RFI Report for TA-3 for Potential Release Sites

3-004(c,d)
3-007
3-014(k,l,o)
3-021
3-049(a)
3-052(b)
3-056(k)
C-3-014

Field Unit 1

Environmental Restoration Project

September 1997

A Department of Energy
Environmental Cleanup Program

Los Alamos
NATIONAL LABORATORY

LA-UR-97-3571

1.0 EXECUTIVE SUMMARY

This report presents the results of the Phase I Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) conducted at Technical Area (TA) 3 at Los Alamos National Laboratory (LANL). This report specifically addresses potential release sites (PRSs) 3-004(c,d), 3-007, 3-014(k,l,o), 3-021, 3-049(a), 3-052(b), 3-056(k), and C-3-014. PRSs 3-014(k,l,o), 3-021, and 3-049(a) are included on the Hazardous and Solid Waste Amendments (HSWA) Module of LANL's RCRA operating permit. Included in this report are the data assessment and analysis approach used in this investigation, and the site-specific results, conclusions, and recommendations regarding RCRA constituents for the PRSs listed above. 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.

PRS 3-004(c) is a dumpster storage area located at the main loading dock for the Chemistry and Metallurgical Research (CMR) building, TA-3-29. Two dumpsters, one receiving compactable waste and the other receiving non-compactable waste, received low-level radioactive waste (with an assay range from 0 to 100 nCi/g) from radioactive material handling areas. The waste material consisted of gloves, paper products, glass, plastic, and metal. Potential contamination for PRS 3-004(c) included metals, semivolatile organic compounds (SVOCs), and radionuclides.

PRS 3-004(d) is a former dumpster storage area located at the west end of wing 9 of TA-3-29. One dumpster formerly occupied this area and received waste that consisted of rags, hardware, machine shop waste, and occasional items from the hot cell located in wing 9. Potential contamination for PRS 3-004(d) included metals and SVOCs.

The objective of the RFI at PRSs 3-004(c,d) was to determine whether contaminants were present at the site and, if so, to determine the extent of contamination. All radiological field screening results were at or below the average background radiological levels for the site. All organic vapor screening results for this site were 0.0 ppm. At PRS 3-004(c), samples were collected from four random locations and one biased location. Five samples from the asphalt matrix were analyzed for radionuclides, and six samples from the tuff were analyzed for SVOCs and metals. One tuff sample was also analyzed for volatile organic compounds (VOCs). At PRS 3-004(d), nine samples (four soil/fill, three soil/tuff, and two tuff) were collected. At least one of the samples was analyzed for each of the following analytes: metals, SVOCs, and VOCs. Background comparison and screening assessment of the fixed laboratory analytical results indicated that no chemicals are present at the site at levels that pose an unacceptable risk to

human health. Therefore, PRSs 3-004(c,d) are proposed for no further action (NFA) based on NFA Criterion 5.

PRS 3-007 consists of a decommissioned firing site located within the Sigma Complex. The site includes two structures: TA-3-159, a containment building for explosive experiments, and TA-3-160, a personnel safety barrier. From 1970 to 1975 approximately 50–75 explosive shot experiments were detonated within TA-3-159. After each shot, the building was rinsed out with water and the water was allowed to drain outside through a gap between the floor and wall. The site was cleaned in the late 1970s, with no high explosives (HE) detected. In the mid 1980s, TA-3-159 was modified to serve as a storage building for thoriaoxide and thorium. Both thoriaoxide and thorium were containerized within the building. Potential contamination for PRS 3-007 included thorium, metals, and HE.

The objective of the RFI at PRS 3-007 was to determine the nature and extent of contamination, if any, associated with this PRS. All radiological field screening results were at or below the average background radiological levels for the site with the exception of one location, which exhibited beta readings slightly above background. All organic vapor screening results for this site were 0.0 ppm. During the RFI at PRS 3-007, five soil samples were collected from four biased locations and one collocated location. All samples were analyzed for isotopic thorium, SVOCs, HE, and metals. Three of the samples were also analyzed for VOCs, and one was analyzed for gross alpha, beta, and gamma activity. Background comparison and screening assessment of the fixed laboratory analytical results indicated that no chemicals are present at the site at levels that pose an unacceptable risk to human health. Therefore, PRS 3-007 is proposed for NFA based on NFA Criterion 5.

PRSs 3-014(k,l) consist of two of the four upper sludge drying beds and PRS 3-014(o) consists of the three lower sludge drying beds at the TA-3 decommissioned waste water treatment plant. The upper drying beds, PRSs 3-014(k,l), were in use from 1964 to 1992, and the lower beds, PRS 3-014(o), from the early 1980s to 1992, when the Sanitary Waste Consolidation System came on line. All beds received sludge from the waste water treatment plant, which received sanitary waste from TA-3. Potential contamination for PRSs 3-014(k,l,o) includes VOCs, SVOCs, pesticides/polychlorinated biphenyls (PCBs), herbicides, radionuclides, and metals. The objective of the RFI was to determine the nature and extent of contamination, if any, associated with these PRSs.

All radiological field screening results were at or below the average background radiological levels for the site. All organic vapor screening results for these sites were 0.0 ppm. Three

samples (one soil and two tuff) were collected each from PRSs 3-014(k,l). Nine samples (three soil and six tuff) were collected from three locations at PRS 3-014(o). The samples were analyzed for SVOCs, pesticides/PCBs, herbicides, radionuclides, and metals. One tuff sample from each location was also analyzed for VOCs. Background comparison and screening assessment of the fixed laboratory analytical results indicated that no chemicals are present at levels that pose an unacceptable risk to human health. Therefore, PRSs 3-014(k,l,o) are proposed for NFA based on NFA Criterion 5.

PRS 3-021 is a decommissioned outfall and the associated daylight channel north of TA-3-170 at the compressed gas facility. PRS 3-021 consists of a former outfall and the associated daylight channel north of TA-3-170. From 1964 to 1976 the outfall discharged caustic wash and rinse water from compressed gas cylinder cleaning operations. Potential contamination associated with PRS 3-021 included SVOCs and metals.

The objective of the RFI was to determine the nature and extent of contamination, if any, associated with this PRS. All radiological field screening results were at or below the average background radiological levels for the site. All organic vapor screening results for this site were 0.0 ppm. Twelve samples (five tuff and seven soil/tuff) were collected from six biased locations at PRS 3-021. All samples were analyzed for SVOCs and metals, and one sample was also analyzed for VOCs. Background comparison and screening assessment of the fixed laboratory analytical results indicated that no chemicals are present at levels that pose an unacceptable risk to human health under the projected future land use. Therefore, PRS 3-021 is proposed for NFA based on NFA Criterion 5.

PRS 3-049(a) consists of a National Pollution Discharge Elimination System (NPDES) (EPA 03A022) permitted outfall that discharges treated cooling water from TA-3-127 at the Sigma Complex. TA-3-127 has been in operation since 1960. From 1984 to 1990 the outfall also received discharge from rinsate tanks associated with electroplating operations at TA-3-66. Potential contamination for PRS 3-049(a) included uranium, metals, and cyanide.

The objective of the RFI was to determine the nature and extent of contamination, if any, associated with this PRS. All radiological field screening results were at or below the average background radiological levels for the site. All organic vapor screening results for this site were 0.0 ppm. Eight random soil sample locations (plus one random duplicate) and two water sample locations were selected for sampling at PRS 3-049(a). At least one sample was analyzed for each of the following analytes: hexavalent chromium, isotopic uranium, VOCs, cyanide, and metals. Background comparison and screening assessment of the fixed laboratory analytical

results indicated that no chemicals are present at levels that pose an unacceptable risk to human health under the projected future land use. Therefore, PRS 3-021 is proposed for NFA based on NFA Criterion 5.

PRSs 3-052(b) and 3-056(k) are located within TA-3 at the north end of the Sigma Complex. PRS 3-052(b) consists of a surface storm drain system located on the north side of TA-3-66. The access area receives storm water from the surrounding roadways, loading docks, and storage areas [including PRS 3-056(k)]. PRS 3-056(k) is an outside storage area located at the north end of TA-3-66 that drains into PRS 3-052(b). The area was previously used to store excess equipment from the Sigma Building and is currently used to store graphite rods for molds and low level radioactive waste inside sealed dumpsters. Potential contamination for PRSs 3-052(b) and 3-056(k) included uranium and metals.

