5.3.1 History

PRS 49-004 and the four open trenches are discussed in detail in Section 6.3 of the work plan (LANL 1992, 7670).

The landfill was used from late 1959 to mid-1961 for open-pit burning of combustible construction wastes and for burial of uncontaminated wastes generated during hydronuclear and related activities in other areas of TA-49 (Purtymun and Stoker 1987, 6688; DOE 1987, 8663 and 8664). During the 1971 cleanup of TA-49, the landfill was reopened for disposal of radiologically uncontaminated materials, principally from Area 11. The landfill was again reopened during the general TA-49 surface cleanup in 1984. A trench reported to be approximately 30 ft wide, 100 ft long, and 15 ft deep was created for burial of uncontaminated debris collected during the cleanup (LANL 1990, 7513).

The purpose of the four trenches (currently open) is unknown. They were evident in 1954 aerial photographs but not in 1935 photographs. The trenches probably were dug with mechanized equipment. One trench appears to have been partially backfilled, and

at least one other trench passes directly through a prehistoric ruin. It seems unlikely the trenches were dug by individuals seeking cultural artifacts because only one trench was near a ruin, and the trench depths are unusually deep for such purposes. The trenches conceivably are related to mine-claim activities before the Atomic Energy Commission acquired the property in the 1940s. However, investigation of available regional mining records shows no reference to the TA-49 area (Eller 1991, 55331). The possibility that the trenches were created by the Laboratory for waste disposal or other purposes is highly unlikely but cannot be excluded categorically.

Chemicals of concern at this PRS include TAL metals, radionuclides, and SVOCs that may have been buried in the landfill and also deposited on the surrounding surface soils through the open burning practices.

5.3.2 Description

Chapter 2 contains a detailed site-specific description including geology, soils, wildlife habitat, and cultural resources.

5.3.3 Previous Investigations

During the A411 survey of TA-49 in 1987, part of the open burning/landfill area surface was sampled; however, results for this area are not discussed in the survey report (Soholt 1990, 7510). In the survey, about 60 soil and 10 vegetation samples were collected on an approximately 25-ft by 25-ft grid covering an 80-ft by 275-ft area. Analytical results and soil sampling locations are summarized in Table 6.3-2 and Figure 6.3-4 in the work plan (LANL 1992, 7670). A few of the sample concentrations were found to be above regional background and indicated highly localized, discontinuous distribution of chemicals. The individual analyte maximum concentrations and total radionuclide concentrations at each sampling point were well below the transuranic action levels for unrestricted site use discussed in Chapter 5 of the work plan (LANL 1992, 7670). Radionuclide concentrations in vegetation at the open burning/landfill area also were reported to be well below levels of concern.

In June 1991, a geophysical survey was carried out at the open burning/landfill area to define the limits of the landfill (Geophex 1991, 8887). The work plan (LANL 1992, 7670) provides an interpretive summary of this work and more detailed geophysical data. Strong magnetic and electromagnetic anomalies were observed for this area, no doubt a result of the considerable quantities of cable and other metallic debris known to be buried in the landfill.

5.3.4 Field Investigation

The objective of this field investigation was to determine if chemicals of concern exist above SALs or background levels in surface and subsurface soils at PRS 49-004 and at the four open trenches. The investigation included a radiological survey conducted with a FIDLER portable gamma spectrometry meter at the open burning/landfill area and at the open trenches. Soil sampling was conducted at the open burning/landfill area.

5.3.4.1 FIDLER Radiological Survey

A radiological survey was performed on a 25-ft by 25-ft grid over PRS 49-004 (Figure 5.3-1). FIDLER measurements were taken at each grid point. No radiologically contaminated areas (i. e., >10 pCi/g) were identified, but there were measurements at or above three standard deviations of background. To further define this area, 18 additional survey points (additional to the ones called for in the work plan) were added at the northwest corner of the grid (supplemental site), and FIDLER measurements were made. No radiologically contaminated areas were identified, but 12 of the locations were above background values (Art 1996, 55332).

A radiological survey was performed on a 10-ft by 10-ft grid over the four open trenches. FIDLER measurements were taken at each grid point. Readings taken at the trenches were consistently above or near three standard deviations of average background. None of the locations exceeded 10 pCi/g, i.e., no radiologically contaminated areas were detected. The consistent nature of the results could indicate a region of increased background activity because of the excavated soil. Single auger holes (one hole in each trench) were drilled through the bottom of three of the trenches, and the soils were examined. Each site had 1.5 to 3 ft of clay soil underlain by pumice. This same pumice material was on the piles of excavated soil at the ends of the trenches. No foreign debris was seen in the augered cuttings. Beta/gamma field screening of the cuttings was within background values. Based on these observations, it appears that no material is buried in these trenches.

5.3.4.2 Soil Sampling

Surface Samples. Each sampling site was field screened for beta/gamma radiation with an ESP-1 meter and for VOCs using an HNU photoionization detector. The beta/gamma measurements ranged between 114 and 253 cpm with an average of 200 cpm. None of these values are considered elevated; the normal Laboratory background is from 150 to 250 cpm. All the photoionization detector measurements were <1 ppm. On August 1, 1995, 26 surface soil samples and 1 field replicate soil sample were collected at the open burning/landfill area, and 8 samples and 1 field replicate were collected at the supplemental site. Sample and location numbers are shown in Table 5.3.4-1.

Each sample was screened for gross alpha and gross beta radiation at the ESH-19 Counting Facility. Minimum, average, and maximum radioactivity of the 36 samples were 0.0, 2.0, and 10.3 pCi/g gross alpha and 2.0, 16.0, and 29.0 pCi/g gross beta. No Laboratory background UTL has been established for gross alpha or beta activity; however, these data can be compared to on-site background sampling locations. At nine on-site background monitoring locations, the minimum, average, and maximum gross alpha activities were 0.0, 3.0, and 6.0 pCi/g, and gross beta activities were 3.0, 12.0, and 20.0 pCi/g. The gross alpha and beta activities present in the screened samples from PRS 49-004 are slightly higher than the surveillance data, but the values indicate no significant concentrations of radionuclides at the site. The samples were then packaged and promptly submitted through chain-of-custody procedures to the SMO for shipment to the analytical laboratories, where gamma spectrometry was performed on all samples. Fifty percent of the samples were randomly selected for TAL metals analyses.

TABLE 5.3.4-1
SUMMARY OF SURFACE SAMPLES TAKEN AT PRS 49-004, OPEN BURNING/LANDFILL AREA

Location ID	Sample ID	Depth (ft)	Matrix	Inorganic Chemicals[a]	Radionuclides[a]
49-6106	0549-95-0315	0–0.5	Soil	783	786[b]
49-6107	0549-95-0316	0–0.5	Soil	783	786[b]
49-6108	0549-95-0317	0–0.5	Soil	—[c]	786
49-6109	0549-95-0318	0–0.5	Soil	—	786
49-6110	0549-95-0319	0–0.5	Soil	—	786
49-6110R[d]	0549-95-0320	0–0.5	Soil	—	786
49-6111	0549-95-0321	0–0.5	Soil	—	786
49-6112	0549-95-0322	0–0.5	Soil	—	786
49-6113	0549-95-0323	0–0.5	Soil	—	786
49-6114	0549-95-0324	0–0.5	Soil	—	786
49-6115	0549-95-0325	0–0.5	Soil	—	786
49-6116	0549-95-0326	0–0.5	Soil	783	786[b]
49-6117	0549-95-0327	0–0.5	Soil	783	786[b]
49-6118	0549-95-0328	0–0.5	Soil	783	786[b]
49-6137	0549-95-0329	0–0.5	Soil	783	786[b]
49-6138	0549-95-0330	0–0.5	Soil	783	786[b]
49-6139	0549-95-0331	0–0.5	Soil	—	786
49-6140	0549-95-0332	0–0.5	Soil	—	786
49-6141	0549-95-0333	0–0.5	Soil	783	786[b]
49-6142	0549-95-0334	0–0.5	Soil	783	786[b]
49-6143	0549-95-0335	0–0.5	Soil	—	786
49-6144	0549-95-0336	0–0.5	Soil	783	786[b]
49-6145	0549-95-0337	0–0.5	Soil	783	786[b]

a. Request numbers.
b. Samples under this request number were analyzed for isotopic plutonium and total uranium, in addition to gamma spectrometry analysis.
c. A dash indicates that analysis was not requested.
d. R indicates field replicate.

TABLE 5.3.4-1 (concluded)

Location ID	Sample ID	Depth (ft)	Matrix	Inorganic Chemicals	Radionuclides
49-6146	0549-95-0338	0–0.5	Soil	—	786
49-6147	0549-95-0339	0–0.5	Soil	783	786[b]
49-6148	0549-95-0340	0–0.5	Soil	783	786[b]
49-6149	0549-95-0341	0–0.5	Soil	—	786
49-6220	0549-95-0342	0–0.5	Soil	—	786
49-6221	0549-95-0343	0–0.5	Soil	783	786[b]
49-6222	0549-95-0344	0–0.5	Soil	783	786[b]
49-6222R	0549-95-0345	0–0.5	Soil	783	786[b]
49-6223	0549-95-0346	0–0.5	Soil	—	786
49-6224	0549-95-0347	0–0.5	Soil	—	786
49-6225	0549-95-0348	0–0.5	Soil	—	786
49-6226	0549-95-0349	0–0.5	Soil	783	786[b]
49-6227	0549-95-0350	0–0.5	Soil	783	786[b]

b. Samples under this request number were analyzed for isotopic plutonium and total uranium, in addition to gamma spectrometry analysis.

Subsurface Samples. As described in the work plan, seven shallow vertical boreholes (49-6213 to 49-6219) were drilled in the open burning/landfill area. These boreholes were drilled on July 13 and 20, 1995, and were approximately 50 ft apart along the longitudinal axis of the area (Figure 5.3-1). The planned depth for each borehole was 15 ft or the depth to undisturbed tuff, whichever occurred first. Samples were collected at every 5-ft interval in each borehole. As each core barrel was opened, the core was field screened for radiation using beta/gamma and alpha meters and for organic vapors using a photoionization detector. Core lithology was logged and visually examined for any discoloration, texture changes, fractures, debris, or other unusual features. There was no detectable alpha activity from the cores, and the beta/gamma measurements ranged between 122 and 300 cpm with an average of 227 cpm. None of these values are considered elevated; the normal Laboratory background is from 150 to 250 cpm. All the photoionization detector measurements were <1 ppm. Because all the field-screening measurements were at or near background values, visual observations were used to select the core segments to be included as samples for analyses. Core segments that were visibly different in color or texture from the host material or that had fracture fill material were included with the sample.

Tuff was typically encountered at 8 to 10 ft in each of the boreholes. At borehole 49-6219, located at the north end of the trench, tuff was encountered at approximately 9 ft.

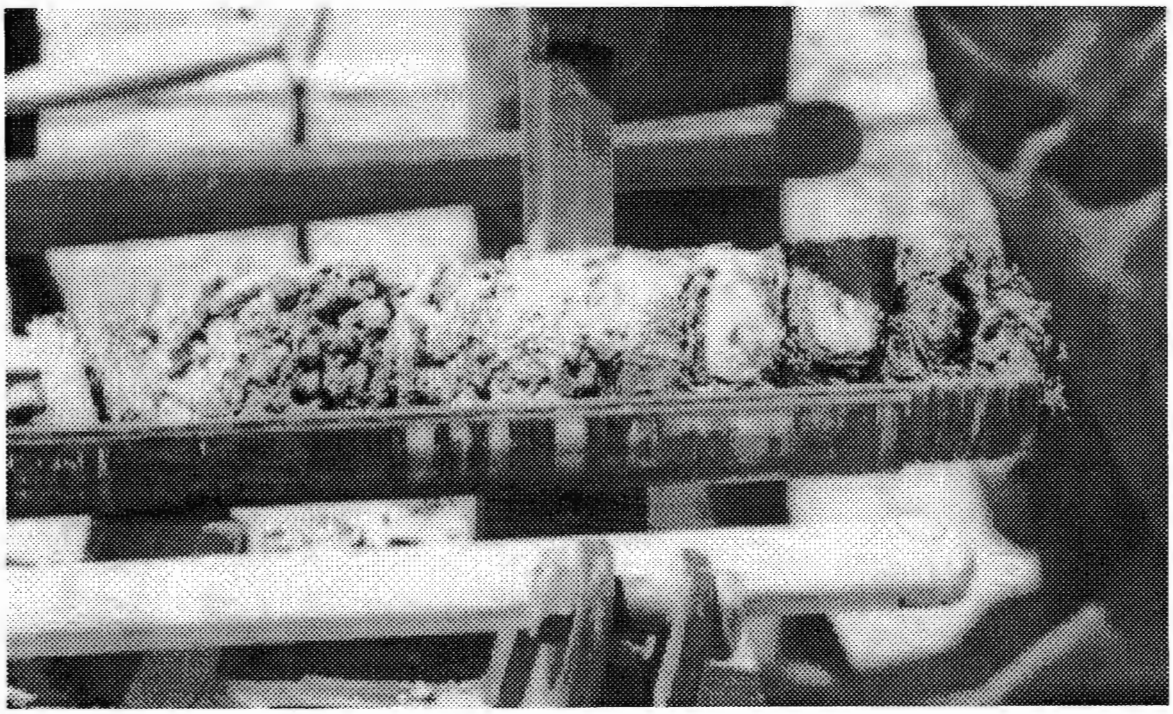
Clay-filled fractures were present in the 10- to 15-ft core of this borehole, and samples were collected of the fracture material (0549-95-0122). At location 49-6218, tuff was also encountered at approximately 9 ft, but the drilling depth was extended to 20 ft to confirm that the trench depth was not greater than 10 ft; however, no samples were taken after 15 ft. At boreholes 49-6214 to 49-6217, 1-in.-diameter copper coaxial cable and metal wire was encountered at approximately the 5- to 9-ft depth. Advancement of the drill string became very difficult, and core recovery was drastically reduced because of the debris encountered. Figure 5.3-4-1 shows the types of debris retrieved during the subsurface sampling of the landfill. For example, at borehole 49-6216, the core from the 5- to 10-ft run consisted entirely of chopped up coaxial cable with no earthen material. In such cases, samples of the core were not submitted for analysis. At the south end of the trench, the core from borehole 49-6214 contained only a small amount of debris, and borehole 49-6213 contained no debris at all, which indicates the southernmost extent of the trench was defined by the drilling and geophysical survey. Table 5.3.4-2 shows sample and location numbers.