The objective of the RFI was to determine the nature and extent of contamination, if any, associated with this PRS. All radiological field screening results were at or below the average background radiological levels for the sites, except one asphalt sample. The background contamination criteria for the site was established at 360 counts per minute (cpm). Beta/gamma activity was slightly elevated in the one sample, with a reading of 430 cpm. The alpha meter had no detectable activity. All organic vapor screening results for the sites were 0.0 ppm. Fifteen samples (nine soil and six soil/tuff) were collected from eight locations at PRS 3-052(b). Eleven samples (four asphalt, two soil, and five soil/tuff) were collected from four locations at PRS 3-056(k). At least one sample was analyzed for each of the following analytes: isotopic uranium, metals, VOCs, and gross alpha, beta, and gamma activity. Background comparison and screening assessment of the fixed laboratory analytical results indicated that no chemicals are present at levels that pose an unacceptable risk to human health under the projected future land use. Therefore, PRSs 3-052(b) and 3-056(k) are proposed for NFA based on NFA Criterion 5.

PRS C-3-014 consists of an outside equipment storage area located along the west and southern walls of the Press Building, TA-3-35, at the Sigma Complex. TA-3-35 was constructed in 1953 and housed operations to fabricate enriched uranium graphite and carbide fuel elements. The northern portion of the building floor is contaminated with uranium-235. In 1991, TA-3-35 was declared inactive due to a lack of funding. However, in 1995 the press was put back into operation. During the operational life of TA-3-35 various pieces of equipment and molds have been stored in the area of C-3-014. Potential contamination for PRS C-3-014 included uranium.

The objective of the RFI was to determine the nature and extent of contamination, if any, associated with this PRS. All radiological field screening results were at or below the average background radiological levels for the site. All organic vapor screening results for this site were 0.0 ppm. Five asphalt samples were collected from four random locations at PRS C-3-014 and analyzed for isotopic uranium. Background comparison and screening assessment of the fixed laboratory analytical results indicated that no chemicals are present at levels that pose an unacceptable risk to human health under the projected future land use. Therefore, PRS C-3-014 is proposed for NFA based on NFA Criterion 5.

Table ES-1 provides a summary of the proposed actions for PRSs addressed in this report.

TABLE ES-1

SUMMARY OF PROPOSED ACTIONS

			PROPOSED ACTION				
HRS NUMBER	HSWA[a]	RADIONUCLIDE COMPONENT[b]	NFA CRITERION	FURTHER ACTION[c]	ADD TO HSWA MODULE[d]	RATIONALE	SECTION NUMBER
3-004(c)		x	5			No chemicals are present at levels that pose an unacceptable risk to human health under the projected future land use.	5.1
3-004(d)			5			No chemicals are present at levels that pose an unacceptable risk to human health under the projected future land use.	5.1
3-007		x	5			No chemicals are present at levels that pose an unacceptable risk to human health under the projected future land use.	5.2
3-014(k)	x	x	5			No chemicals are present at levels that pose an unacceptable risk to human health under the projected future land use.	5.3
3-014(l)	x	x	5			No chemicals are present at levels that pose an unacceptable risk to human health under the projected future land use.	5.3
3-014(o)	x	x	5			No chemicals are present at levels that pose an unacceptable risk to human health under the projected future land use.	5.3
3-021	x		5			No chemicals are present at levels that pose an unacceptable risk to human health under the projected future land use.	5.4
3-049(a)	x	x	5			No chemicals are present at levels that pose an unacceptable risk to human health under the projected future land use.	5.5
3-052(b)		x	5			No chemicals are present at levels that pose an unacceptable risk to human health under the projected future land use.	5.6
3-056(k)		x	5			No chemicals are present at levels that pose an unacceptable risk to human health under the projected future land use.	5.6
C-3-014		x	5			No chemicals are present at levels that pose an unacceptable risk to human health under the projected future land use.	5.7

[a] An X in this column indicates that the site is listed on the Hazardous and Solid Waste Amendments (HSWA) Module (Module VIII) of the Laboratory's RCRA operating permit.

[b] An X in this column indicates that the site has a radionuclide component.

[c] VCA, EC, further investigation, or CMS.

[d] An X in this column indicates that hazardous constituents were confirmed at a site not already listed on the HSWA Module. The site requires further action; therefore, the site needs to be added to the Module.

5 • 0550R • 5.04

CONTENTS

1.0 INTRODUCTION 1

1.1 General Site History 1

1.2 RFI Overview 2

2.0 ENVIRONMENTAL SETTING 8

2.1 Climate 8

2.2 Geology 8

2.2.1 Geologic Setting 8

2.2.2 Soils 9

2.3 Hydrology 12

2.3.1 Surface Water 12

2.3.2 Groundwater 12

3.0 APPROACH TO DATA ASSESSMENT AND ANALYSIS 13

3.1 Sample Analyses 13

3.1.1 Analytical Methods 14

3.1.2 Data Validation 14

3.2 Process for the Identification of COPCs 17

3.2.1 Inorganic Chemicals 17

3.2.2 Radionuclides 18

3.2.3 Organic Chemicals 19

3.2.4 Risk-Based Screening Assessment 19

3.3 Human Health Assessment 20

3.3.1 Risk Due to Naturally Occurring Inorganic Chemicals in Soils (Background) 20

3.3.2 Risk Assessment 22

3.4 Ecological Assessment 23

4.0 RESULTS OF QUALITY ASSURANCE/QUALITY CONTROL ACTIVITIES 23

4.1 Quality Assurance/Quality Control Results for PRSs 3-004(c,d) 23

4.1.1 Inorganic Analysis 23

4.1.2 Organic Analysis 24

4.1.3 Radiochemical Analysis 25

4.2 Quality Assurance/Quality Control Results for PRS 3-007 25

4.2.1 Inorganic Analysis 25

4.2.2 Organic Analysis 25

4.2.3 Radiochemical Analysis 26

4.3 Quality Assurance/Quality Control Results for PRS 3-014(k,l,o) 26

4.3.1 Inorganic Analysis 26

4.3.2 Organic Analysis 27

4.3.3 Radiochemical Analysis 28

4.4 Quality Assurance/Quality Control Results for PRS 3-021 29

4.4.1 Inorganic Analysis 29

4.4.2 Organic Analysis 29

4.4.3 Radiochemical Analysis 30

4.5 Quality Assurance/Quality Control Results for PRS 3-049(a) 30

4.5.1 Inorganic Analysis 30

4.5.2 Organic Analysis 30

4.5.3 Radiochemical Analysis 31

4.6 Quality Assurance/Quality Control Results for PRS 3-052(b),056(k) 31

4.6.1 Inorganic Analysis 31
4.6.2 Organic Analysis 31
4.6.3 Radiochemical Analysis 32
4.7 Quality Assurance/Quality Control Results for PRS C-3-014 32
4.7.1 Inorganic Analysis 32
4.7.2 Organic Analysis 32
4.7.3 Radiochemical Analysis 32
5.0 SPECIFIC RESULTS, CONCLUSIONS, AND RECOMMENDATIONS 33
5.1 PRSs 3-004(c,d), Dumpster Storage Area 33
5.1.1 History 33
5.1.2 Description 33
5.1.3 Previous Investigation 34
5.1.4 Field Investigations 34
5.1.5 Evaluation of Inorganics for PRS 3-004(c) 38
5.1.6 Evaluation of Radionuclides for PRS 3-004(c) 39
5.1.7 Evaluation of Organic Chemicals for PRS 3-004(c) 40
5.1.8 Evaluation of Inorganics for PRS 3-004(d) 42
5.1.9 Evaluation of Radionuclides for PRS 3-004(d) 44
5.1.10 Evaluation of Organic Chemicals for PRS 3-004(d) 44
5.1.11 Risk-Based Screening Assessment 45
5.1.12 Human Health Risk Assessment 48
5.1.13 Preliminary Ecological Assessment 49
5.1.14 Conclusions and Recommendations 49

5.2 PRS 3-007, Decommissioned Firing Site 48
5.2.1 History 48
5.2.2 Description 50
5.2.3 Previous Investigation 50
5.2.4 Field Investigations 50
5.2.5 Evaluation of Inorganics 51
5.2.6 Evaluation of Radionuclides 52
5.2.7 Evaluation of Organic Chemicals 55
5.2.8 Risk-Based Screening Assessment for PRS 3-007 56
5.2.9 Human Health Risk Assessment 56
5.2.10 Preliminary Ecological Assessment 56
5.2.11 Conclusions and Recommendations 57
5.3 PRS 3-014(k,l,o), Sludge Drying Beds 57
5.3.1 History 57
5.3.2 Description 57
5.3.3 Previous Investigation 58
5.3.4 Field Investigations 58
5.3.5 Evaluation of Inorganics for PRS 3-014(k) 60
5.3.6 Evaluation of Radionuclides for PRS 3-014(k) 63
5.3.7 Evaluation of Organic Chemicals for PRS 3-014(k) 63
5.3.8 Evaluation of Inorganics for PRS 3-014(l) 64
5.3.9 Evaluation of Radionuclides for PRS 3-014(l) 65
5.3.10 Evaluation of Organic Chemicals for PRS 3-014(l) 65