All samples were screened for gross alpha/beta before shipment to the analytical laboratory. Minimum, average, and maximum radioactivity of the 19 samples from PRS 49-004 were 0.0, 5.9, and 17.3 pCi/g gross alpha and 0.0, 14.5, and 45.5 pCi/g gross beta. No Laboratory background UTL has been established for gross alpha or beta activity; however, these data can be compared to TA-49 background data. At nine on-site monitoring locations, the minimum, average, and maximum gross alpha activities were 0.0, 3.0, and 6.0 pCi/g, and gross beta activities were 3.0, 12.0, and 20.0 pCi/g. The gross alpha and beta activities present in the screened samples from PRS 49-004 are slightly higher than the background data, but the values indicate no significant concentrations of radionuclides at the site. The samples were then packaged and promptly submitted through chain-of-custody procedures to the SMO for shipment to the analytical laboratories, where gamma spectrometry was performed on all samples. Fifty percent of the samples were randomly selected for TAL metals and SVOC analyses.

5.3.5 Evaluation of Inorganic Chemicals

Twenty-eight soil samples collected at PRS 49-004 were analyzed for TAL metals and total uranium. Of the 28 samples, 24 were collected from mesa top soil and 4 were collected from Unit 3 Tshirege Member of the Bandelier Tuff. Each inorganic result was compared to the geologically appropriate background screening value (Longmire et al. 1995, 55115 and 52227).

Nine inorganic chemicals (aluminum, barium, calcium, chromium, copper, magnesium, nickel, uranium, and vanadium) were detected in Unit 3 samples at concentrations above their respective background screening values. Because Unit 3 site data for these metals are inadequate to support statistical tests, these inorganic chemicals are carried forward to the screening assessment. Five additional inorganic chemicals (lead, manganese, mercury, potassium, and zinc) were detected in mesa top soil samples at concentrations above their respective background screening values. Mercury was not subjected to further background comparisons because the background data for this metal are inadequate to support the prescribed statistical tests. Mercury is, therefore,



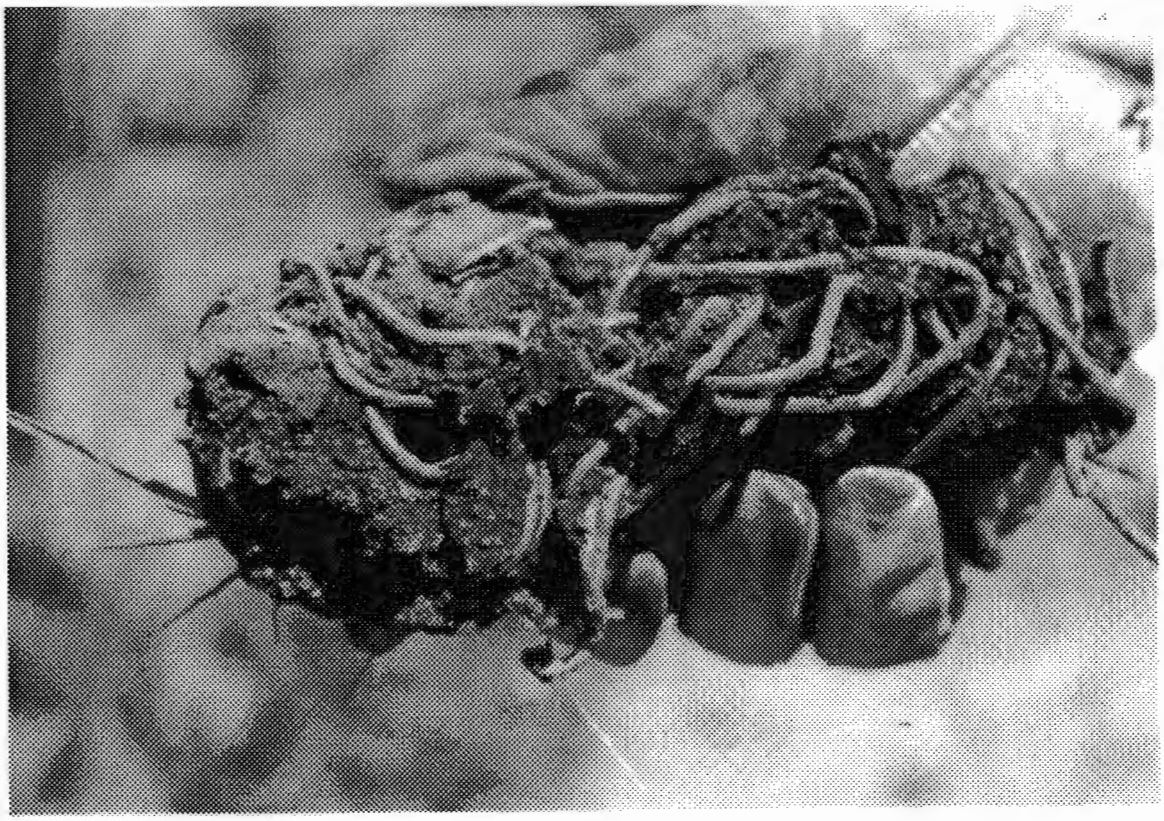


Figure 5.3.4-1. Debris retrieved from drilling at PRS 49-004, landfill.

TABLE 5.3.4-2
SUMMARY OF SUBSURFACE SAMPLES TAKEN AT PRS 49-004, OPEN BURNING/LANDFILL AREA

Location ID	Sample ID	Depth (ft)	Matrix	SVOCs[a]	Inorganic Chemicals[a]	Radionuclides[a]
49-6213	0549-95-0101	2–5	Soil	—[b]	—	687
49-6213	0549-95-0102	5–10	Soil	682	683	687[c]
49-6213	0549-95-0103	10–12	Soil	682	683	687[c]
49-6214	0549-95-0104	2–5	Soil	682	683	687[c]
49-6214	0549-95-0105	5–9.5	Soil	682	683	687[c]
49-6214	0549-95-0106	10–12.5	Soil	—	—	687
49-6215	0549-95-0107	0–5	Soil	682	683	687[c]
49-6215	0549-95-0108	6–9.5	Soil	—	—	687
49-6216	0549-95-0110	1.5–4	Soil	—	—	687
49-6216	0549-95-0111	18.1–20	Soil	726	727	728[c]
49-6216	0549-95-0112	20–22	Soil	—	—	728
49-6217	0549-95-0113	3–5	Soil	682	683	687[c]
49-6217	0549-95-0114	8–10	Soil	—	—	687
49-6218	0549-95-0117	3–5	Soil	—	—	687
49-6218	0549-95-0118	8–10	Soil	—	—	687
49-6218	0549-95-0119	12.5–15	Soil	682	683	687[c]
49-6219	0549-95-0120	3–5	Soil	—	—	687
49-6219	0549-95-0121	7.5–10	Soil	682	683	687[c]
49-6219	0549-95-0122	10.5–11.5, 12–13	Soil	682	683	687[c]

a. Request numbers.
b. A dash indicates that analysis was not requested.
c. Samples under this request number were analyzed for isotopic plutonium and total uranium, in addition to gamma spectrometry analysis.

carried forward to the screening assessment. Further background comparisons were performed for lead, manganese, potassium, and zinc. The Gehan modification to the Wilcoxon Rank Sum test and the Quantile test were used for these evaluations (Section 3.2.1). Observed significance levels (p-values) for these tests are presented in Table 5.3.5-1. The results for lead, manganese, potassium, and zinc are indicative of site concentrations that are greater than background.

TABLE 5.3.5-1
STATISTICAL TESTS FOR BACKGROUND COMPARISON

Analyte	Gehan Test P-Value	Quantile Test P-Value
Lead	<0.00005	0.0715
Manganese	<0.00005	0.0073
Potassium	<0.00005	<0.00005
Zinc	<0.00005	<0.00005

Based on the background comparisons and further statistical tests performed to compare site and background data, aluminum, barium, calcium, chromium, copper, lead, magnesium, manganese, mercury, nickel, potassium, uranium, vanadium, and zinc are carried forward to the screening assessment. The concentrations for each sample that had at least one value above background screening values for these inorganics are presented in Table 5.3.5-2. The locations of these samples are shown in Figure 5.3.5-1.

Qualifiers shown in Table 5.3.5-2 were assigned during baseline validation. However, the data are usable for site-specific decisions. As discussed in Section 4.1, barium data were qualified J- in four samples and UJ in two samples because of low-percent recovery (68%) in the matrix spike sample. The qualifiers indicate a possible low bias, but even if the barium sample results were adjusted upward by 68%, the resulting values would still be below background screening values. Therefore, the data are still considered valid. Manganese data were qualified J- in ten samples because the RPD in the duplicate sample analysis was above acceptance criteria. This difference can often be attributed to sample inhomogeneity. The manganese concentrations may be biased low. The magnitude of these biases should not affect the outcome of the screening assessments, and the data are considered usable.

5.3.6 Evaluation of Radionuclides

Twenty-eight soil samples collected at PRS 49-004 were analyzed for isotopic plutonium. These 28 samples and an additional 27 samples were also analyzed by gamma spectrometry.

Uranium, which is carried forward to the screening assessment in Section 5.3.8, will be evaluated as both a noncarcinogen and a radionuclide during the screening assessment. Therefore, uranium will not be evaluated further in this section.

Analyses of radionuclides by gamma spectrometry often leads to the reporting of concentrations (for certain radionuclides) that are inappropriate for evaluation as potential site contaminants. These include short-lived activation/fission products, naturally occurring background radionuclides, and daughter radionuclides. These

TABLE 5.3.5-2
INORGANICS WITH CONCENTRATIONS[a] EXCEEDING BACKGROUND SCREENING VALUES AT PRS 49-004

Location ID	Sample ID	Aluminum	Barium	Calcium	Chromium	Copper	Lead	Magnesium
Surface Samples								
UTL		**38700**	**315**	**6120**	**19.3**	**15.5**	**23.3**	**4610**
SAL		**77000**	**5300**	**n/a[b]**	**210**	**2800**	**400**	**n/a**
49-6214	0549-95-0105	14100	162(J-)	3730	11.7	10.4	19.9	2910
49-6215	0549-95-0107	10500	156(J-)	2640	8.6	**16.2[c]**	18.1	1870
49-6217	0549-95-0113	13100	152(J-)	2960	10.5	14.2	15.4	2440
49-6116	0549-95-0326	12300	137	2170	8.2	10.6	14.2	2040
49-6117	0549-95-0327	9570	132	1990	6.6	11	17.5	1760
49-6118	0549-95-0328	10600	123	2120	7.8	12.1	13.3	2040
49-6137	0549-95-0329	14500	159	2820	9.6	9.6	13	2480
49-6138	0549-95-0330	11600	162	2750	8.8	14.5	16.7	2170
49-6141	0549-95-0333	15900	156	2400	11.5	11.9	15.4	2410
49-6142	0549-95-0334[b]	10050	130	2390	8.29	12.6	14.8	1950
49-6144	0549-95-0336	10500	149	1940	8.4	14.5	18.9	1960
49-6145	0549-95-0337	19100	187	2650	13.8	15.3	16.6	2800
49-6147	0549-95-0339	18200	192	3010	12.7	13.6	15.8	2800
49-6221	0549-95-0343	16600	208	3600	11.7	12.8	21.6	2880
49-6222	0549-95-0344	9140	199	4740	7.2	**17.9**	**24.1**	2280
49-6222	0549-95-0345	15400	226	4910	10.5	**22.4**	**23.8**	2840
49-6226	0549-95-0349	10500	171	2820	7.4	8.3	17	1850
49-6227	0549-95-0350	12200	183	3480	8.3	10.8	20.3	2030
Subsurface (Unit 3) Samples								
UTL		**3700**	**28**	**1520**	**2.1**	**2**	**16.2**	**628**
49-6213	0549-95-0103	**4910**	**42.2(J-)**	1400	**3.9**	2.2(U)	5.8	**1080**
49-6216	0549-95-0111[b]	**4620**	**39**	1320	**3.4**	**112**	2.7	**1040**
49-6218	0549-95-0119	3210	25.4(UJ)	519(U)	2.3(U)	2.4(U)	6.4	642(U)
49-6219	0549-95-0122	**4830**	41.7(UJ)	**1550**	**3.4**	2.6(U)	7.8	**1270**

a. Concentrations in mg/kg.
b. n/a = not available.
c. Bold, enlarged values indicate concentrations above background screening values.

TABLE 5.3.5-2 (concluded)

Location ID	Sample ID	Manganese	Mercury	Nickel	Potassium	Uranium	Vanadium	Zinc
Surface Samples								
UTL		**714**	**0.1[e]**	**15.2**	**3410**	**5.45**	**41.9**	**50.8**
SAL		**3200**	**23**	**1500**	**n/a**	**230**	**540**	**23000**
49-6214	0549-95-0105	**878(J)**	0.05(U)	12.2	2120	3.3	31.8	35.1
49-6215	0549-95-0107	386(J)	0.05(U)	7.7(U)	1670	4	19.3	42.4
49-6217	0549-95-0113	392(J)	0.06(U)	9.6	2030	3.6	23.6	**70.6**
49-6116	0549-95-0326	471(J-)	**0.11**	6.9	2170	2.12	17.4	**142**
49-6117	0549-95-0327	371(J-)	0.1(U)	6.1	1820	1.72[d]	14.5	**96.2**
49-6118	0549-95-0328	351(J-)	0.1(U)	6.7	2090	1.59	17.9	**64**
49-6137	0549-95-0329	396(J-)	0.1(U)	8	2820	1.99	19.5	**50.9**
49-6138	0549-95-0330	707(J-)	0.11(U)	8.6	2720	1.86	20	**159**
49-6141	0549-95-0333	464(J-)	0.1(U)	8.8	**3500**	1.7	25.1	**64**
49-6142	0549-95-0334[d]	330	0.105(U)	7.62	2420	1.92	17.8	**69.7**
49-6144	0549-95-0336	439	0.1(U)	8.4	**4030**	2.43	18.7	**812**
49-6145	0549-95-0337	427	0.11(U)	10.5	**4240**	2.29	30.3	49.8
49-6147	0549-95-0339	402	0.09(U)	10.4	**4030**	2.58	26.5	47
49-6221	0549-95-0343	476	0.1(U)	10.3	**3870**	**6.88[d]**	23.7	47
49-6222	0549-95-0344	512	0.11(U)	7.5	**4310**	**8.1**	17.5	48.5
49-6222	0549-95-0345	524	0.11(U)	9	**5420**	**8.7**	22.9	**57**
49-6226	0549-95-0349	384	0.1(U)	6.9	2490	**8.4**	17.2	30.8
49-6227	0549-95-0350	456	0.01(U)	7.4	2920	**10.7**	18.5	37.2
Subsurface (Unit 3) Samples								
UTL		**426**	**n/a**	**2.6**	**735**	**1.64**	**4.01**	**59**
49-6213	0549-95-0103	139(J)	0.05(U)	4.5(U)	925(U)	**3.3**	5.2(U)	26.8
49-6216	0549-95-0111[d]	175	0.12(U)	**3.3**	**1120**	**1.65**	**4.2**	28.7
49-6218	0549-95-0119	175	0.06(U)	2.7(U)	631(U)	**3.6**	3.7(U)	27.9
49-6219	0549-95-0122	134	0.06(U)	4.5(U)	894(U)	**3.3**	4.6(U)	16

d. Value represents the maximum of a sample concentration and its laboratory duplicate.
e. Value represents the maximum reported background concentration in soil (Longmire et al. 1995, 55115).