5.3.11 Evaluation of Inorganics for PRS 3-014(o) 66
5.3.12 Evaluation of Radionuclides for PRS 3-014(o) 68
5.3.13 Evaluation of Organic Chemicals for PRS 3-014(o) 68
5.3.14 Risk-Based Screening Assessment for PRSs 3-014(k,l,o) 70
5.3.15 Human Health Risk Assessment 76
5.3.16 Preliminary Ecological Assessment 78
5.3.17 Conclusions and Recommendations 78
5.4 PRS 3-021, Decommissioned Outfall 78
5.4.1 History 79
5.4.2 Description 79
5.4.3 Previous Investigation 79
5.4.4 Field Investigations 79
5.4.5 Evaluation of Inorganics 82
5.4.6 Evaluation of Radionuclides 84
5.4.7 Evaluation of Organic Chemicals 84
5.4.8 Risk-Based Screening Assessment for PRS 3-021 84
5.4.8.1 Discussion of COPCs 85
5.4.9 Human Health Risk Assessment 86
5.4.10 Preliminary Ecological Assessment 86
5.4.11 Conclusions and Recommendations 86
5.5 PRS 3-049(a), Active Outfall 86
5.5.1 History 86
5.5.2 Description 87

5.5.3 Previous Investigation 87
5.5.4 Field Investigations 87
5.5.5 Evaluation of Inorganics 88
5.5.6 Evaluation of Radionuclides 92
5.5.7 Evaluation of Organic Chemicals 93
5.5.8 Risk-Based Screening and Assessment for PRS 3-040(a) 94
5.5.8.1 Discussion of COPCs 97
5.5.9 Human Health Risk Assessment 98
5.5.10 Preliminary Ecological Assessment 98
5.5.11 Conclusions and Recommendations 99
5.6 PRS 3-052(b), Storm Drains, and 3-056(k), Outdoor Storage Area 99
5.6.1 History 99
5.6.2 Description 100
5.6.3 Previous Investigation 100
5.6.4 Field Investigations 100
5.6.5 Evaluation of Inorganics for PRS 3-052(b) 105
5.6.6 Evaluation of Radionuclides for PRS 3-052(b) 106
5.6.7 Evaluation of Organic Chemicals for PRS 3-052(b) 106
5.6.8 Evaluation of Inorganics for PRS 3-056(k) 106
5.6.9 Evaluation of Radionuclides for PRS 3-056(k) 107
5.6.10 Evaluation of Organic Chemicals for PRS 3-056(k) 110
5.6.11 Risk-Based Screening Assessment for PRS 3-052(b) and 3-056(k) 111
5.6.12 Human Health Risk Assessment 113

5.6.13 Preliminary Ecological Assessment 113
5.6.14 Conclusions and Recommendations 114
5.7 PRS C-3-014, Outdoor Storage Area 114
5.7.1 History 114
5.7.2 Description 114
5.7.3 Previous Investigation 115
5.7.4 Field Investigations 115
5.7.5 Evaluation of Inorganics 118
5.7.6 Evaluation of Radionuclides 118
5.7.7 Evaluation of Organic Chemicals 119
5.7.8 Risk-Based Screening Assessment for PRS C-3-014 119
5.7.9 Human Health Risk Assessment 120
5.7.10 Preliminary Ecological Assessment 120
5.7.11 Conclusions and Recommendations 120
REFERENCES 121
APPENDIX A ANALYTICAL RESULTS A-1
APPENDIX B DATA VALADATION B-1
APPENDIX C RISK ASSESSMENT CALCULATIONS C-1

LIST OF TABLES

TABLE ES-1	Summary of Proposed Actions	vi
TABLE 3.3.1-1	Risk Due to Background Concentrations of Inorganic Chemicals in Soil Assuming a Residential Scenario	22
TABLE 5.1.4-1.	Summary of Samples Collected at PRS 3-004(c,d)	38
TABLE 5.1.5-1	Inorganic Chemicals with Concentrations Exceeding Background Screening Values at PRS 3-004(c)	39
TABLE 5.1.6-1	Radionuclides with Concentrations Exceeding Minimum Detectable Activity at PRS 3-004(c)	40
TABLE 5.1.7-1	Detected PAHs at PRS 3-004(c)	41
TABLE 5.1.8-1	Inorganic Chemicals with Concentrations Exceeding Background Screening Values at PRS 3-004(d)	43
TABLE 5.1.10-1	Detected Organic Concentrations at PRS 3-004(d)	45
TABLE 5.1.11-1	Multiple Chemical Evaluation for PRS 3-004(c)	47
TABLE 5.1.11-2	Multiple Radionuclide Evaluation for PRS 3-004(c)	47
TABLE 5.1.11-3	Multiple Chemical Evaluation for PRS 3-004(d)	48
TABLE 5.2.5-1	Inorganic Chemicals with Concentrations Exceeding Background Screening Values at PRS 3-007	54
TABLE 5.2.6-1	Radionuclide Detected from Gamma Spectroscopy Analysis from Samples Collected at PRS 3-007	55
TABLE 5.2.7-1	Detected Organic Concentrations at PRS 3-007	55
TABLE 5.2.8-1	Multiple Chemical Evaluation for PRS 3-007	57
TABLE 5.3.5-1	Inorganic Chemicals with Concentrations Exceeding Background Screening Values at PRS 3-014(k)	62
TABLE 5.3.8-1	Inorganic Chemicals with Concentrations Exceeding Background Screening Values at PRS 3-014(l)	64

TABLE 5.3.9-1 Radionuclides with Concentrations Exceeding Minimum Detectable Activity at PRS 3-014(l) 65

TABLE 5.3.10-1 Detected Organic Concentrations at PRS 3-014(l) 66

TABLE 5.3.11-1 Inorganic Chemicals with Concentrations Exceeding Background Screening Values in Soil at PRS 3-014(o) 67

TABLE 5.3.11-2 Inorganic Chemicals with Concentrations Exceeding Background Screening Values in Tuff at PRS 3-014(o) 67

TABLE 5.3.12-1 Radionuclides with Concentrations Exceeding Background Screening Values at PRS 3-014(o) 68

TABLE 5.3.13-1 Detected Organic Concentrations at PRS 3-014(o) 69

TABLE 5.3.14-1 Multiple Chemical Evaluation for PRS 3-014(k) 71

TABLE 5.3.14-3 Multiple Chemical Evaluation for PRS 3-014(l) 73

TABLE 5.3.14-4 Multiple Radionuclide Evaluation for PRS 3-014(l) 73

TABLE 5.3.14-5 COPCs Exceeding SAL at PRS 3-014(o) 74

TABLE 5.3.14-6 Multiple Chemical Evaluation for PRS 3-014(o) 75

TABLE 5.3.14-7 Multiple Radionuclide Evaluation for PRS 3-014(o) 75

TABLE 5.3.15-1 Industrial SAL Comparison for COPCs at PRS 3-014(o) 77

TABLE 5.4.5-1 Inorganic Chemicals with Concentrations Exceeding Background Screening Values at PRS 3-021 83

TABLE 5.5.5-1 Inorganic Chemicals with Concentrations Exceeding Background Screening Values at PRS 3-049(a), Sediment Catchment Basins 90

TABLE 5.5.4-1. Summary of Samples Collected at PRS 3-049(a) 90

TABLE 5.5.5-2 Inorganic Chemicals with Detected Concentrations in Water Samples at PRS 3-049(a) 91

TABLE 5.5.6-1 Radionuclides with Concentrations Exceeding Background Screening Values at PRS 3-049(a), Sediment Catchment Basins 92

TABLE 5.5.6-2	Radionuclides with Detected Concentrations in Water Samples at PRS 3-049(a)	93
TABLE 5.5.7-1	Detected Organic Concentrations at PRS 3-049(a)	93
TABLE 5.5.8-1	Multiple Chemical Evaluation for PRS 3-049(a)	95
TABLE 5.5.8-2	Multiple Radionuclide Evaluation for PRS 3-049(a)	96
TABLE 5.5.8-3	Evaluation of Water Samples for PRS 3-049(a)	96
TABLE 5.6.4-1.	Summary of Samples Collected at PRSs 3-056(k) and 3-052(b)	104
TABLE 5.6.5-1	Inorganic Chemicals with Concentrations Exceeding Background Screening Values at PRS 3-052(b)	105
TABLE 5.6.6-1	Inorganic Chemicals with Concentrations Exceeding Background Screening Values at PRS 3-056(k)	107
TABLE 5.6.9-1	Radionuclides in Soil with Concentrations Exceeding Background Screening Values at PRS 3-056(k)	108
TABLE 5.6.9-2	Detected Radionuclides in Soil by Gamma Spectroscopy at PRS 3-056(k)	108
TABLE 5.6.9-3	Radionuclides in Asphalt with Concentrations Exceeding Minimum Detectable Activity at PRS 3-056(k)	109
TABLE 5.6.9-4	Detected Radionuclides in Asphalt by Gamma Spectroscopy at PRS 3-056(k)	110
TABLE 5.6.10-1	Detected Organic Concentrations at PRS 3-056(k)	110
TABLE 5.6.11-1	Multiple Chemical Evaluation for PRS 3-052(b)	112
TABLE 5.6.11-2	Multiple Chemical Evaluation for PRS 3-056(k)	113
TABLE 5.6.11-3	Multiple Radionuclide Evaluation for PRS 3-056(k)	113
TABLE 5.7.4-1	Summary of Samples Collected at PRS C-3-014	118
TABLE 5.7.6-1	Radionuclides with Concentrations Exceeding Minimum Detectable Activity at PRS C-3-014	119
TABLE 5.7.8-1	Multiple Radionuclide Evaluation for PRS C-3-014	120

TABLE A-1 Inorganic Data Results for PRS 3-004(c) A-3
TABLE A-2 Radionuclide Data Results for PRS 3-004(c) A-4
TABLE A-3 Organic Data Results for PRS 3-004(c) A-5
TABLE A-4 Inorganic Data Results for PRS 3-004(d) A-5
TABLE A-5 Organic Data Results for PRS 3-004(d) A-7
TABLE A-6 Inorganic Data Results for PRS 3-007 ..... A-8
TABLE A-7 Radionuclide Data Results for PRS 3-007 ..... A-9
TABLE A-8 Organic Data Results for PRS 3-007 ..... A-9
TABLE A-9 Inorganic Data Results for PRS 3-014(k) A-10
TABLE A-10 Radionuclide Data Results for PRS 3-014(k) A-10
TABLE A-11 Organic Data Results for PRS 3-014(k) A-11
TABLE A-12 Inorganic Data Results for PRS 3-014(l) A-12
TABLE A-13 Radionuclide Data Results for PRS 3-014(l) A-12
TABLE A-14 Organic Data Results for PRS 3-014(l) A-13
TABLE A-15 Inorganic Data Results for PRS 3-014(o) A-14
TABLE A-16 Radionuclide Data Results for PRS 3-014(o) A-16
TABLE A-17 Organic Data Results for PRS 3-014(o) A-17
TABLE A-18 Inorganic Data Results for PRS 3-021 ..... A-19
TABLE A-19 Inorganic Data Results for PRS 3-049(a) A-21
TABLE A-20 Radionuclide Data Results for PRS 3-049(a) A-22
TABLE A-21 Organic Data Results for PRS 3-049(a) A-23
TABLE A-22 Inorganic Data Results for PRS 3-052(b) A-24
TABLE A-23 Radionuclide Data Results for PRS 3-052(b) A-25

TABLE 2-24	Organic Data Results for PRS 3-052(b)	A-26
TABLE A-25	Inorganic Data Results for PRS 3-056(k)	A-27
TABLE A-26	Radionuclide Data Results for PRS 3-056(k)	A-29
TABLE A-27	Organic Data Results for PRS 3-056(k)	A-31
TABLE A-28	Radionuclide Data Results for PRS C-3-014	A-32
TABLE B-1	Summary Table of Quality Control Results for PRS3-004(c,d)	B-1
TABLE B-2	Summary Table of Quality Control Results for PRS 3-007	B-3
TABLE B-3	Summary Table of Quality Control Results for PRSs 3-014(k,l,o)	B-4
TABLE B-4	Summary Table of Quality Control Results for PRS 3-021	B-8
TABLE B-5	Summary Table of Quality Control Results for PRS 3-049(A)	B-9
TABLE B-6	Summary Table of Quality Control Results for PRSs 3-052(b) and 3-056(k)	B-10
TABLE B-7	Summary Table of Quality Control Results for PRS C-3-014	B-13
TABLE C-1	Risk Due to PAHs at PRS 3-004(c) Sample 0103-97-0280	C-2
TABLE C-2	Risk Due to PAHs at PRS 3-004(d) Sample 0103-97-0284	C-3
TABLE C-3	Chemical RME Residential Risk Estimate for PRS 3-014(o)	C-5
TABLE C-4	Radionuclide RME Dose Estimate for PRS 3-014(o)	C-5
TABLE C-5	Industrial Risk Estimate for COPCs at PRS 3-014(o)	C-6
TABLE C-6	Summary of P-Values for Statistical Tests that Compared PRS 3-021Data to LANL-Wide Soil Background Data	C-12

LIST OF FIGURES

Fig. 1.1-1 Location of TA-3 within Los Alamos National Laboratory, Los Alamos County, New Mexico 3

Fig. 1.1-2 Location of TA-3 with respect to Laboratory TAs and surrounding land holdings. 4

Fig. 1.1-4 Topographic map of TA-3 (SE quadrant) showing locations of PRSs. 6

Fig. 2.2.1-1 Generalized stratigraphy of TA-3. 10

Fig. 2.2.2-1 Typical profiles of common soils at TA-3. 11

Fig. 5.1.4-1 Locations of samples collected at PRSs 3-004(c and d). 36

Fig. 5.2.4-1 Locations of samples collected at PRS 3-007. 53

Fig. 5.3.4-1 Locations of samples collected at PRSs 3-014(k,l,o). 61

Fig. 5.4.4-1 Locations of samples collected at PRS 3-021. 81

Fig. 5.5.4-1 Locations of samples collected at PRS 3-049(a). 89

Fig. 5.6.4-1 Locations of samples collected at PRSs 3-056(k) and 3-052(b). 102

Fig. 5.7.4-1 Locations of samples collected at AOC C-3-014. 117

Fig. C-1. Box plot comparison of PRS 3-021 data and LANL background aluminum data by media. C-12

Fig. C-2. Box plot comparison of PRS 3-021 data and LANL background arsenic data by media. C-13

Fig. C-3. Box plot comparison of PRS 3-021 data and LANL background barium data by media. C-13

Fig. C-4. Box plot comparison of PRS 3-021 data and LANL background calcium data by media. C-14

Fig. C-5. Box plot comparison of PRS 3-021 data and LANL background chromium data by media. C-14

Fig. C-6. Box plot comparison of PRS 3-021 data and LANL background copper data by media. C-15

Fig. C-7. Box plot comparison of PRS 3-021 data and LANL background iron data by media. ... C-15

Fig. C-8. Box plot comparison of PRS 3-021 data and LANL background lead data by media. .. C-16

Fig. C-9. Box plot comparison of PRS 3-021 data and LANL background nickel data by media. C-16

Fig. C-10. Box plot comparison of PRS 3-021 data and LANL background vanadium data by media. C-17

Fig. C-11. Box plot comparison of PRS 3-021 data and LANL background zinc data by media. .. C-17

Fig. C-12. Bivariate plot of arsenic versus aluminum for PRS 3-021 data and LANL background data by media. C-18

Fig. C-13. Bivariate plot of barium versus aluminum for PRS 3-021 data and LANL background data by media. C-18

Fig. C-14. Bivariate plot of calcium versus aluminum for PRS 3-021 data and LANL background data by media. C-19

Fig. C-15. Bivariate plot of chromium versus aluminum for PRS 3-021 data and LANL background data by media. C-19

Fig. C-16. Bivariate plot of copper versus aluminum for PRS 3-021 data and LANL background data by media. C-20

Fig. C-17. Bivariate plot of iron versus aluminum for PRS 3-021 data and LANL background data by media. C-20

Fig. C-18. Bivariate plot of lead versus aluminum for PRS 3-021 data and LANL background data by media. C-21

Fig. C-19. Bivariate plot of nickel versus aluminum for PRS 3-021 data and LANL background data by media. C-21

Fig. C-20. Bivariate plot of vanadium versus aluminum for PRS 3-021 data and LANL background data by media. C-22

Fig. C-21. Bivariate plot of zinc versus aluminum for PRS 3-021 data and LANL background data by media. C-22

1.0 INTRODUCTION

This report presents the results of a Phase I Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) conducted at Technical Area (TA) 3 at Los Alamos National Laboratory (LANL). The potential release sites (PRSs) discussed in this report are 3-004(c,d), 3-007, 3-014(k,l,o), 3-021, 3-049(a), 3-052(b), 3-056(k), and C-3-014. PRSs 3-014(k,l,o), 3-021, and 3-049(a) are included on the Hazardous and Solid Waste Amendments (HSWA) Module of LANL's RCRA operating permit. Included in this report are the data assessment and analysis approach used in this investigation, and the site-specific results, conclusions, and recommendations regarding RCRA constituents for the PRSs listed above. 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.