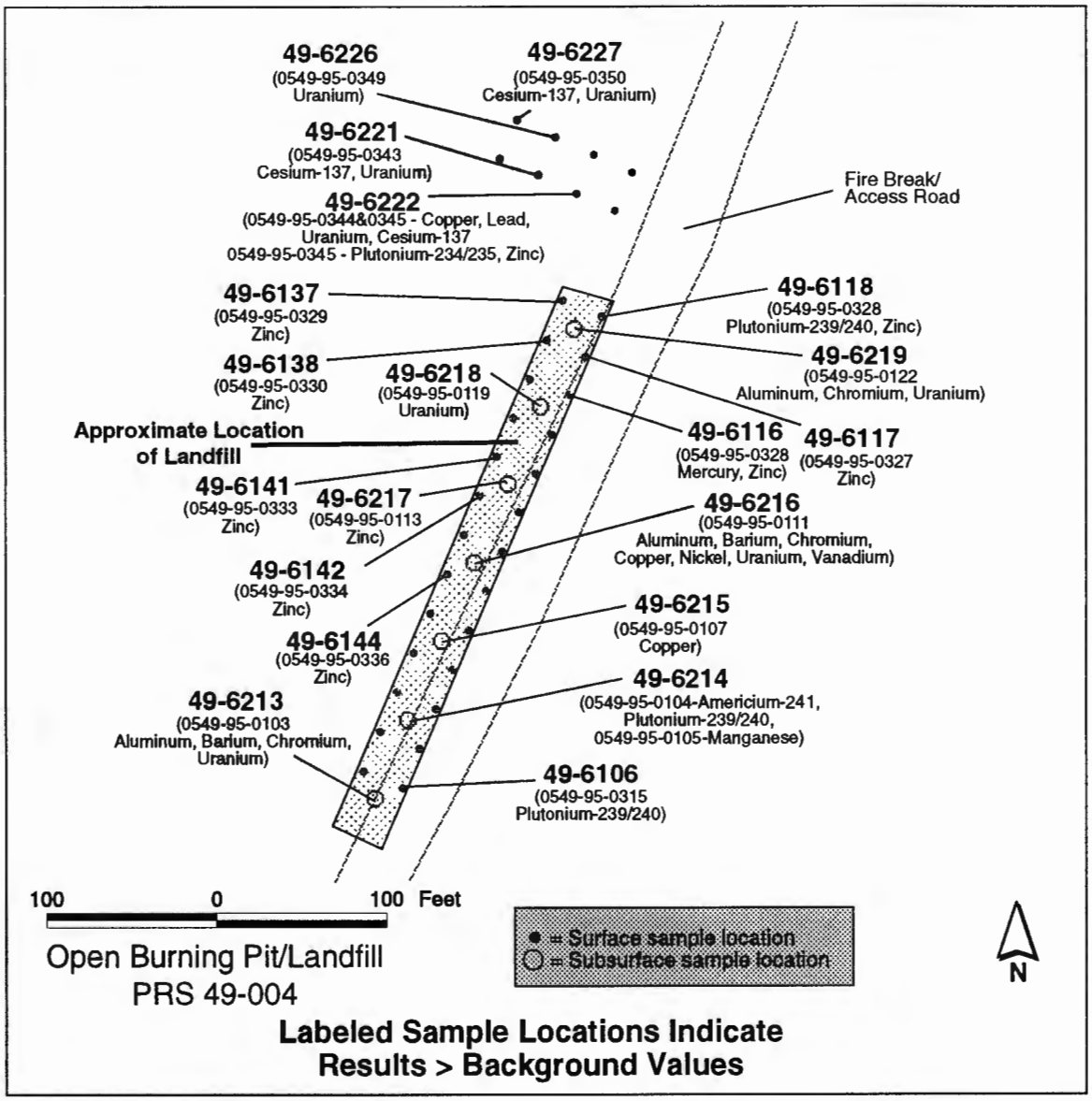


Figure 5.3.5-1. Locations of samples with inorganic concentrations above background screening values.

classes of radionuclides are generally not considered site contaminants for the reasons discussed below.

- Seven short-lived activation/fission products reported at PRS 49-004 (barium-140, cesium-134, cobalt-57, europium-152, manganese-54, ruthenium-106, and sodium-22) have half-lives ranging between a few days and 13.6 years. Several of these radionuclides are used as internal standards to measure equipment performance and laboratory background (or contamination). Because activation/fission products with short half-lives are routinely reported for reasons not related to RFI investigations and are not expected to be occur at this PRS, these short-lived activation/fission products are eliminated as potential radionuclide contaminants.

- Potassium-40 is a naturally occurring radionuclide that is routinely reported because it is used as an internal standard to measure such things as equipment performance and laboratory background (or contamination). There are no known processes at this PRS that used this radionuclide, and reported concentrations are generally within known background ranges for potassium-40 (Longmire et al. 1995, 55115 and 52227). Potassium-40 will not be considered a potential radionuclide contaminant at this site.
- Daughters of naturally occurring radionuclides (uranium and thorium) are also reported in gamma spectrometry analyses. These daughters (e.g., isotopes of actinium, bismuth, lead, protactinium, radium, radon, thallium, and thorium) are normally present in secular equilibrium concentrations and are not directly evaluated as potential radionuclide contaminants. Daughter radionuclide activities can be attributed to background concentrations of the parent and thus were not retained as potential contaminants.

EQLs and minimum detectable activities are often not available for those radionuclides reported in gamma spectrometry analysis. A value of three times the measurement uncertainty (3-sigma or three standard deviations) is used to calculate a sample-specific minimum detectable activity, which is then used in the same manner as a detection limit. This methodology is similar to Currie's method of determining radionuclide maximum detectable activity (Currie 1988, 55422). The 3-sigma screening value takes into account variability because of counting statistics but does not account for spectral peak identification problems. Thus, 3-sigma screening is conservative and may include radionuclides whose presence is spuriously reported because of spectral interferences or misidentifications. Cerium-144, cobalt-60, neptunium-237, and uranium-235 were eliminated from further consideration based on this criterion.

Americium-241, cesium-137, plutonium-238, and plutonium-239/240 are the remaining radionuclides that were detected. Plutonium-238 was eliminated from further consideration based on a comparison to background screening values. Americium-241, cesium-137, and plutonium-239/240 are carried forward to the screening assessment. The concentrations for each sample that had at least one detected value for these three radionuclides are presented in Table 5.3.6-1. The locations of these samples are shown in Figure 5.3.5-1.

5.3.7 Evaluation of Organic Chemicals

Ten soil samples collected at PRS 49-004 were analyzed for SVOCs. One organic, 2-chloronaphthalene, was detected in one of these samples and is carried forward to the screening assessment. This chemical was detected in sample 0549-95-0105 (location 49-6214) at a concentration of 0.36 mg/kg.

5.3.8 Risk-Based Screening Assessment

Fourteen inorganic chemicals detected at concentrations greater than background screening values or having no background data for comparison were carried forward to the screening assessment. Three radionuclides (in addition to total uranium) were detected at concentrations exceeding background screening values and are carried forward to the screening assessment. One organic chemical was detected and is carried

forward to the screening assessment. The screening assessment includes a comparison to SALs and an MCE, as described in "Risk-Based Corrective Action Process" (Dorries 1996, 55575).

TABLE 5.3.6-1
RADIONUCLIDES WITH CONCENTRATIONS[a] EXCEEDING BACKGROUND SCREENING VALUES AT PRS 49-004

Location ID	Sample ID	Americium-241	Cesium-137	Plutonium-239/240
UTL		0.336[b]	1.7[b]	0.092[b]
SAL		22	5.1	24
49-6214	0549-95-0104	**0.43** [c]	0.09(U)	**0.419**
49-6106	0549-95-0315	0.155	0.166	**0.134**
49-6118	0549-95-0328	0.048(U)	0.068(U)	**0.095**
49-6221	0549-95-0343	0.045(U)	**2.02**	0.07
49-6222	0549-95-0344	0.106(U)	**3.28**	0.072
49-6222R[d]	0549-95-0345	0.035(U)	**2.97**	**0.094**
49-6227	0549-95-0350	-0.251(U)	**2.24**	0.074[e]

a. Concentrations are in pCi/g.
b. Value represents the maximum background concentration from environmental surveillance reports.
c. Bold, enlarged values indicate concentrations above background screening values.
d. R indicates field replicate.
e. Value represents the maximum of a sample concentration and its laboratory duplicate.

No chemicals were detected at concentrations exceeding SALs at PRS 49-004. Three of the inorganic chemicals carried forward from the background comparisons have no SALs for comparison. These include calcium, magnesium, and potassium. Calcium, magnesium, and potassium are essential nutrients that can be eliminated as COPCs on the basis of best professional judgment (EPA 1989, 8021). Although none of these chemicals have a SAL, as essential nutrients they may be compared to the RDA for children and adults.

The calcium RDA is 800 mg/day for a child and 1200 mg/day for an adult. The highest detected concentration of calcium that exceeds background screening values was 1550 mg/kg. At the EPA default child soil ingestion rate of 200 mg/day, a child would ingest about 0.3 mg of calcium per day. At the EPA default adult soil ingestion rate of 100 mg/day, an adult would ingest about 0.2 mg of calcium per day. Because both amounts are considerably less than the RDAs, calcium is eliminated as a COPC.

The magnesium RDA is 80 mg/day for a 1- to 3-year-old child and 280 mg/day for an adult female. The highest detected concentration of magnesium that exceeds background screening values was 1270 mg/kg. At the EPA default child soil ingestion rate of 200 mg/day, a child would ingest about 0.3 mg of magnesium per day. At the EPA default adult soil ingestion rate of 100 mg/day, an adult female would ingest about

0.1 mg of magnesium per day. Because both amounts are considerably less than the RDAs, magnesium is eliminated as a COPC.

The estimated minimum requirement for potassium is 1600 to 2000 mg/day. The highest detected concentration of potassium that exceeds background screening values was 5420 mg/kg. At the EPA default child soil ingestion rate of 200 mg/day, a child would ingest about 1.1 mg of potassium per day. At the EPA default adult soil ingestion rate of 100 mg/day, an adult would ingest about 0.5 mg of potassium per day. Because both amounts are considerably less than the estimated minimum requirement, potassium is eliminated as a COPC.

The fifteen remaining chemicals were detected at concentrations below their respective SALs. These remaining chemicals are divided into three classes (carcinogens, noncarcinogens, and radionuclides) to evaluate possible additive effects within each class of chemicals in an MCE (Dorries 1996, 55575). Chromium was the only chemical carcinogen detected at PRS 49-004; therefore, an MCE is not performed for this class. Chromium was detected at a maximum concentration of 3.9 mg/kg, which is well below its SAL of 210 mg/kg. Chromium is therefore eliminated as a COPC. Uranium is evaluated as a radionuclide, as well as for its noncarcinogenic effects. The MCE for PRS 49-004 is presented in Table 5.3.8-1.

The sum (0.6) of the normalized values for noncarcinogens is less than unity, indicating that the potential for adverse human health effects from exposure is unlikely. Therefore, all noncarcinogens at concentrations below SAL are eliminated as COPCs. Although the sum of the normalized values for radionuclides is 1.0, little potential for adverse human health effects exists because the SALs used in the MCE comparison are based on residential exposure assumptions. PRS 49-004 is on a relatively flat mesa top area that is under institutional control, and residential exposure is not feasible. Therefore, all radionuclides are eliminated as COPCs. In addition, the major contributor to this sum is cesium 137, which has a half-life of 30 years. The decay of this radionuclide over the next few years will continue to reduce the sum of the normalized values for radionuclides.

5.3.9 Human Health Risk Assessment

No COPCs were identified for PRS 49-004; therefore, no human health risk assessment was performed.

5.3.9.1 Review of COPCs and Extent of Contamination

Although fourteen inorganic chemicals, four radionuclides, and one organic chemical were identified above background screening values or above detection limits at this PRS, no risk-based COPCs were identified. As described in Section 5.3.4, the sampling activities were biased toward areas where contamination would be expected. The grid size and sampling locations described in Section 5.3.4 are adequate to determine the nature of contamination from this PRS, as described in the work plan (LANL 1992, 7670). Because no COPCs were identified, there is no extent of contamination.

TABLE 5.3.8-1
MCE FOR PRS 49-004

Analyte	Location ID	Sample Number	Maximum Concentration	SAL	Normalized Value
Noncarcinogens[a]					
Aluminum	49-6213	0549-95-0103	4910	77000	0.06
Barium	49-6213	0549-95-0103	42.2	5300	0.008
2-Chloronaphthalene	49-6214	0549-95-0105	0.36	5200	0.00007
Copper	49-6216	0549-95-0111	112	2800	0.04
Lead	49-6222	0549-95-0344	24.1	400	0.06
Manganese	49-6214	0549-95-0105	878	3200	0.3
Mercury	49-6116	0549-95-0326	0.11	23	0.005
Nickel	49-6216	0549-95-0111	3.3	1500	0.002
Uranium	49-6226	0549-95-0349	10.7	230	0.05
Vanadium	49-6216	0549-95-0111	4.2	540	0.008
Zinc	49-6144	0549-95-0336	812	23000	0.04
			Sum	=	**0.6**
Radionuclides[b]					
Americium-241	49-6214	0549-95-0104	0.43	22	0.02
Cesium-137	49-6222	0549-95-0344	3.28	5.1	0.6
Plutonium -39/240	49-6214	0549-95-0104	0.419	24	0.02
Uranium	49-6226	0549-95-0350	10.7 (mg/kg)	29 (mg/kg)	0.4
			Sum	=	**1.0**

a. Units for noncarcinogens are mg/kg.
b. Units for radionuclides are pCi/g, except where noted.

5.3.10 Preliminary Ecological Assessment

An ecological risk evaluation was not performed because the Laboratory ER Project, in cooperation with the New Mexico Environment Department and EPA Region 6, is developing an approach for ecological risk assessment. This site will be evaluated for ecological concerns as soon as the ecological risk screening assessment methodology can be conducted for this ecological unit.

5.3.11 Conclusions and Recommendations

The objective of the Phase I RFI at PRS 49-004 was to determine the presence or absence of contamination associated with the open burning/landfill area and the four open trenches. No COPCs were identified in the human health screening assessment.

Soil samples were collected from the area with the highest potential for contamination (surface and subsurface samples within the landfill). As described in Section 5.3.4.1, no radioactive contamination was detected in the open trenches, and it appears that no material was buried there. It is recommended that NFA be taken with the landfill and open trenches. Because no COPCs were identified, the data suggest that widespread contamination at concentrations of human health concern has not occurred.

This site is proposed for NFA, based on NFA Criterion 5. A Class III permit modification will be requested to remove this site from the Hazardous and Solid Waste Amendments Module of the Laboratory's hazardous waste facility permit.