1.1 General Site History

TA-3, located on South Mesa, contains the core operational facilities at LANL. TA-3 is bounded on the north by Los Alamos and Sandia Canyons and on the south by Mortandad and Two Mile Canyons. TA-3 is almost completely developed and is composed of buildings; roads; large, paved parking lots; and landscaped and open areas. Included in TA-3 are the principal administration buildings, library, cafeteria, shops, warehouses, several large laboratory buildings housing diverse groups and programs, and numerous smaller buildings serving specialized functions. In addition, there are maintenance garages, a gas-fired electrical generating plant, a compressed gas facility, and a sewage treatment plant (decommissioned in 1993). Approximately one-third of the area is enclosed within a security fence for controlled access.

Further information on each PRS can be found in Chapter 5 of this report and in the following subsections of the RFI Work Plan for Operable Unit 1114, Addendum 1 (LANL 1995, 1291): Subsection 5.13 for PRS 3-049(a), Subsection 5.14 for PRS 3-021, Subsection 5.15 for PRSs 3-052(b) and 3-056(k), Subsection 5.18 for PRS C-3-014, Subsection 5.22 for PRS 3-007, and Subsection 5.23 for PRSs 3-004(c,d). For PRSs 3-014(k,l,o), please refer to the RFI Report for 53 Potential Release Sites in TAs-3,59,60,61, February 1996, (Environmental Restoration Project 1996, 1352).

1.2 RFI Overview

The conceptual models for PRSs 3-004(c,d), 3-007, 3-021, 3-049(a), 3-052(b), 3-056(k), and C-3-014 are presented Chapter 4, Subsection 4.4 of the RFI Work Plan for Operable Unit 1114, Addendum 1 (LANL 1995, 1201). The conceptual model for PRSs 3-014(k,l,o) is presented in Chapter 4, Subsection 4.3 in the RFI Work Plan for Operable Unit 1114 (LANL 1993, 1090). The conceptual model for these PRSs assumes that inhalation, ingestion, and dermal contact with soil and surface water are the primary exposure pathways. The conceptual model also assumes external radiation from subsurface soils if excavation or erosion at the site would occur.

The primary objective of the RFI for these PRSs was to determine whether contamination was present. Therefore, samples were collected at locations where contaminants would most likely be found if present.

1.3 Field Activities

Field activities at PRSs 3-004(c,d), 3-007, 3-014(k,l,o), 3-021, 3-049(a), 3-052(b), 3-056(k), and C-3-014 were conducted during July 1997. Activities were conducted according to Subsections 5.13, 5.14, 5.15, 5.18, 5.22, and 5.23 of the RFI Work Plan for Operable Unit 1114, Addendum 1 (LANL 1995, 1201), and Subsection 5.7 of the RFI Report for TAs-3,50,60,61 (Environmental Restoration Project 1996, 1352). Sampling activities were conducted separately for each PRS, except where PRSs were linked by physical extent and a similar investigation approach. With the exception of the deviations noted in Chapter 5, all field activities were conducted in accordance with LANL Environmental Restoration (ER) Project standard operating procedures (SOPs) current at the time the sampling was conducted. All samples were collected, documented, and preserved using the following applicable procedures: LANL-ER-SOP-06.09, "Spade and Scoop Method;" LANL-ER-SOP-06.10, "Hand Auger and Thin-Wall Tube Sampler;" LANL-ER-SOP-6.28, "Chip Sampling of Porous Surfaces;" LANL-ER-SOP-01.04, "Sample Control and Field Documentation;" and LANL-ER-SOP-01.102, "Sample Containers and Preservation" (LANL 1993, 0875). All other field activities followed approved LANL ER SOPs unless otherwise noted in Section 5.

The general field activities applicable to all PRSs are described below. Details of the field activities at the individual PRSs are included in Section 5.0 of this document.

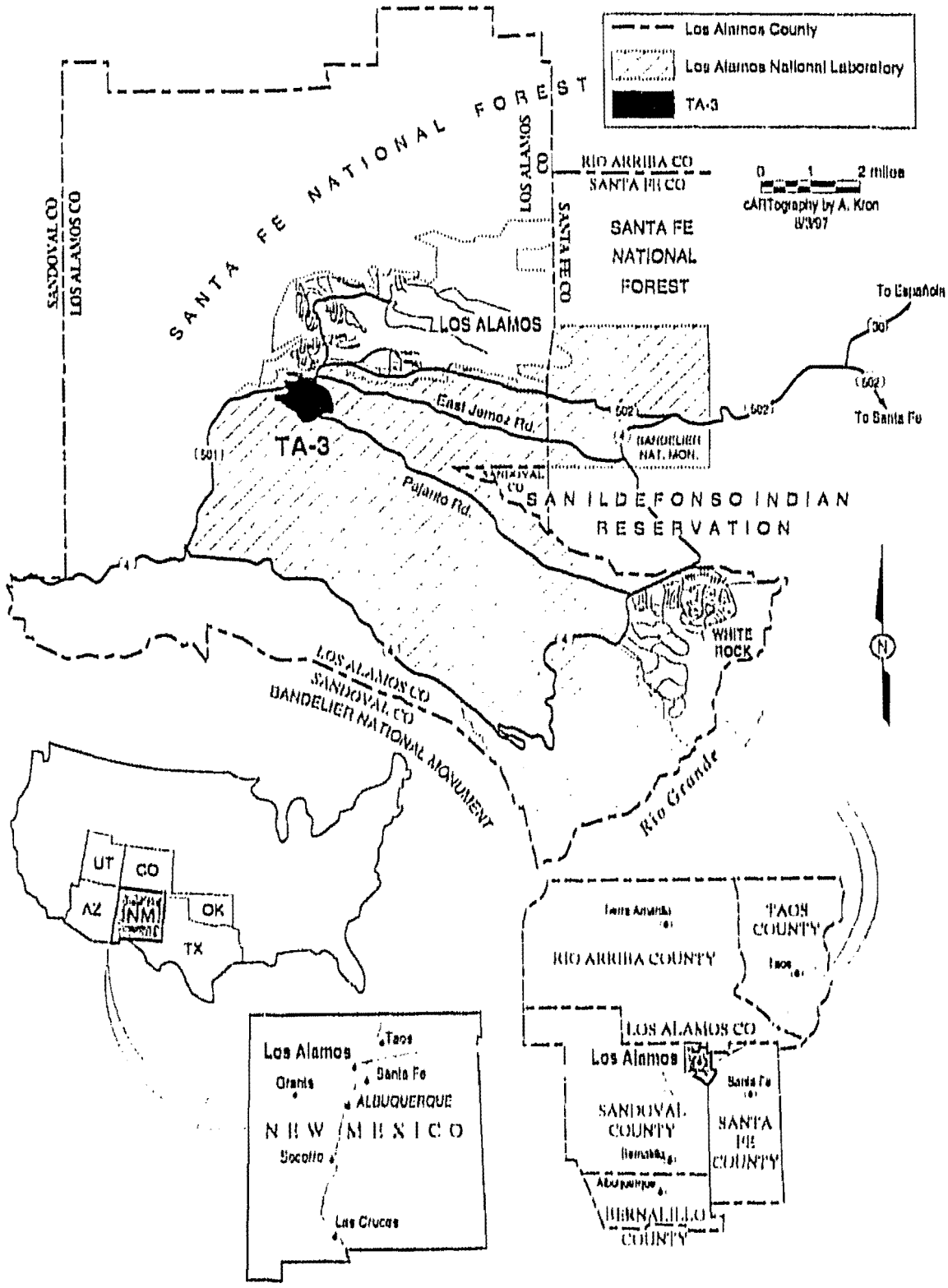


Fig. 1.1-1 Location of TA-3 within Los Alamos National Laboratory, Los Alamos County, New Mexico