5.4 Area 5: PRSs 49-008(a), Surface Soils; 49-006, Sump; and 49-005(b), Small Landfill; and Transformer Stations

PRS 49-008(a) is the surface soil in Area 5, 49-005(b) is the location of a small construction debris landfill, and 49-006 is a sump (Figure 5.4-1). The transformer stations are not identified as PRSs but are considered part of PRS 49-008(a). Lead and copper were detected above SALs in one surface sample, and PCBs were detected above the SAL in one sample and its duplicate at the western transformer station. A qualitative human health risk assessment indicated the risk posed by these chemicals should be minimal, and these PRSs are recommended for NFA.

5.4.1 History

PRSs 49-008(a), 49-006, and 49-005(b) are discussed in detail in Sections 6.3 and 6.4 of the work plan (LANL 1992, 7670).

Area 5 served as the main control area for the hydronuclear and related experiments conducted at TA-49 from 1959 to 1961. Many experimental support activities also were located in this area. Most of the structures were trailers and were located mostly in the eastern half of Area 5. An elevated tower (Building TA-49-96), located in the northwest corner of Area 5, was used to photograph hydronuclear and related experiments in Areas 1 through 4. Photographic activities probably occurred for the most part in a trailer (J-13-3) that contained a darkroom with a drain line. Trailer J-11-4 housed a radiochemistry laboratory. Waste chemicals from operations in the laboratory were bottled for off-site disposal. Lead sheets (used in trailers J-11-4 and J-16-8) and lead bricks were used as shielding during the counting of low-level radioactive samples. Lead bricks also were stored on the north edge of Area 5. The Zia Engineering diary indicates that in November 1959 two sump holes were drilled in Area 5. However, the exact number of sumps drilled and their ultimate use is unknown. No sumps are shown on any of Engineering drawings of Area 5. The sumps possibly were used to dispose of small volumes of waste chemicals, notably, spent photographic solutions. Engineering drawings also showed that the underground counting room (structure TA-49-67) was equipped with a concrete sump for drainage collection. It is unknown whether the sump ever collected chemical liquids. However, the small size of the sump (1.5 by 1.5 ft) indicates that the volume of collected liquids (if any) was very small. Electrical transformers were located just west and north of the Area 5 fence. Transformer oil of unknown composition probably was used, but the volume is likely to have been very small, according to available information (LANL 1992, 7670). It is unknown whether or

not PCBs were present, and sampling apparently has not been performed. Operations in Area 5 never involved large amounts of hazardous or radioactive materials.

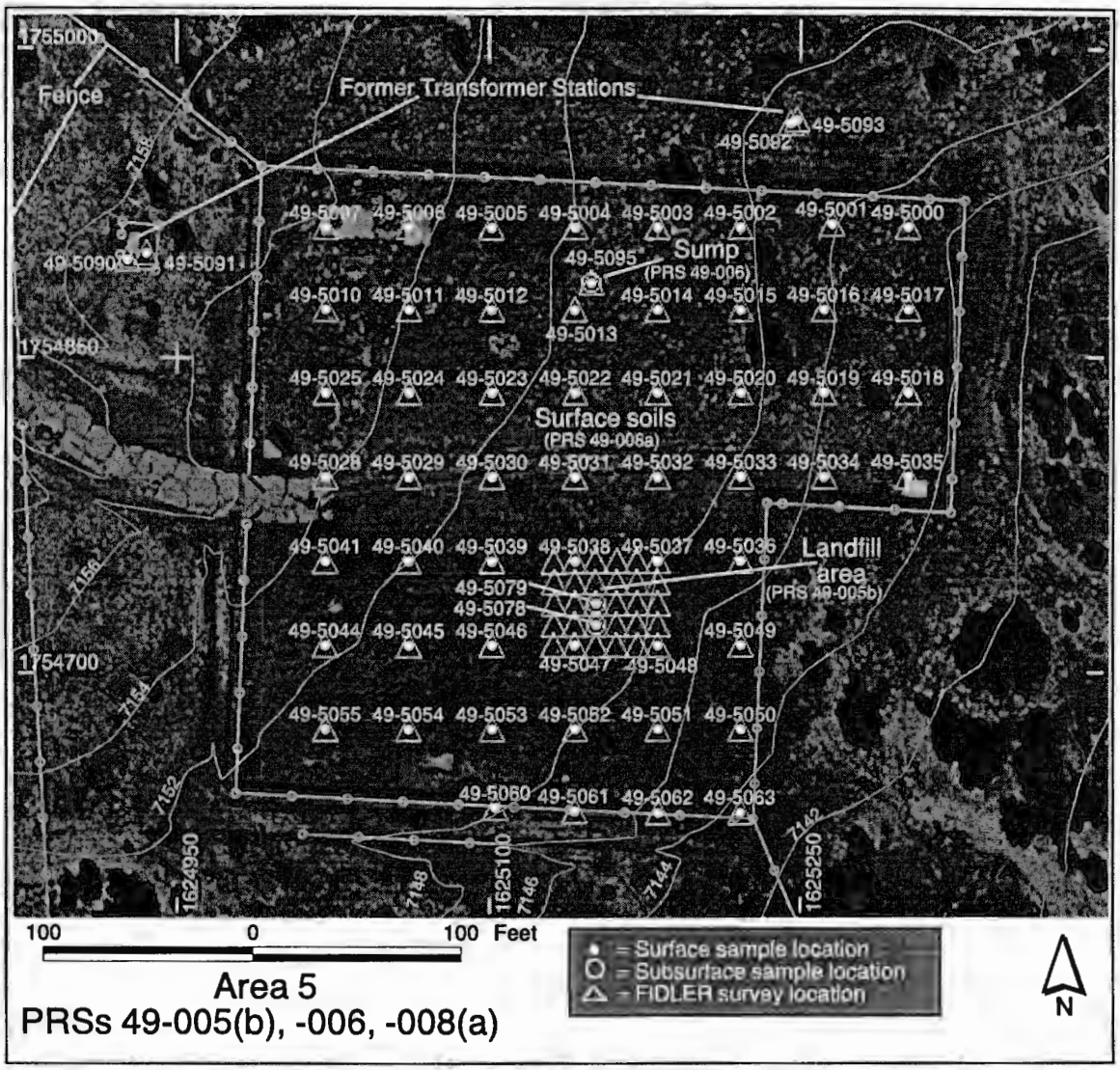


Figure 5.4-1. Sampling locations, facilities, and features at PRSs 49-008(a), 49-006, and 49-005(b).

Activities in Area 5 after 1961 were very limited and probably did not involve significant quantities of hazardous or radioactive materials. Almost all structures were removed or destroyed between 1961 and 1984, primarily during routine equipment removal in 1964 and major cleanup campaigns in 1971 and 1984. Other combustible structures were destroyed by the La Mesa forest fire in June 1977. At present, the only surface structures remaining in Area 5 are the DT-5A observation well enclosure (structure TA-49-101) and the concrete pads of the former transformer station (TA-49-14) and the photographic tower.

At least some of the debris collected during the 1984 cleanup may have been disposed of in a small existing pit or sump in Area 5; dimensions were less than 10 ft by 10 ft by 10 ft (LANL 1992, 7670). This landfill is listed as PRS 49-005(b).

Chemicals of concern are TAL metals and radionuclides around the structure locations, PCBs at the two electrical transformer locations, and SVOCs at the sump and landfill. The total quantity of photographic solutions generated during all Area 5 activities probably would have been less than a few hundred gallons (LANL 1992, 7670). Any release that might have occurred would likely have been through drains to the sump or to nearby soils. Airborne and other inadvertent transport of extremely low levels of radionuclides from Area 2 (and possibly from Areas 1, 2A, 2B, 4, and 11) to Area 5 soils is a remote possibility. Because of the small, isolated nature of any such releases, contamination levels from this mechanism are expected to be undetectable. Small amounts of metallic debris (possibly including some lead bricks) remain on the surface.

5.4.2 Description

Chapter 2 contains a detailed site-specific description including geology, soils, wildlife habitat, and cultural resources.

5.4.3 Previous Investigations

During the 1959 to 1961 operations and the 1971 and 1984 cleanups, extensive and frequent field monitoring for gross alpha, beta, and gamma radioactivity was conducted. Interviews with health physics personnel who were on site during these operations indicate that no significant levels of radioactivity were detected. However, only partial documentation is available, and there is no analytical information available for surface or subsurface samples.

5.4.4 Field Investigation

The objective of this field investigation was to determine if chemicals of concern exist above SALs or background levels in surface and subsurface soils at Area 5. The chemicals of concern are TAL metals and radionuclides around the structure locations, PCBs at two electrical transformer locations, and SVOCs at 49-006 and 49-005(b). The investigation included a radiological survey conducted with a FIDLER portable gamma spectrometry meter and soil sampling.

5.4.4.1 FIDLER Radiological Survey

As described in the work plan, a 40-ft by 40-ft grid (54 points) was land surveyed within the fenced area (LANL 1992, 7670). The grid was centered within the fenced region because this was the area of maximum use and thus has the highest likelihood for contamination above levels of concern. A 10-ft by 10-ft grid (30 points) was land surveyed over the landfill. Both grids are shown in Figure 5.4-1. FIDLER measurements were taken at each grid point. No radiologically contaminated areas were identified, and none of the measurements exceeded three standard deviations of the average background. Based on the FIDLER survey results, no additional soil sampling sites were selected (Art 1996, 55332).

5.4.4.2 Soil Sampling

Surface Samples. Before samples were collected at the former transformer locations, each sampling site was field screened for beta/gamma radiation with an ESP-1 meter and for VOCs with an HNU photoionization detector. The beta/gamma measurements ranged between 211 and 256 cpm with an average of 238 cpm. None of these values are considered elevated; the normal Laboratory background is from 150 to 250 cpm. All the photoionization detector measurements were <1 ppm. On May 17, 1995, two surface soil samples were collected at each of the transformer locations. One field replicate was also collected. Each sample was screened for gross alpha and gross beta radiation at the ESH-19 Counting Facility, as specified by the work plan (LANL 1992, 7670). Minimum, average, and maximum radioactivities of the five samples from the transformer sites were 13, 16, and 20 pCi/g gross alpha and 12, 17, and 23 pCi/g gross beta. No Laboratory background UTL has been established for gross alpha or beta activity; however, these data can be compared to on-site background data. At nine TA-49 background monitoring locations, the minimum, average, and maximum gross alpha activities were 0.0, 3.0, and 6.0 pCi/g, and gross beta activities were 3.0, 12.0, and 20.0 pCi/g. The gross alpha and beta activities present in the screened samples are slightly greater than the TA-49 background data, but the values indicate no significant radionuclide contamination at the site. The work plan called for field methods to screen for PCBs at these sites. Specifically, Appendix C of the work plan called for the use of a DEXSIL L2000 PCB/chloride analyzer or an alternative method with a suitable detection limit. The work plan stated that the chosen method should have a detection limit of 10 mg/kg. However, because it was less expensive and a lower detection limit could be achieved (0.25 mg/kg), samples were submitted to the Laboratory Organic Analysis Group (CST-12) for PCB (Aroclor 1242, 1254, and 1260) analysis.

Before samples were collected on the 40-ft grid on July 19 and 20, 1995, each sampling site was field screened for beta/gamma radiation with an ESP-1 meter and for VOCs with an HNU photoionization detector. The beta/gamma measurements ranged between 90 and 250 cpm with an average of 160 cpm. None of these values are considered elevated; the normal Laboratory background is from 150 to 250 cpm. All the photoionization detector measurements were <1 ppm. Fifty-seven surface soil samples were collected (Table 5.4.4-1), 54 from the grid and 3 field replicates. Three other surface samples were also collected at the locations of the sump and the landfill area (Table 5.4.4-2). Each sample was screened for gross alpha and gross beta radiation at the ESH-19 Counting Facility, as specified by the work plan (LANL 1992, 7670). Minimum, average, and maximum radioactivities of the 13 samples from PRS 49-008(a) were 0.0, 8.0, and 34.0 pCi/g gross alpha and 0.0, 17.0, and 40.0 pCi/g gross beta. No Laboratory background UTL has been established for gross alpha or beta activity; however, these data can be compared to on-site background data. At nine TA-49 background monitoring locations, the minimum, average, and maximum gross alpha activities were 0.0, 3.0, and 6.0 pCi/g, and gross beta activities were 3.0, 12.0, and 20.0 pCi/g. The gross alpha and beta activities present in the screened samples from PRS 49-008(a) are slightly higher than the TA-49 background data, but the values indicate no significant radionuclide contamination at the site. The samples were packaged and promptly submitted through chain-of-custody procedures to the SMO for shipment to the

analytical laboratories, where gamma spectrometry was performed on all samples. Twenty-five percent of the samples, randomly selected before sampling, were analyzed for TAL metals.

TABLE 5.4.4-1
SUMMARY OF SAMPLES TAKEN AT PRS 49-008(a), AREA 5 SURFACE SAMPLES

Location ID	Sample ID	Depth (ft)	Matrix	Inorganic Chemicals[a]	Radionuclides[a]
49-5000	0549-95-0123	0–0.5	Soil	—[b]	720
49-5001	0549-95-0124	0–0.5	Soil	—	720
49-5002	0549-95-0125	0–0.5	Soil	—	720
49-5003	0549-95-0126	0–0.5	Soil	—	720
49-5004	0549-95-0127	0–0.5	Soil	—	720
49-5005	0549-95-0128	0–0.5	Soil	—	720
49-5006	0549-95-0129	0–0.5	Soil	—	720
49-5007	0549-95-0130	0–0.5	Soil	719	720[c]
49-5010	0549-95-0131	0–0.5	Soil	—	720
49-5011	0549-95-0132	0–0.5	Soil	—	720
49-5012	0549-95-0144	0–0.5	Soil	—	720
49-5013	0549-95-0145	0–0.5	Soil	719	720[c]
49-5014	0549-95-0146	0–0.5	Soil	—	720
49-5015	0549-95-0147	0–0.5	Soil	719	720[c]
49-5016	0549-95-0148	0–0.5	Soil	—	720
49-5017	0549-95-0149	0–0.5	Soil	—	720
49-5018	0549-95-0150	0–0.5	Soil	—	720
49-5019	0549-95-0151	0–0.5	Soil	—	720
49-5020	0549-95-0152	0–0.5	Soil	719	720[c]
49-5021	0549-95-0153	0–0.5	Soil	719	720[c]
49-5022	0549-95-0154	0–0.5	Soil	719	720[c]
49-5023	0549-95-0012	0–0.5	Soil	719	720[c]
49-5024	0549-95-0156	0–0.5	Soil	—	720
49-5025	0549-95-0157	0–0.5	Soil	—	720
49-5028	0549-95-0158	0–0.5	Soil	—	720
49-5029	0549-95-0159	0–0.5	Soil	—	720
49-5029R[d]	0549-95-0160	0–0.5	Soil	—	720

a. Request numbers.
b. A dash indicates that analysis was not requested.
c. Samples under this request number were analyzed for isotopic plutonium and total uranium, in addition to gamma spectrometry analysis.
d. R indicates replicates.

TABLE 5.4.4-1 (concluded)

Location ID	Sample ID	Depth (ft)	Matrix	Inorganic Chemicals	Radionuclides
49-5030	0549-95-0161	0–0.5	Soil	—	720
49-5031	0549-95-0162	0–0.5	Soil	719	720[c]
49-5032	0549-95-0163	0–0.5	Soil	—	720
49-5033	0549-95-0164	0–0.5	Soil	—	720
49-5034	0549-95-0165	0–0.5	Soil	719	720[c]
49-5035	0549-95-0166	0–0.5	Soil	—	720
49-5036	0549-95-0167	0–0.5	Soil	727	728[c]
49-5037	0549-95-0168	0–0.5	Soil	—	728
49-5038	0549-95-0169	0–0.5	Soil	—	728[c]
49-5038R	0549-95-0170	0–0.5	Soil	—	728[c]
49-5039	0549-95-0171	0–0.5	Soil	—	728
49-5040	0549-95-0172	0–0.5	Soil	727	728[c]
49-5041	0549-95-0173	0–0.5	Soil	—	728
49-5044	0549-95-0174	0–0.5	Soil	—	728
49-5045	0549-95-0175	0–0.5	Soil	727	728[c]
49-5046	0549-95-0176	0–0.5	Soil	—	728
49-5047	0549-95-0177	0–0.5	Soil	—	728
49-5048	0549-95-0178	0–0.5	Soil	727	728[c]
49-5049	0549-95-0179	0–0.5	Soil	—	728
49-5050	0549-95-0180	0–0.5	Soil	—	728
49-5051	0549-95-0181	0–0.5	Soil	—	728
49-5052	0549-95-0182	0–0.5	Soil	—	728
49-5052R	0549-95-0183	0–0.5	Soil	—	728
49-5053	0549-95-0184	0–0.5	Soil	—	728
49-5054	0549-95-0185	0–0.5	Soil	—	728
49-5055	0549-95-0186	0–0.5	Soil	727	728[c]
49-5060	0549-95-0187	0–0.5	Soil	—	728
49-5061	0549-95-0188	0–0.5	Soil	—	728
49-5062	0549-95-0189	0 - 0.5	Soil	—	728
49-5063	0549-95-0190	0–0.5	Soil	—	728

c. Samples under this request number were analyzed for isotopic plutonium and total uranium, in addition to gamma spectrometry analysis.

TABLE 5.4.4-2
SUMMARY OF SAMPLES TAKEN AT AREA 5 PRSs 49-006, SUMP, AND 49-005(b), LANDFILL

Location ID	Sample ID	Depth (ft)	Matrix	SVOCs[a]	Inorganic Chemicals[a]	Radionuclides[a]
49-5095	0549-95-0134	0–0.5	Soil	—[b]	719	720[c]
49-5095	0549-95-0133	5–10	Soil	726	727	728
49-5078	0549-95-0136	0–0.5	Soil	—	719	720[c]
49-5078	0549-95-0135	3.6–5	Soil	726	727	728[c]
49-5079	0549-95-0139	0–0.5	Soil	—	719	720[c]
49-5079	0549-95-0138	3.3–5	Soil	726	727	728[c]
49-5079R[d]	0549-95-0137	3.3–5	Soil	726	727	728[c]

a. Request numbers.
b. A dash indicates that analysis was not requested.
c. Samples under this request number were analyzed for isotopic plutonium and total uranium, in addition to gamma spectrometry analysis.
d. R indicates field replicates.

Subsurface Samples. As specified in the work plan, two borehole sites were selected at the location of 49-005(b) (landfill), and one borehole site was selected at 49-006 (sump). The landfill site was readily located because it is contained within the concrete-walled basement of the counting room; the top of the walls are still visible. The location of the sump was less certain but was based on aerial photography interpretation. The aerial photography report concluded that the location of the sump would probably have a higher infiltration rate than the surrounding soil, would tend to collect rainfall water, and thus would support the growth of vegetation. Because Area 5 was completely razed by the 1977 La Mesa fire, any subsequent growth of shrubs or trees could be possible locations of the sump(s) (Wells, 44820). A single bush growing in the north-central part of Area 5 near the former location of the photography trailer was selected as the most likely location of a sump. No other sumps or indications of sumps could be located. The planned depth for each borehole was 10 ft or the depth to undisturbed tuff, whichever occurred first. Samples were to be collected from the bottom 5-ft interval of the boreholes.

On July 20, 1995, the three boreholes were drilled using a truck-mounted, hollow-stem-auger drill rig and 5-ft-length core barrel soil samplers. As drilling proceeded, each core barrel was opened, and the core was field screened for radiation using beta/gamma and alpha meters and for organic vapors using a photoionization detector. The lithology of the core was logged and visually examined for any discoloration, texture changes, fractures, debris, or other extraordinary features. There was no detectable alpha activity from the cores, and the beta/gamma measurements ranged between 120 and 200 cpm;

the normal Laboratory background is from 150 to 250 cpm. All the photoionization detector measurements were <1 ppm.

At the landfill (boreholes 49-5078 and 49-5079), the drilling could not go past 5 ft because of an impenetrable obstruction that was encountered in both boreholes. This obstruction most likely was the concrete floor of the counting room. Wire and cable wrapped around the outside of the auger flights demonstrated that debris had been buried at this site; samples also contained an iron- and organic-rich silty clay. Two subsurface soil samples and one replicate were collected from the boreholes. Borehole 49-5095 (sump) was drilled to depth of 10 ft. Tuff was encountered at approximately 5 ft below the ground surface. One sample was taken in the 5- to 10-ft interval. Sample and location numbers for the subsurface samples and the corresponding surface samples are shown in Table 5.4.4-2. Each sample was screened for gross alpha and gross beta radiation at the ESH-19 Counting Facility. Radioactivities of the three samples from locations 49-5078, 49-5079, and 49-5095 were 10.0, 4.0, and 1.0 pCi/g gross alpha and 5.0, 20.0, and 22.0 pCi/g gross beta, respectively. These values indicate no significant radionuclide contamination at the site. Samples were packaged and promptly submitted through chain-of-custody procedures to the SMO for shipment to the analytical laboratories, where gamma spectrometry was performed on all samples. Samples were analyzed for TAL metals and SVOCs.

5.4.5 Evaluation of Inorganic Chemicals

Twenty-one soil samples collected at PRSs 49-005(b), 49-006, and 49-008(a) were analyzed for TAL metals. These 21 samples and 2 additional samples collected at PRS 49-008(a) were also analyzed for total uranium. Of the 23 samples, 22 were collected from mesa top soil, and 1 was collected from Unit 3 Tshirege Member of the Bandelier Tuff. Each site inorganic result was compared to the geologically appropriate background screening value (Longmire et al. 1995, 55115 and 52227).

Two inorganic chemicals (chromium and magnesium) were detected in Unit 3 samples at concentrations above their respective background screening values. Because the amount of Unit 3 site data for these metals is inadequate to support statistical tests, chromium and magnesium are carried forward to the screening assessment. Eleven additional inorganic chemicals (antimony, arsenic, copper, iron, lead, mercury, nickel, potassium, silver, thallium, and zinc) were detected in mesa top soil samples at concentrations above their respective background screening values. Antimony, mercury, silver, and thallium were not subjected to further background comparisons because the background data for these metals are inadequate to support the prescribed statistical tests. Antimony, mercury, silver, and thallium are, therefore, carried forward to the screening assessment because of the lack of background information. Uranium was evaluated as an inorganic chemical and was below background; it will not be evaluated further in this section.

Further background comparisons were performed for arsenic, copper, iron, lead, nickel, potassium, and zinc. The Gehan modification to the Wilcoxon Rank Sum test and the Quantile test were used for these evaluations (Section 3.2.1). Observed significance levels (p-values) for these tests are presented in Table 5.4.5-1.

TABLE 5.4.5-1
STATISTICAL TESTS FOR BACKGROUND COMPARISON

Analyte	Gehan Test P-Value	Quantile Test P-Value
Arsenic	1	0.9915
Copper	0.0014	0.0015
Iron	0.7445	0.812
Lead	0.0729	0.5839
Nickel	0.295	0.812
Potassium	0.1278	0.0015
Zinc	<0.00005	0.0232

The results for copper, potassium, and zinc are indicative of site concentrations that are greater than background. The results for arsenic, iron, lead, and nickel are indicative of site concentrations that are not statistically elevated above background. However, upon further evaluation, the data for lead show that one concentration at 10,100 mg/kg is more than 300 times larger than the rest of the site concentrations. The following boxplot[2] (Figure 5.4.5-1) represents the background data for lead and the site data for lead. The maximum value of 10,100 mg/kg is excluded from the boxplot. The boxplot indicates that the remainder of the data for lead appear to be within background. However, because of the high lead concentration, lead will be carried forward to the screening assessment for further evaluation.

Based on the background comparisons and further statistical tests, antimony, chromium, copper, lead, mercury, magnesium, potassium, silver, thallium, and zinc are carried forward to the screening assessment. The data for each sample that had at least one concentration above its background screening value for these inorganics are presented in Table 5.4.5-2. The locations of these samples are shown in Figure 5.4.5-2.

[2] Boxplots have proven to be good exploratory tools. The ends of the box represent the interquartile range (IQR), which is specified by the 25th (lower end of the box) and the 75th (upper end of the box) percentiles of the data distribution. The line within the box represents the median (50th percentile) of the data distribution. Thus, the box indicates concentration values for the central half of the data, and concentration shifts can be readily assessed by comparing the boxes. The square brackets represent 1.5*IQR. These brackets give some indication of the data that may be possible outliers. The lines above and below the square brackets represent specific observed data concentrations.

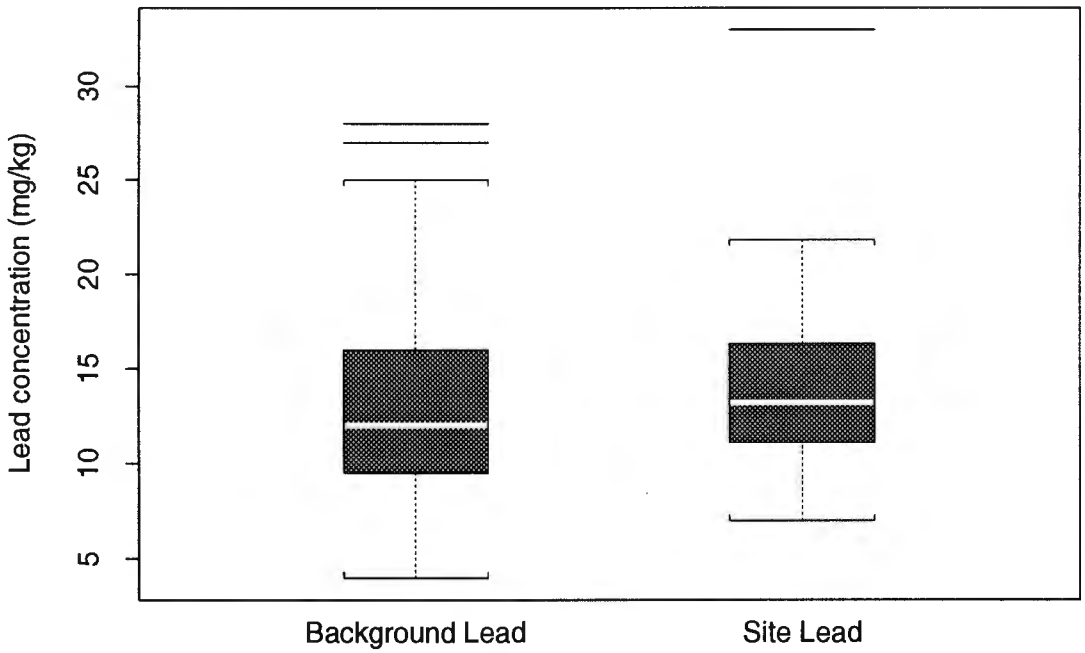


Figure 5.4.5-1. Background and site data for lead.

Qualifiers shown in Table 5.4.5-2 were assigned during baseline validation. However, the data are usable for site-specific decisions. As discussed in Section 4.1, antimony data were qualified UJ in nine samples and J- in one sample because the percent recovery for the matrix spike sample was below the lower control limit. In this case, the quantitation limit is an estimated quantity, but antimony was not detected in the sample data qualified UJ. The sample with a detected concentration of antimony may be biased low.

5.4.6 Evaluation of Radionuclides

Twenty-three soil samples collected at PRSs 49-005(b), 49-006, and 49-008(a) were analyzed for isotopic plutonium. These samples and an additional 41 samples were also analyzed by gamma spectrometry. Uranium, which was determined to be within background in the previous section, will not be evaluated further in this section.

Ten radionuclides were reported by the gamma spectrometry analysis. Analyses of radionuclides by gamma spectrometry often leads to the reporting of concentrations for certain radionuclides that are inappropriate to evaluate as potential site contaminants. This includes short-lived activation/fission products. This class of radionuclides is generally not considered a site contaminant. Four short-lived activation/fission products reported at PRSs 49-005(b), 49-006, and 49-008(a) (barium-140, europium-152,

TABLE 5.4.5-2

INORGANICS WITH CONCENTRATIONS[a] EXCEEDING BACKGROUND SCREENING VALUES AT PRSs 49-005(b), 49-006, AND 49-008(a)

Analyte	All Soil Data	SAL	Location 49-5023, Sample 0549-95-0012[b]	Location 49-5007, Sample 0549-95-0130	Location 49-5095, Sample 0549-95-0134	Location 49-5079, Sample 0549-95-0137	Location 49-5079, Sample 0549-95-0138	Location 49-5079, Sample 0549-95-0139
Antimony	**1**	**31**	0.77(UJ)	**3.5(J-)[c]**	0.84(UJ)	0.74(UJ)	0.73(UJ)	0.83(UJ)
Chromium	**19.3**	**210**	7	10.3	9.9	9.5	9.6	11
Copper	**15.5**	**2800**	10.1	**3950[d]**	**86.4**	6.9	6.9	8.6
Lead	**23.3**	**400**	21.8	**10100**	**33**	13.2	12.6	16.3
Magnesium	**4610**	**n/a[e]**	946	1360	1890	1980	1900	2290
Mercury	**0.1[f]**	**23**	0.11(U)	0.11(U)	0.12(U)	0.11(U)	0.11(U)	0.1(U)
Potassium	**3410**	**n/a**	1200	1570	2230	2610	2570	**3500**
Silver	**n/a[g]**	**380**	0.2(UJ)	**2**	0.75(U)	**0.28**	**0.24**	0.2(U)
Thallium	**1[f]**	**5.4**	1.4(U)	1.5(U)	1.5(U)	1.4(U)	1.3(U)	1.5(U)
Zinc	**50.8**	**23000**	**53.3**	**388**	**227**	35	33.6	37

a. Concentrations in mg/kg.

b Value represents the maximum of a sample concentration and its laboratory duplicate.

c. Bold, enlarged values indicate concentrations above background screening values.

d. Bold, enlarged, and underlined values indicate concentrations above SALs.

e. n/a = not available

f. Value represents the maximum reported background concentration in soil.

g. For silver, the detection limit is used as a background screening value.