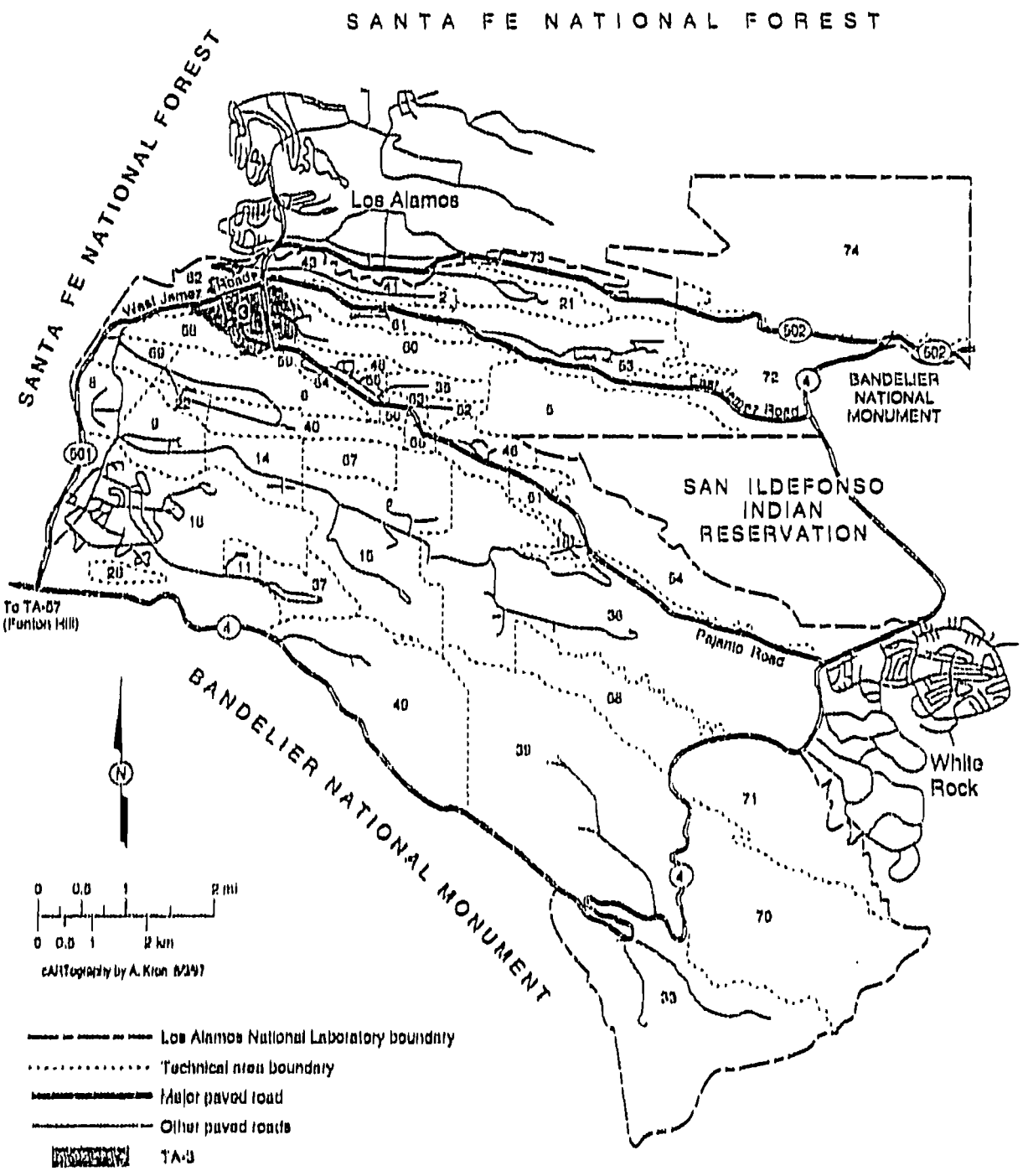


Fig. 1.1-2 Location of TA-3 with respect to Laboratory TAs and surrounding land holdings.

Fig. 1.1-3 Location of PRSs on quadrant map.

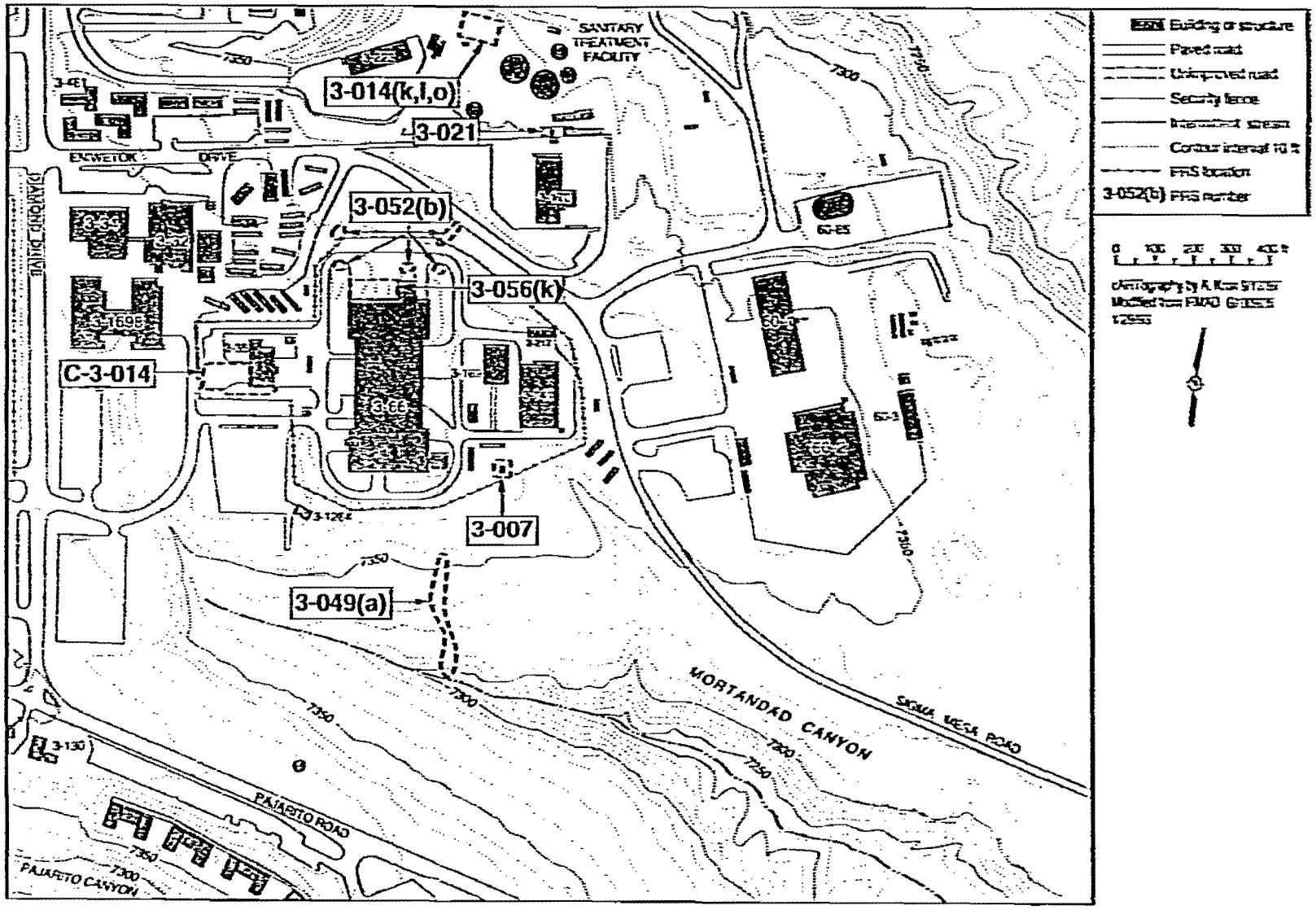


Fig. 1.1-4 Topographic map of TA-3 (SE quadrant) showing locations of PRSs.

Site Survey. A site survey was conducted to evaluate all available information for each PRS. Site survey activities included interviews with present and past site personnel, review of historical documents (including aerial photographs, maps, and engineering drawings), and site inspections. Potential sample locations were identified during the site inspections.

Geodetic Survey. At PRSs 3-004(c,d), 3-056(k), and C-3-014 a geodetic survey was conducted to establish grid coordinates to be used in conjunction with the random sampling scheme.

Upon completion of field activities, a geodetic survey was conducted for all sample locations at PRSs 3-004(c,d), 3-007, 3-014(k,l,o), 3-021, 3-049(a), 3-052(b), 3-056(k), and C-3-014. Survey coordinates were recorded in the New Mexico state planar coordinate system, and identification numbers were assigned to each sampling location for entry into the LANL ER Project Facility for Information Management, Analysis, and Display (FIMAD).