TABLE 5.4.5-2 (concluded)

Analyte	All Soil Data	SAL	Location 49-5013, Sample 0549-95-0145	Location 49-5031, Sample 0549-95-0162	Location 49-5036, Sample 0549-95-0167	Location 49-5048, Sample 0549-95-0178	Unit 3	Location 49-5095, Sample 0549-95-0133
Antimony	**1**	**31**	0.81	0.79(UJ)	0.81(UJ)	0.82(UJ)	**0.4**	0.75(UJ)
Chromium	**19.3**	**210**	10.5	7.3	10.7	9.8	**2.1**	**2.3**
Copper	**15.5**	**2800**	**22.7**	**19.9**	12.6	8	**2**	1.7
Lead	**23.3**	**400**	16.4	12.3	13	12.1	**16.2**	2.4
Magnesium	**4610**	**n/a**	2060	1500	2200	1870	**628**	**714**
Mercury	**0.1[f]**	**23**	0.11(U)	0.1(U)	**0.12**	0.11(U)	**n/a**	0.1(U)
Potassium	**3410**	**n/a**	2930	1720	2570	2690	**735**	499
Silver	**n/a[g]**	**380**	0.19(U)	0.62(U)	**0.33**	**0.3**	**1.9**	0.18(U)
Thallium	**1[f]**	**5.4**	1.5(U)	1.4(U)	**1.5**	1.5(U)	**1.7**	1.4(U)
Zinc	**50.8**	**23000**	44.6	30.1	32.8	36.1	**59**	14.6

f. Value represents the maximum reported background concentration in soil.

g. For silver, the detection limit is used as a background screening value.

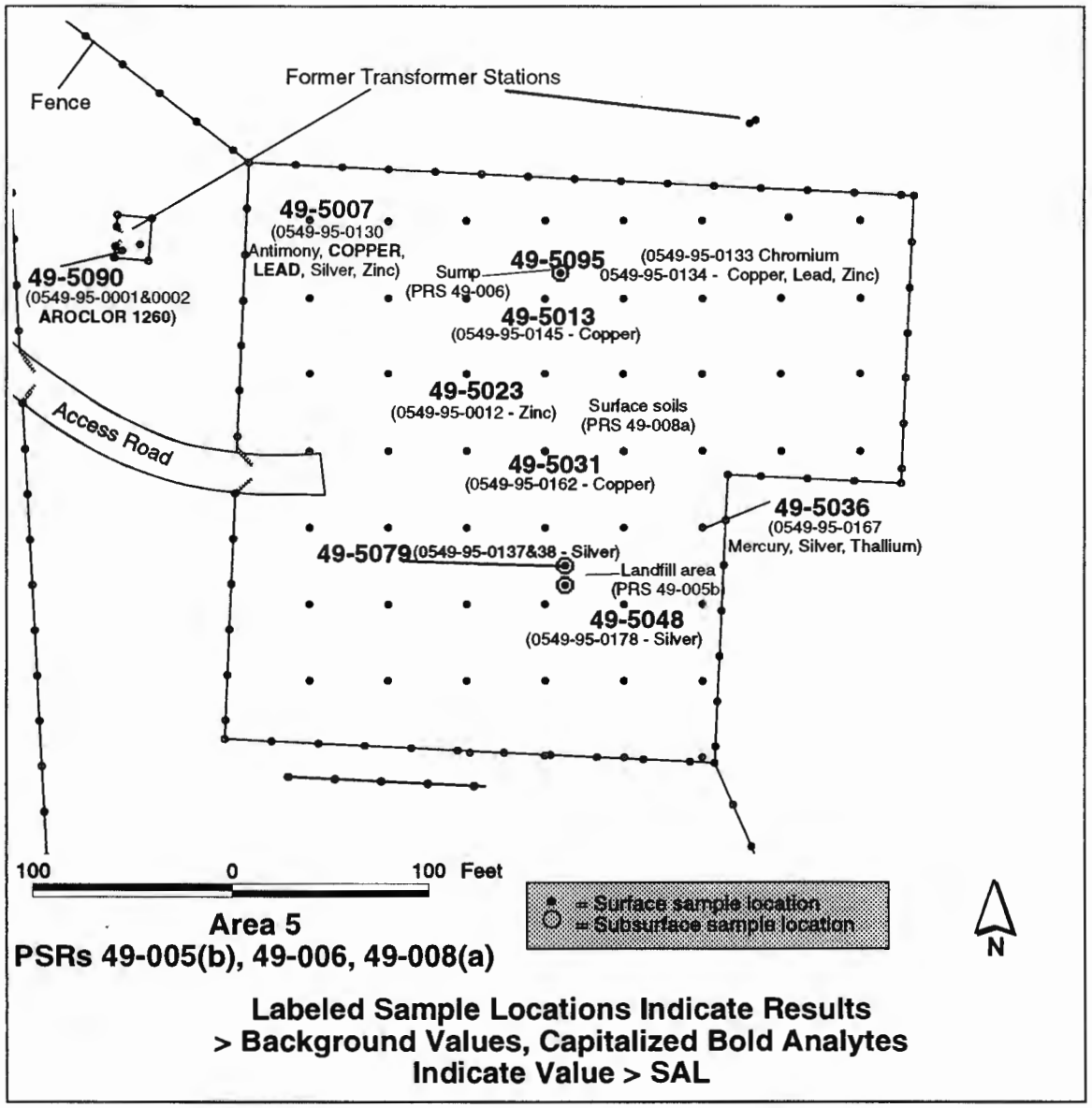


Figure 5.4.5-2. Locations of samples with inorganic concentrations above background screening values.

ruthenium-106, and sodium-22) have half-lives ranging between a few days and 13.6 years. Several of these radionuclides are used as internal standards to measure equipment performance and laboratory background (or contamination). Because activation/fission products with short half-lives are routinely reported for reasons not related to RFI investigations and are not expected to occur at these PRSs, these short-lived activation/fission products are eliminated as potential radioactive contaminants.

EQLs and minimum detectable activities are often not available for those radionuclides reported in gamma spectrometry analysis. A value of three times the measurement uncertainty (3-sigma or three standard deviations) is used to calculate a sample-specific minimum detectable activity, which is then used in the same manner as a detection limit. This methodology is similar to Currie's method of determining radionuclide maximum

detectable activity (Currie 1988, 55422). The 3-sigma screening value takes into account variability because of counting statistics but does not account for spectral peak identification problems. Thus, 3-sigma screening is conservative and may include radionuclides whose presence is spuriously reported because of spectral interferences or misidentifications. Americium-241, cerium-144, cobalt-60, neptunium-237, and plutonium-238 were eliminated from further consideration based on this criterion.

Cesium-137 and plutonium-239/240 are the remaining radionuclides that were detected. They were eliminated from further consideration based on the fact that they were below background screening values. Therefore, no radionuclides are carried forward to the screening assessment.

5.4.7 Evaluation of Organic Chemicals

Four soil samples collected at PRSs 49-005(b), 49-006, and 49-008(a) were analyzed for SVOCs. No organics were detected in these samples. Therefore, no SVOCs are carried forward to the screening assessment. Four samples and one field replicate collected at PRS 49-008(a) were analyzed for PCBs. One PCB, Aroclor 1260, was detected in duplicate samples and was carried forward to the screening assessment (Table 5.4.7-1).

5.4.8 Risk-Based Screening Assessment

Ten inorganic chemicals detected at concentrations greater than background screening values or having no background data for comparison were carried forward to the screening assessment. No radionuclides were detected at concentrations exceeding background screening values. One organic chemical, Aroclor 1260, was detected. The screening assessment includes a comparison to SALs and an MCE (Dorries 1996, 55575).

TABLE 5.4.7-1
AMOUNT OF AROCLOR IN SURFACE SAMPLES TAKEN AT THE TRANSFORMER LOCATIONS (AREA 5)

Location ID	SAMPLE ID	Amount (mg/kg)
49-5090	0549-95-0001	2.40
49-5090R*	0549-95-0002	3.20
49-5091	0549-95-0003	0.37

* R indicates field replicate.

Copper and lead were detected at one location in PRS 49-008(a) at concentrations exceeding their SALs. These concentrations are shown in Table 5.4.8-1. Copper and lead are retained as COPCs and are discussed in Section 5.4.9. Aroclor 1260, a PCB, was also detected at concentrations exceeding SAL in duplicate samples collected at one of the transformer locations. These concentrations are shown in Table 5.4.8-2.

TABLE 5.4.8-1
PRS 49-008(a) INORGANIC CHEMICALS WITH CONCENTRATIONS* THAT EXCEED SALs

Analyte	Depth (ft)	SAL	Location 49-5007, Sample 0549-95-0130
Copper	0–0.5	2800	3950
Lead	0–0.5	400	10100

* Concentrations in mg/kg.

TABLE 5.4.8-2
PRS 49-008(a) ORGANIC CHEMICALS WITH CONCENTRATIONS THAT EXCEED SALs

Sample ID	Location ID	Depth (ft)	Aroclor 1260 (mg/kg)
SAL	**n/a**	**n/a**	**1**
0549-95-0001	49-5090	0–0.5	2.4
0549-95-0002	49-5090R*	0–0.5	3.2

* R indicates field replicate.

The PCB soil samples are located in a restricted access area within the MDA AB exclusion area and are within a chain-link fence topped by barbed wire that surrounds the transformer pad. The transformer pad is situated on a flat area of the mesa top and free of any defined surface water drainage channels. Toxic Substances Control Act (TSCA) requirements for decontaminating PCB spills in restricted access areas (other than outdoor electrical substations) require soil cleanup to 25 ppm PCBs by weight. Because the detected concentrations of this PCB are less than the TSCA required cleanup levels, it is not retained as a COPC.

Two of the inorganic chemicals carried forward from the background comparisons have no SALs for comparison. These include magnesium and potassium. Magnesium and potassium are essential nutrients that can be eliminated as COPCs on the basis of best professional judgment (EPA 1989, 8021). Although neither of these chemicals have a SAL, as essential nutrients they may be compared to the RDA for children and adults.

The magnesium RDA is 80 mg/day for a 1- to 3-year-old child and 280 mg/day for an adult female. The highest detected concentration of magnesium that exceeds background screening values at PRSs 49-005(b), 49-006, and 49-008(a) was 714 mg/kg. At the EPA default child soil ingestion rate of 200 mg/day, a child would ingest about 0.1 mg of magnesium per day. At the EPA default adult soil ingestion rate of 100 mg/day, an adult female would ingest about 0.05 mg of magnesium per day. Because both amounts are considerably less than the RDAs, magnesium is eliminated as a COPC.

The estimated minimum requirement for potassium is 1600 to 2000 mg/day. The highest detected concentration of potassium that exceeds background screening values at PRSs

49-005(b), 49-006, and 49-008(a) was 3500 mg/kg. At the EPA default child soil ingestion rate of 200 mg/day, a child would ingest about 0.7 mg of potassium per day. At the EPA default adult soil ingestion rate of 100 mg/day, an adult would ingest about 0.4 mg of potassium per day. Because both amounts are considerably less than the estimated minimum requirement, potassium is eliminated as a COPC.

The six remaining chemicals were detected at concentrations below their respective SALs. These remaining chemicals are divided into three classes (carcinogens, noncarcinogens, and radionuclides) to evaluate possible additive effects within each class of chemicals in an MCE (Dorries 1996, 55575). Chromium was the only carcinogen detected; therefore, an MCE was not performed for this class. Chromium was detected at a maximum concentration of 2.3 mg/kg, well below its SAL of 210 mg/kg. It is eliminated as a COPC. No radionuclides were detected; therefore, an MCE was not performed for this class. The MCE for noncarcinogens is presented in Table 5.4.8-3.

TABLE 5.4.8-3
MCE FOR NONCARCINOGENS AT PRSs 49-005(b), 49-006, AND 49-008(a)

Analyte	Location ID	Sample Number	Maximum Concentration	SAL	Normalized Value
Antimony	49-5007	0549-95-0130	3.5	31	0.1
Mercury	49-5036	0549-95-0167	0.12	23	0.005
Silver	49-5007	0549-95-0130	2	380	0.005
Thallium	49-5036	0549-95-0167	1.5	5.4	0.3
Zinc	49-5007	0549-95-0130	388	23000	0.02
			Sum	**=**	**0.4**

The sum (0.4) of the normalized values is less than unity, indicating that the potential for adverse human health effects from exposure is unlikely. Therefore, all noncarcinogens at concentrations below SAL are eliminated as COPCs. Only copper and lead are retained as COPCs.

5.4.9 Human Health Risk Assessment

Copper and lead were identified as COPCs by the screening assessment for PRS 49-005(b). A quantitative human health risk assessment was not performed for this PRS. However, a qualitative evaluation of these COPCs is presented below.

Copper and lead were detected at concentrations above their respective SALs at a single location. The soil at this location had a black, burned appearance and contained some very small pieces of metal. A small (2- to 3-inch diameter) congealed puddle of melted metal, evident on the ground surface at this location (49-5007), is the probable source of these elevated concentrations (Figure 5.4.9-1). SALs were not exceeded in any of the other 22 locations sampled. Location 49-5007 is within the MDA AB exclusion fence, and will be managed as a controlled area for the indefinite future. Because the sample location represents a discrete source rather than widespread contamination, and human access to the area is limited, NFA is proposed for this area.

5.4.9.1 Review of COPCs and Extent of Contamination

Although 10 inorganic chemicals were identified above background screening values at these PRSs, no risk-based COPCs were identified. As described in Section 5.4.4, the sampling activities were biased toward areas where contamination would be expected. The grid size and sampling locations described in Section 5.4.4 are adequate to determine the nature of contamination from these PRSs, as described in the work plan (LANL 1992, 7670). The lateral extent of contamination is well enough defined for copper and lead to determine that potential adverse human health effects are unlikely.

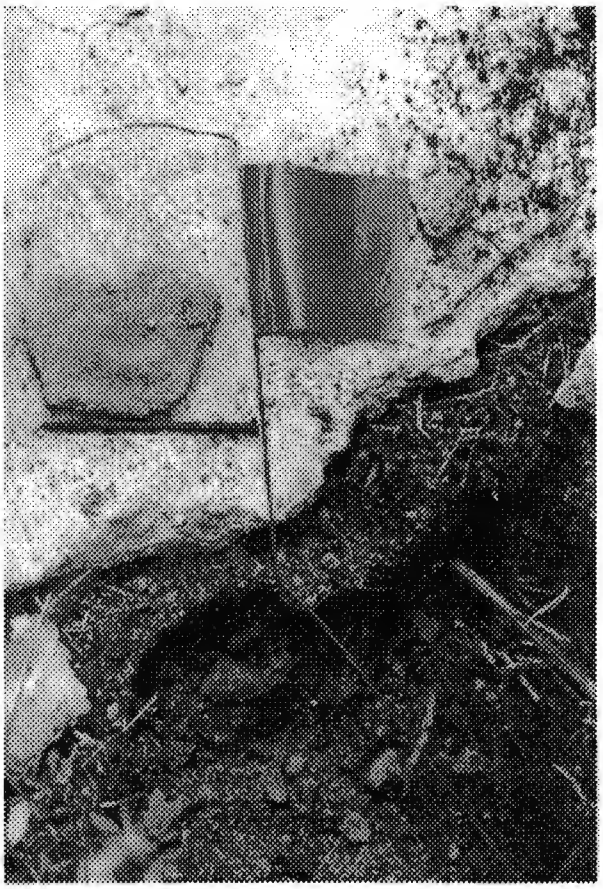


Figure 5.4.9-1. Congealed lead found at sample location 49-5007.

5.4.10 Preliminary Ecological Assessment

An ecological risk evaluation was not performed because the Laboratory ER Project, in cooperation with the New Mexico Environment Department and EPA Region 6, is developing an approach for ecological risk assessment. This site will be evaluated for ecological concerns as soon as the ecological risk screening assessment methodology can be conducted for this ecological unit.

5.4.11 Conclusions and Recommendations

The objective of the Phase 1 RFI at PRSs 49-005(b), 49-006, and 49-008(a) was to determine the presence or absence of contamination associated with the main control area for the hydronuclear experiments. Copper and lead were identified as COPCs in the human health screening assessment but were eliminated as COPCs in a qualitative risk assessment.

Soil samples were collected from the area with the highest potential for contamination (surface and subsurface samples within the fenced area of Area 5, in the small landfill, and at a sump location). Because no COPCs were identified, the sample data suggest that widespread contamination at concentrations of human health concern has not occurred.

These sites are proposed for NFA, based on NFA Criterion 5. A Class III permit modification will be requested to remove these sites from the Hazardous and Solid Waste Amendments Module of the Laboratory's hazardous waste facility permit.

5.5 Area 6: PRS 49-008(b), Surface Soils

PRS 49-008(b) consists of surface soils in Area 6 that may have been impacted by support activities for the hydronuclear program (Figure 5.5-1). Mercury, silver, and thallium were detected in samples at levels above background screening values but below SALs. This PRS is recommended for NFA.

Figure 5.5-1. Sampling locations, facilities, and features at PRS 49-008(b).

5.5.1 History

PRS 49-008(b) is discussed in detail in Section 6.3 of the work plan (LANL 1992, 7670).

A portion of Area 6 just north of Frijoles Mesa Drive and west of the main control area was developed as a general support area very early in the hydronuclear program (Eller 1991, 55331). This portion included storage and office buildings and structures used by carpenters and electricians. An area approximately 400 ft^2 in size was used to store lumber, fencing, and steel. Cables, pipes, and sand for backfilling shafts also were store

there. All of these structures had been removed by 1977. Anecdotal information suggests that a small lead-casting shop may also have operated briefly in this area.

Operations in this area would have been greatly complicated by radioactive contamination, and therefore, the presence of radioactive materials was very closely controlled (Eller 1991, 55331). For example, after the initial TA-49 experiments, a directive was issued that "salvage material from shot holes will be marked as to the hole from which it came, and will be sorted in a separate area within Area 6 for future use or disposal" (LANL 1992, 7670). It is therefore conceivable that materials with trace contamination were stored in the area temporarily, but effective contamination controls no doubt were in place (LANL 1992, 7670). It is known that low levels of contamination were tracked into some Area 6 structures during the unintended release of radioactivity in Area 2 in 1960, as stated in Chapter 7 of the work plan (LANL 1992, 7670). However, it is highly likely that this contamination was low level, very localized, and quickly cleaned up.

Currently, Area 6 contains the Day Room (TA-49-115, also known as the Antenna Test Facility), and equipment trailers. These facilities are now being used by the Laboratory's High-Power Microwave Group (AOT-9). Chemicals of concern at this PRS are TAL metals and radionuclides.

5.5.2 Description

Chapter 2 contains a detailed site-specific description including geology, soils, wildlife habitat, and cultural resources.

5.5.3 Previous Investigations

No previous investigations have been performed for Area 6.

5.5.4 Field Investigation

The objective of this field investigation was to determine if chemicals of concern exist above SALs or background levels in surface soils at Area 6. The chemicals of concern are TAL metals and radionuclides around the present and former structure locations.

5.5.4.1 FIDLER Radiological Survey

As described in the work plan, an elongated sampling grid with 40-ft spacing (75 points) was land surveyed around the open areas of the Antenna Test Facility. FIDLER measurements were taken at each grid point. No radiologically contaminated areas were found, and all measurements were within three standard deviations of the average background (Art 1996, 55332). Therefore, the grid points chosen for sample collection were randomly selected.

5.5.4.2 Surface Soil Sampling

Before samples were collected on August 1, 1995, each sampling site was field screened for beta/gamma radiation with an ESP-1 meter and for VOCs using an HNU photoionization detector. The beta/gamma measurements ranged between 163 and 273 cpm with an average of 216 cpm. None of these values are considered elevated; the normal Laboratory background is from 150 to 250 cpm. All the photoionization detector measurements were <1 ppm. Twenty-one surface soil samples were collected, including

two field replicates. Sample and location numbers are shown in Table 5.5.4-1. Each sample was screened for gross alpha and gross beta radiation at the ESH-19 Counting Facility before shipment to the analytical laboratory. Minimum, average, and maximum radioactivities of the samples were 0.0, 3.0, and 13.0 pCi/g gross alpha and 5.0, 15.0, and 26.0 pCi/g gross beta. No Laboratory background UTL has been established for gross alpha or beta activity; however, these data can be compared to on-site background sampling locations. At the nine TA-49 background monitoring locations, the minimum, average, and maximum gross alpha activities were 0.0, 3.0, and 6.0 pCi/g, and gross beta activities were 3.0, 12.0, and 20.0 pCi/g. The gross alpha and beta activities are slightly higher than the background data, but the values indicate no significant radionuclide contamination at the site. Samples were packaged and promptly submitted through chain-of-custody procedures to the SMO for shipment to the analytical laboratories, where gamma spectrometry was performed on all samples. Fifty-seven percent of the samples, which were randomly selected, were analyzed for TAL metals, total uranium, and isotopic plutonium.

5.5.5 Evaluation of Inorganic Chemicals

Twelve samples collected from mesa top soils at PRS 49-008(b) were analyzed for TAL metals and total uranium. Each site inorganic result was compared to the geologically appropriate background screening value (Longmire et al. 1995, 55115 and 52227).

Three inorganics (mercury, silver, and thallium) were detected at concentrations above their respective background screening values. Because the background data for these metals are inadequate to support statistical tests, these three metals are carried forward to the screening assessment. Uranium was evaluated as an inorganic chemical and was below background; it will not be evaluated further in this section. The data for each sample that had at least one concentration above its background screening value are presented in Table 5.5.5-1. The locations of these samples are shown in Figure 5.5.5-1.

5.5.6 Evaluation of Radionuclides

Twelve soil samples collected at PRSs 49-008(b) were analyzed for isotopic plutonium. These 12 samples and an additional 9 samples were also analyzed by gamma spectrometry. Because uranium was determined to be within background in the inorganic chemical evaluation, it will not be evaluated further in this section.

Nine radionuclides were reported by the gamma spectrometry analysis. Analyses of radionuclides by gamma spectrometry often leads to the reporting of concentrations for certain radionuclides that are inappropriate to evaluate as potential site contaminants. This includes short-lived activation/fission products. This class of radionuclides is generally not considered a site contaminant. Four short-lived activation/fission products reported at PRS 49-008(b) (barium-140, europium-152, ruthenium-106, and sodium-22) have half-lives ranging between a few days and 13.6 years. Several of these radionuclides are used as internal standards to measure equipment performance and laboratory background (or contamination). Because activation/fission products with short half-lives are routinely reported for reasons not related to RFI investigations and are not expected to occur at these PRSs, these short-lived activation/fission products are eliminated as potential radionuclide contaminants.

TABLE 5.5.4-1
SUMMARY OF SAMPLES TAKEN AT PRS 49-008(b), AREA 6

Location ID	Sample ID	Depth (ft)	Matrix	Inorganic Chemicals[a]	Radionuclides[a]
49-6000	0549-95-0294	0–0.5	Soil	783	786[c]
49-6006	0549-95-0295	0–0.5	Soil	—[b]	786
49-6016	0549-95-0296	0–0.5	Soil	—	786
49-6017	0549-95-0297	0–0.5	Soil	783	786[c]
49-6020	0549-95-0298	0–0.5	Soil	—	786
49-6028	0549-95-0299	0–0.5	Soil	—	786
49-6031	0549-95-0300	0–0.5	Soil	783	786[c]
49-6034	0549-95-0301	0–0.5	Soil	783	786[c]
49-6039	0549-95-0302	0–0.5	Soil	783	786[c]
49-6050	0549-95-0303	0–0.5	Soil	—	786
49-6052	0549-95-0304	0–0.5	Soil	—	786
49-6053	0549-95-0305	0–0.5	Soil	783	786[c]
49-6066	0549-95-0306	0–0.5	Soil	783	786[c]
49-6066R[d]	0549-95-0307	0–0.5	Soil	783	786[c]
49-6067	0549-95-0308	0–0.5	Soil	783	786[c]
49-6068	0549-95-0309	0–0.5	Soil	783	786[c]
49-6069	0549-95-0310	0–0.5	Soil	783	786[c]
49-6069R	0549-95-0311	0–0.5	Soil	783	786[c]
49-6070	0549-95-0312	0–0.5	Soil	—	786
49-6077	0549-95-0313	0–0.5	Soil	—	786
49-6079	0549-95-0314	0–0.5	Soil	—	786

a. Request numbers.
b. A dash indicates that analysis was not requested.
c. Samples under this request number were analyzed for isotopic plutonium and total uranium, in addition to gamma spectrometry analysis.
d. R indicates replicate.

TABLE 5.5.5-1
INORGANICS WITH CONCENTRATIONS[a] EXCEEDING BACKGROUND SCREENING VALUES AT PRS 49-008(b)

Location ID	Sample ID	Mercury	Silver	Thallium
UTL		0.1 [b]	n/a[c]	1 [b]
SAL		23	380	5.4
49-6000	0549-95-0294	0.1 (U)	**0.268**[d, e]	1.3 (U)
49-6066	0549-95-0306	**0.11**	0.21(U)	1.2 (U)
49-6067	0549-95-0308	0.1 (U)	0.34(U)	**1.3**

a. Concentrations in mg/kg
b. Value represents the maximum reported background concentration in soil (Longmire et al. 1995, 55115).
c. n/a = not available. For silver, the detection limit is used as a background screening value.
d. Value represents the maximum of a sample concentration and its laboratory duplicate.
e. Bold, enlarged values indicate concentrations above background screening values.

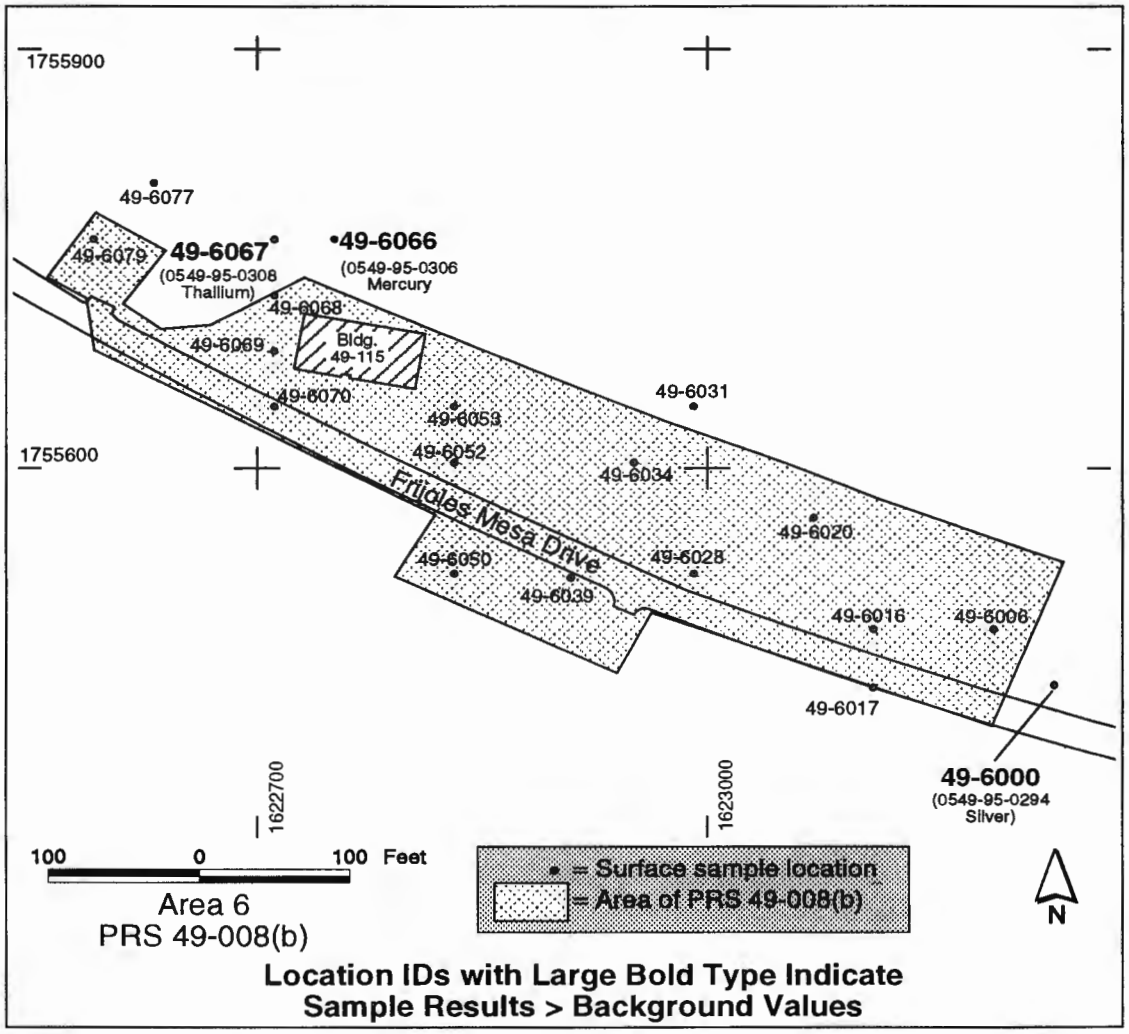


Figure 5.5.5-1. Locations of samples with inorganic concentrations above background screening values.