Field Screening. Field screening for radionuclides and organic vapors was conducted at all PRSs for worker health and safety as prescribed in Subsection 5.0.5.1 of the July 1995 RFI Work Plan for OU 1114 , Addendum 1 (LANL 1995, 1291). Screening for beta/gamma radiation was performed using an Eberline™ ESP-1 rate meter with a HP260 pancake probe. Screening for alpha radiation was performed using a Ludlum™ Model 139 survey meter with an air proportional alpha detector. If the radiological field screening results exceeded three standard deviations or more above background for a sample, the sample was submitted for gross alpha/beta, gamma spectroscopy, and tritium laboratory analyses. Organic vapor monitoring was performed using an OVM Model 580B photoionization detector (PID). If VOC field screening indicated a concentration greater than background readings, an adjacent sample was collected at the sample interval where the highest VOC concentration was detected in the original sample. Background is defined as the PID/FID reading in ambient air prior to screening the soil samples. In the absence of field-detected VOCs, 10% of the sample locations (where VOCs are a COPC) were randomly selected for confirmatory sampling. Site-specific field screening information and results are described throughout Section 5 of this document.

Sample Collection. Samples at each PRS were collected using a variety of techniques. Asphalt samples were collected at PRSs 3-004(c), C-3-014, and 3-056(k) with the use of a breaker bar and/or an electric rotary hammer drill. The underlying soil/tuff samples were collected with a 3-in. diameter stainless steel hand auger. Sediments at PRS 3-049(a) were collected with stainless steel scoops and the water samples were collected directly from flowing water. Surface sediments at PRSs 3-014(k,l,o) were collected with a spade and scoop and underlying tuff was collected with a stainless steel hand auger. Soil/tuff samples at PRSs 3-004(d), 3-007, 3-021, and 3-052(b) were collected with a stainless steel hand auger.

Samples for volatile organic compounds (VOCs) and total petroleum hydrocarbons (TPH) analyses were collected immediately from the sampled media. The remaining media was placed into a stainless steel bowl and homogenized before the sample was collected. Appropriate quality assurance/quality control (QA/QC) samples were also collected. Upon completion of sampling activities, the remaining sample media was returned to the approximate original depth. The field equipment (spoons, bowls, augers, etc.) was cleaned and decontaminated between sampling events. All samples were submitted to the Radiological Screening Laboratory at TA-21 to address transportation requirements, and to the Sample Management Office (SMO) for distribution to contract analytical laboratories.

2.0 ENVIRONMENTAL SETTING

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 to range from 50°F to 90°F. During the winter, temperatures typically range from 15°F to 50°F. Normal annual precipitation in Los Alamos, including rainfall and water-equivalent snowfall, is 18 in. Of this total, approximately 40% occurs as brief, intense thunderstorms during July and August. Stream flow in canyons can occur as a result of these storms. Spring snowmelt runoff may also induce stream flow in area canyons. Winter snowfall averages 61 in. annually (ESG 1989, 0308). Wind speeds are less than 2.5 m/s (5.6 mph) about 40% of the time and greater than 5 m/s (11 mph) about 20% of the time. Strong winds occur mainly in the spring. The predominant wind direction is from the south-southwest.

2.2 Geology

A detailed discussion of the geology and soils of the entire Los Alamos area can be found in Sections 2.5.1 and 2.5.1.3 of the LANL ER Installation Work Plan (IWP) (LANL 1995, 1275). A summary of that material, emphasizing conditions in the TA-3 area, is presented below.

2.2.1 Geologic Setting

TA-3 is located on South Mesa at an approximate elevation of 7300 ft and overlies up to 1100 ft of unsaturated volcanic tuff and sediments of the Bandelier and Puye Formations. The topography of South Mesa at TA-3 has undergone considerable cultural modification due to the

Installation of various roads, utilities, buildings, and other Laboratory facilities. The generalized stratigraphy in the areas investigated, consists of an excavated/disturbed surface soil immediately underlain by Unit 3 and Unit 4 of the Tshirege Member of the Bandelier Tuff (Fig. 2.2.1-1).

The upper reaches of Sandia and Mortandad Canyons are also present in the areas investigated for this RFI report. The walls of Mortandad and Sandia Canyons generally consist of ledges alternating with steep slopes. In the upper reaches of the canyons the slopes are gentle and mantled with up to several feet of colluvium and soil.

2.2.2 Soils

Soils at TA-3 have been disturbed by human activity in the construction and operation of the Laboratory facilities. Most of these areas have been affected to some degree, with the result that natural soil profiles are, in general, not well preserved. In some cases, soil has been removed or buried by fill during construction.

Where undisturbed soil exists on the mesa top at TA-3, it is both thin and patchy. These soils do not contain abundant organics and they lack well developed and defined soil horizons. These immature soils belong to the Hackroy soil series, which consists of very shallow to shallow, well-drained soils. Soil textures range from sandy loam to clay.

In contrast, the undisturbed soils that occupy the mesa slopes or the floor of the drainage channel itself are formed on alluvial material. These soils are thicker, more mature (with well developed soil horizons), and they contain more organics than the mesa top soils. These soils belong to the Nyjack soil series (Nyhan et al. 1978, 0161). The Nyjack series consists of moderately deep, well-drained soils with textures that range from gravelly, sandy loam to clay loam, depending on whether they developed on the hill slope or the valley floor.

The general character of these soils and their association with rock type, climate, slope, and vegetation are described in a soil survey of Los Alamos County (Nyhan et al. 1978, 0161) (Fig. 2.2.2-1). A geomorphologic study of the PRSs to identify the general thickness and variability of soils (including the A, B, and C horizons) was not completed because of the nature of the excavated/disturbed areas that the PRSs occupy. Where applicable, sediment traps and the soil/tuff interface were identified for sampling. Section 5 of this report provides additional information regarding the location of sediment traps and depth to the soil/tuff interface for each PRS.