EQLs and minimum detectable activities are often not available for those radionuclides reported in gamma spectrometry analysis. A value of three times the measurement uncertainty (3-sigma or three standard deviations) is used to calculate a sample-specific minimum detectable activity, which is then used in the same manner as a detection limit. This methodology is similar to Currie's method of determining radionuclide maximum detectable activity (Currie 1988, 55422). The 3-sigma screening value takes into account variability in count rate but does not account for spectral peak identification problems. Thus, 3-sigma screening is conservative and may include radionuclides whose presence is spuriously reported because of spectral interferences or misidentifications. Americium-241, cerium-144, cobalt-60, neptunium-237, and plutonium-239/240 were eliminated from further consideration based on this criterion.

Cesium-137 and plutonium-238 are the remaining radionuclides that were detected. They were eliminated from further consideration based on comparison to background screening values. Therefore, no radionuclides are carried forward to the screening assessment.

5.5.7 Evaluation of Organic Chemicals

No samples were submitted for organic analysis for PRS 49-008(b) because the work plan did not identify any organic chemicals as possible contaminants.

5.5.8 Risk-Based Screening Assessment

Three inorganic chemicals detected at concentrations greater than background screening values were carried forward to the screening assessment. No radionuclides were detected at concentrations exceeding background screening values, and no organic chemical analyses were requested; therefore, none are carried forward to the screening assessment. The screening assessment includes a comparison to SALs and an MCE, as described in "Risk-Based Corrective Action Process" (Dorries 1996, 55575).

No COPCs were detected at concentrations exceeding their respective SALs at PRS 49-008(b). All of the COPCs carried forward from the background comparisons have SALs for comparison. The three inorganic chemicals carried forward from the background screening were detected at concentrations below their respective SALs. These chemicals were categorized into three classes (carcinogens, noncarcinogens, and radionuclides) to evaluate possible additive effects within each class of chemicals in an MCE (Dorries 1996, 55575). No carcinogens or radionuclides were detected at concentrations above background screening values, and an MCE is not performed for these classes. The MCE for noncarcinogens is presented in Table 5.5.8-1.

The sum (0.2) of the normalized values in the MCE is less than unity, indicating that the potential for adverse human health effects from exposure is unlikely. Therefore, all noncarcinogens are eliminated as COPCs.

5.5.9 Human Health Risk Assessment

No COPCs were identified in the human health screening assessment; therefore, no human health risk assessment was performed.

TABLE 5.5.8-1
MCE* FOR NONCARCINOGENS AT PRS 49-008(b)

Analyte	Location ID	Sample Number	Maximum Concentration	SAL	Normalized Value
Mercury	49-6066	0549-95-0306	0.11	23	0.005
Silver	49-6000	0549-95-0294	0.268	380	0.0007
Thallium	49-6067	0549-95-0308	1.3	5.4	0.2
			Sum	**=**	**0.2**

* Concentrations in mg/kg

5.5.9.1 Review of COPCs and Extent of Contamination

Although three inorganic chemicals were identified above background screening values at this PRS, no risk-based COPCs were identified. No radionuclides were detected at concentrations exceeding background screening values. No organic chemical analyses were conducted. As described in Section 5.5.4, the sampling activities were biased toward areas where contamination would be expected. The grid size and sampling locations described in Section 5.5.4 are adequate to determine the nature of contamination from this PRS, as described in the work plan (LANL 1992, 7670). Because no COPCs were identified, determination of the extent of contamination is irrelevant.

5.5.10 Preliminary Ecological Assessment

An ecological risk evaluation was not performed because the Laboratory ER Project, in cooperation with the New Mexico Environment Department and EPA Region 6, is developing an approach for ecological risk assessment. This site will be evaluated for ecological concerns as soon as the ecological risk screening assessment methodology can be conducted for this ecological unit.

5.5.11 Conclusions and Recommendations

The objective of the Phase 1 RFI at PRS 49-008(b) was to determine the presence or absence of contamination associated with the general support area for the hydronuclear program. No COPCs were identified in the human health screening assessment.

Soil samples were collected from randomly selected grid nodes on a 40-ft grid surveyed over the area. Because no COPCs were identified, the evidence suggests that widespread contamination at concentrations of human health concern has not occurred.

This site is proposed for NFA, based on NFA Criterion 5. A Class III permit modification will be requested to remove this site from the Hazardous and Solid Waste Amendments Module of the Laboratory's hazardous waste facility permit.

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APPENDIX A
ANALYTICAL DATA

Results of analyses can be found in the Facility for Information Management, Analysis, and Display. Hard copies of supporting information will be provided upon request. Chemicals that are reported by analytical laboratories as nondetects have not been included in the tables of this Resource Conservation and Recovery Act facility investigation report. Nonetheless, nondetected chemicals are often part of the decision-making process, and it is important to note that analyses for these chemicals were performed. This appendix provides a list of the target analytes in each analytical suite for which samples were taken.

Inorganic Suite

Aluminum	Calcium	Magnesium	Silver
Antimony	Chromium	Manganese	Sodium
Arsenic	Cobalt	Mercury	Thallium
Barium	Copper	Nickel	Vanadium
Beryllium	Iron	Potassium	Zinc
Cadmium	Lead	Selenium	

Semivolatile Organic Suite

Acenaphthene	Dibenzofuran	Isophorone
Acenaphthylene	1,2-Dichlorobenzene	2-Methylnaphthalene
Aniline	1,3-Dichlorobenzene	2-Methylphenol
Anthracene	1,4-Dichlorobenzene	4-Methylphenol
Azobenzene	3,3'-Dichlorobenzidine	Naphthalene
Benzo(a)anthracene	2,4-Dichlorophenol	2-Nitroaniline
Benzoic acid	Diethylphthalate	3-Nitroaniline
Benzo(b)fluoranthene	Dimethyl phthalate	4-Nitroaniline
Benzo(k)fluoranthene	2,4-Dimethylphenol	Nitrobenzene
Benzo(g,h,i)perylene	2,4-Dinitrophenol	2-Nitrophenol
Benzo(a)pyrene	Di-n-butylphthalate	4-Nitrophenol
Benzyl alcohol	4,6-Dinitro-2-methylphenol	N-Nitrosodimethylamine
Bis(2-chloroethoxy)methane	2,4-Dinitrotoluene	N-Nitrosodiphenylamine
Bis(2-chloroethyl)ether	2,6-Dinitrotoluene	N-Nitroso-di-n-propylamine
4-Bromophenylphenyl ether	Di-n-octylphthalate	2,2'-oxybis(1-Chloropropane)
Butylbenzylphthalate	Bis(2-ethylhexyl)phthalate	Pentachlorophenol
4-Chloroaniline	Fluoranthene	Phenanthrene
4-Chloro-3-methylphenol	Fluorene	Phenol
2-Chloronaphthalene	Hexachlorobenzene	Pyrene
2-Chlorophenol	Hexachlorobutadiene	1,2,4-Trichlorobenzene
4-Chlorophenylphenyl ether	Hexachlorocyclopentadiene	2,4,5-Trichlorophenol
Chrysene	Hexachloroethane	2,4,6-Trichlorophenol
Dibenzo(a,h)anthracene	Indeno(1,2,3-cd)pyrene	

Polychlorinated Biphenyl Suite

Aroclor 1016	Aroclor 1242	Aroclor 1260
Aroclor 1221	Aroclor 1248	
Aroclor 1232	Aroclor 1254	

High-Explosives Suite

2-Amino-4,6-dinitrotoluene (2-AM-DNT)	Nitrobenzene (NB)
4-Amino-2,6-dinitrotoluene (4-Am-DNT)	2-Nitrotoluene (2-NT)
1,3-Dinitrobenzene (1,3-DNB)	3-Nitrotoluene (3-NT)
2,4-Dinitrotoluene (2,4-DNT)	4-Nitrotoluene (4-NT)
2,6-Dinitrotoluene (2,6-DNT)	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	1,3,5-Trinitrobenzene (1,3,5-TNB)
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	2,4,6-Trinitrotoluene (2,4,6-TNT)

Radiochemical Suite

Actinium-228	Cesium-137	Neptunium-237	Radium-226
Americium-241	Cobalt-57	Plutonium-238	Radium-228
Annihilation radiation	Cobalt-60	Plutonium-239/240	Radon-219
Barium-140	Europium-152	Potassium-40	Ruthenium-106
Bismuth-211	Lead-210	Protactinium-231	Sodium-22
Bismuth-212	Lead-211	Protactinium-234	Thallium-208
Bismuth-214	Lead-212	Protactinium-234m	Thorium-227
Cerium-144	Lead-214	Radium-223	Thorium-234
Cesium-134	Manganese-54	Radium-224	Uranium-234, -235, and -238

APPENDIX B
DATA VALIDATION

TABLE B-1
DATA VALIDATION TABLE FOR TECHNICAL AREA 49 SAMPLES

Request Number	Sample ID	Suite	Comments
Potential Release Sites (PRSs) 49-002 and 49-005(a), Area 10			
719	0549-95-0141 0549-95-0143	Inorganic chemicals	Results for manganese are qualified J- for low-percent recovery in matrix spike sample. Results for antimony and selenium are qualified UJ for low-percent recovery in matrix spike sample.
727	0549-95-0140 0549-95-0142	Inorganic chemicals	Results for antimony are qualified UJ for low-percent recovery in matrix spike sample.
794	0549-95-0252 0549-95-0253 0549-95-0255 0549-95-0256 0549-95-0258 0549-95-0260 0549-95-0264	Inorganic chemicals	Results for arsenic and selenium are qualified UJ for low-percent recovery in matrix spike sample and high relative percent difference (RPD) in duplicate sample. Results for lead are qualified J- for low-percent recovery in matrix spike sample and high RPD in duplicate sample.
PRSs 49-003 and 49-008(c), Area 11			
656	0549-95-0024 0549-95-0026 0549-95-0029 0549-95-0031 0549-95-0034 0549-95-0036 0549-95-0037 0549-95-0038 0549-95-0043 0549-95-0044 0549-95-0046 0549-95-0047 0549-95-0049 0549-95-0050 0549-95-0051 0549-95-0055 0549-95-0058	Inorganic chemicals	Results for selenium are qualified UJ for low-percent recovery in matrix spike sample. Results for are beryllium qualified J for high RPD in duplicate sample.

TABLE B-1 (continued)

Request Number	Sample ID	Suite	Comments
679	0549-95-0065 0549-95-0066 0549-95-0072 0549-95-0075 0549-95-0078 0549-95-0087 0549-95-0093 0549-95-0096 0549-95-0099 0549-95-0100	Inorganic chemicals	Results for manganese are qualified J+ for high percent recovery in matrix spike. Results for antimony are qualified UJ for low-percent recovery in matrix spike sample.
680	0549-95-0065 0549-95-0072	Radionuclides	Results for total uranium are qualified J for low lifetime decay values. quality control criteria met for gamma spectrometry and plutonium isotopes.
PRS 49-004			
683	0549-95-0102	Inorganic chemicals	Results for antimony and selenium are qualified UJ for low-percent recovery in matrix spike sample. Results for arsenic and barium are qualified J- for low-percent recovery in matrix spike sample. Results for manganese are qualified J for high RPD in duplicate sample.
683	0549-95-0103 0549-95-0121	Inorganic chemicals	Results for antimony, arsenic, and selenium are qualified UJ for low-percent recovery in matrix spike sample. Results for barium are qualified J- for low-percent recovery in matrix spike sample. Results for manganese are qualified J for high RPD in duplicate sample.
683	0549-95-0104 0549-95-0105	Inorganic chemicals	Results for antimony and selenium are qualified UJ for low-percent recovery in matrix spike sample. Results for arsenic and barium are qualified J- for low-percent recovery in matrix spike sample. Results for manganese are qualified J for high RPD in the duplicate sample.
683	0549-95-0107 0549-95-0113	Inorganic chemicals	Results for antimony, arsenic, and selenium are qualified UJ for low-percent recovery in matrix spike sample. Results for barium are qualified J- for low-percent recovery in the matrix spike sample. Results for manganese are qualified J for high RPD in the duplicate sample.

TABLE B-1 (continued)

Request Number	Sample ID	Suite	Comments
683	0549-95-0119 0549-95-0122	Inorganic chemicals	Results for barium, antimony, arsenic, and selenium are qualified UJ for low-percent recovery in matrix spike sample. Results for manganese are qualified J for high RPD in the duplicate sample.
727	0549-95-0111	Inorganic chemicals	Results for antimony are qualified UJ for low-percent recovery in matrix spike sample.
783	0549-95-0315 0549-95-0316 0549-95-0326 0549-95-0327 0549-95-0328 0549-95-0329 0549-95-0330 0549-95-0333	Inorganic chemicals	Results for antimony are qualified R for low-percent recovery in matrix spike sample. Results for manganese are qualified J- for low-percent recovery in matrix spike sample.
783	0549-95-0334 0549-95-0336 0549-95-0337 0549-95-0339 0549-95-0340 0549-95-0343 0549-95-0344 0549-95-0345 0549-95-0349 0549-95-0350	Inorganic chemicals	Results for antimony and selenium are qualified R for low-percent recovery in matrix spike sample.
PRSs 49-005(b), 49-006, and 49-008(a)			
719	0549-95-0012 0549-95-0139 0549-95-0134 0549-95-0136 0549-95-0145 0549-95-0147 0549-95-0152 0549-95-0153 0549-95-0154 0549-95-0162 0549-95-0165	Inorganic chemicals	Results for manganese are qualified J- for low-percent recovery in the matrix spike sample. Results for antimony and selenium are qualified UJ for low-percent recovery in the matrix spike sample.
719	0549-95-0130	Inorganic chemicals	Result for antimony is qualified J- for low-percent recovery in the matrix spike sample. Result for selenium is qualified UJ for low-percent recovery in the matrix spike sample.

TABLE B-1 (concluded)

Request Number	Sample ID	Suite	Comments
727	0549-95-0133 0549-95-0135 0549-95-0137 0549-95-0138 0549-95-0167 0549-95-0172 0549-95-0175 0549-95-0178 0549-95-0186	Inorganic chemicals	Results for antimony are qualified UJ for low-percent recovery in the matrix spike sample.
PRS 49-008(b)			
783	0549-95-0294 0549-95-0297 0549-95-0300 0549-95-0301 0549-95-0302 0549-95-0305 0549-95-0306 0549-95-0307 0549-95-0308 0549-95-0309 0549-95-0310 0549-95-0311	Inorganic chemicals	Results for antimony are qualified R for low-percent recovery in matrix spike sample. Results for manganese are qualified J- for low-percent recovery in matrix spike sample.

APPENDIX C
RISK ASSESSMENT CALCULATIONS

No quantitative risk assessment was performed on Potential Release Sites 49-002, 49-003, 49-004, 49-005(a, b), 49-006, and 49-008(a, b, c).