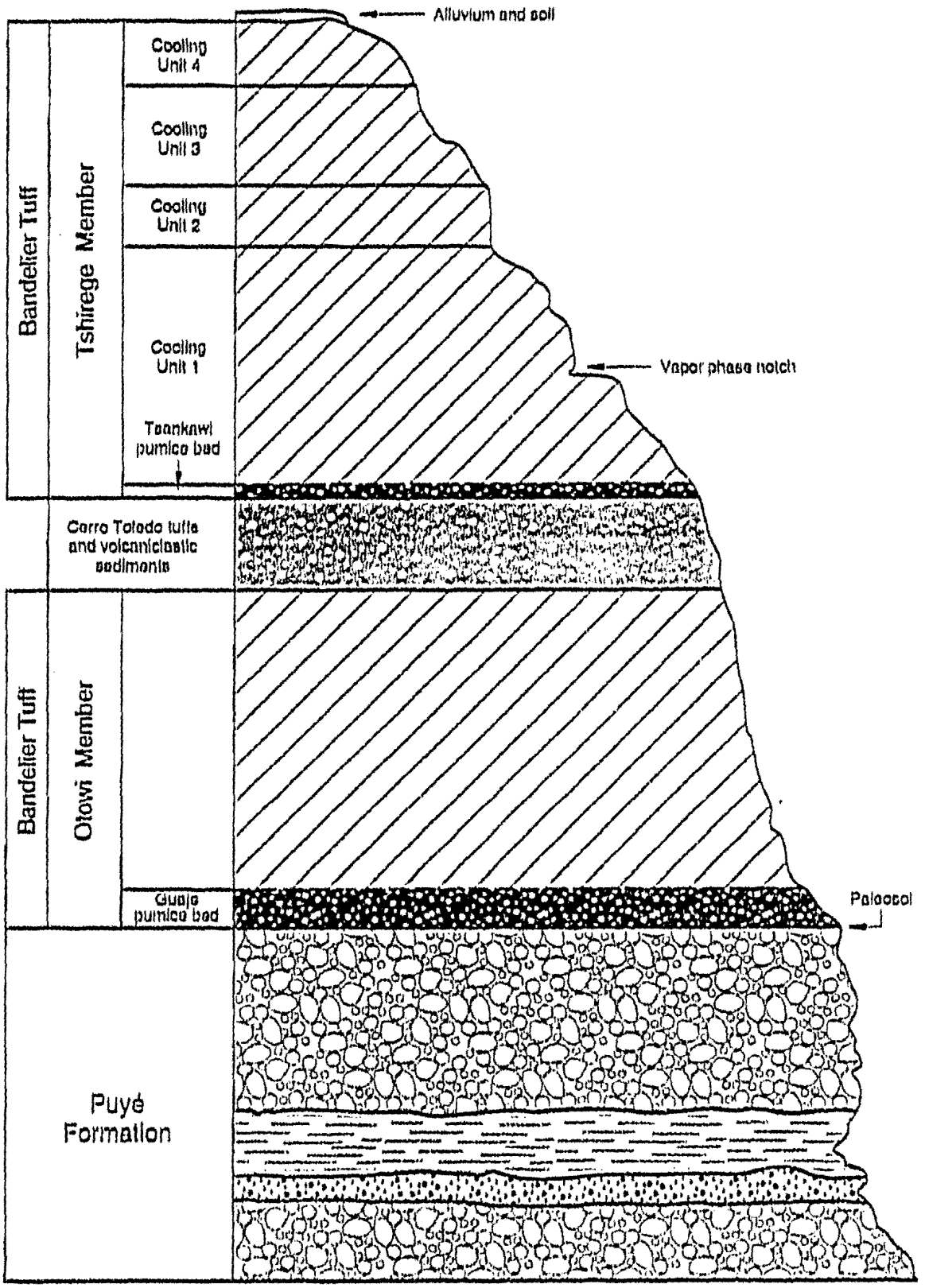


Figure 2.2.1-1 Generalized stratigraphy of TA-3.

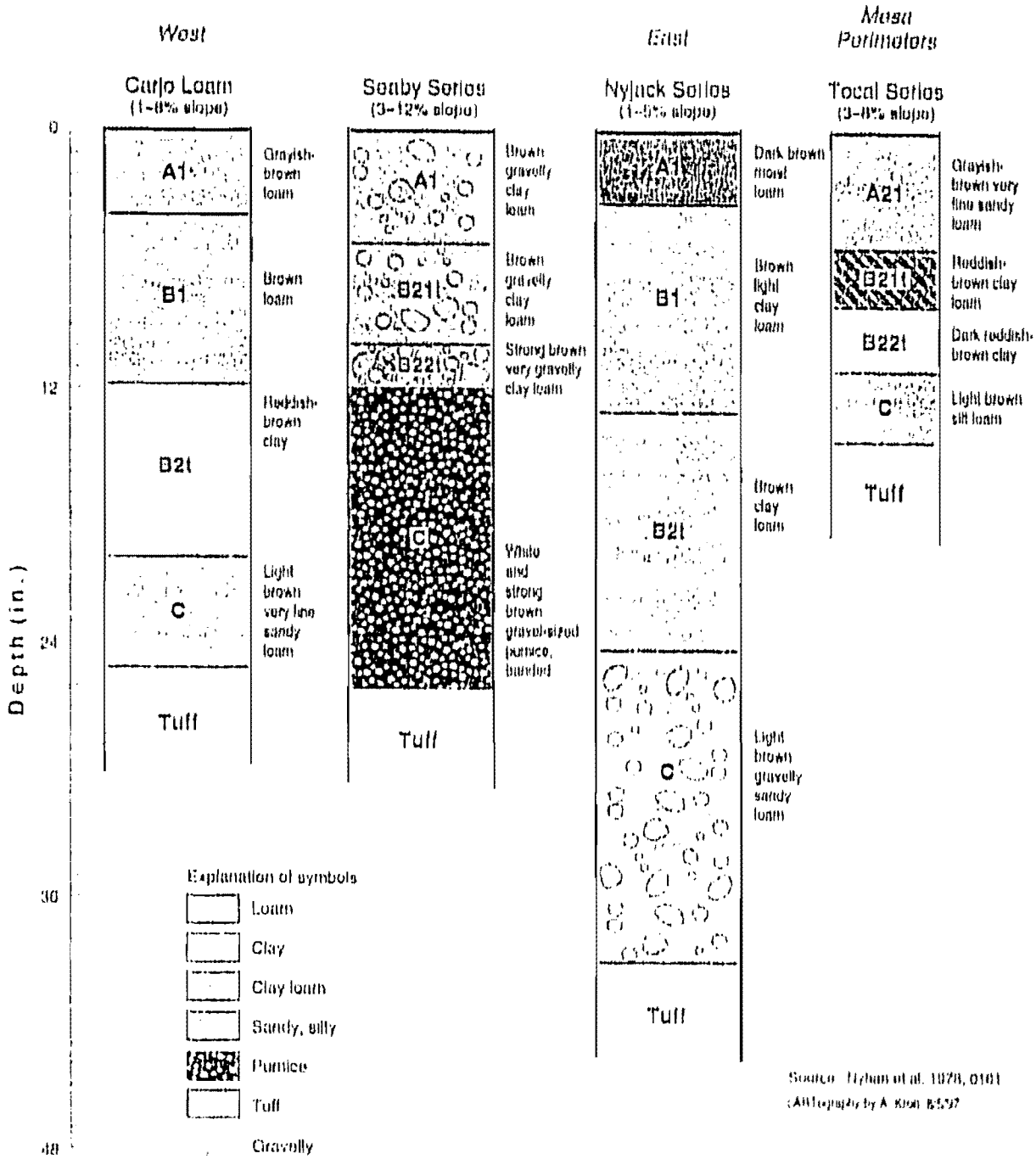


Fig. 2.2.2-1 Typical profiles of common soils at TA-3.

2.3 Hydrology

The hydrology of the Pajarito Plateau is summarized in Section 2.5.2 of the IWP (LANL 1995, 1275). Site-specific conditions are summarized below.

2.3.1 Surface Water

There is a potential for surface water flows from PRSs 3-004(c,d), 3-007, and C-3-014 into upper Mortandad Canyon through a combination of sheet flow, surface channels and storm drain outfalls. PRS 3-049(a) is an active permitted National Pollutant Discharge Elimination System (NPDES) outfall receiving cooling tower blow down that flows through a series of small catchment basins before falling into upper Mortandad Canyon. There is a potential for surface water from PRS 3-049(a) also flows into upper Mortandad Canyon. In addition, Mortandad Canyon receives surface runoff from a large part of TA-3 and other TAs along the mesa tops adjoining the canyon. There is also a potential for surface water drainage flows from 3-014(k,l,o), 3-021, 3-052(b), and 3-056(k) into Sandia Canyon through a combination of surface channels and outfalls, and into the large established wetlands area in the middle section of the canyon. Topography for individual PRSs or PRS aggregates is illustrated on sampling location figures in Section 5.

2.3.2 Groundwater

The main aquifer beneath TA-3 is at an elevation of approximately 5 900 ft (determined in test well 2 in Pueblo Canyon, and in Otowi 4 in Los Alamos Canyon), within sediments of the Puye and Tesuque Formations (Purtymun 1995,1293; Broxton and Eller 1995, 1162) and is overlain by over 1200 ft of tuff and volcaniclastic sediments. No perched or alluvial aquifers are known to be present in, or to underlie, TA-3. A shallow aquifer is present in the alluvium of Los Alamos Canyon in the vicinity of TA-21, approximately 3 miles northeast of TA-3 (Broxton and Eller 1995, 1162). In addition, near TA-21 a perched groundwater zone is present beneath Los Alamos Canyon at a depth of 325 ft in the Guaje pumice bed. The lateral extent of this intermediate-depth perched aquifer, particularly to the southwest beneath TA-3, is not known.

LA-UR-96-4144

3.0 APPROACH TO DATA ASSESSMENT AND ANALYSIS

The approach to data assessment used by the ER Project is described in the policy document "Risk-Based Corrective Action Process." (Dorries 1996, 1297). The approach includes:

- sampling and analysis design,
- field investigation and collection of field and quality assurance (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 sets,
- exploratory data analysis,
- focused validation when necessary to further assess questionable data,
- comparison of validated analytical results with LANL background data,
- comparison of validated analytical results with screening action levels (SALs),
- evaluation of sufficiency of data sets 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 RFI report.

3.1 Sample Analyses

Samples were collected in accordance with the sampling design specified in sections 5.12, 5.13, 5.14, 5.15, 5.18, 5.22, and 5.23 of the RFI Work Plan for Operable Unit 1114, Addendum 1 (LANL 1995, 1291). For PRSs 3-014(k,l,o), samples were collected in accordance with the sampling design specified in section 5.7 of the RFI Report for 53 Potential Release Sites in TAs-3,59,60,61, (Environmental Restoration Project 1996, 1352). Samples were submitted to the radiological screening laboratory at TA-21 and to the SMO for distribution to contract analytical laboratories.

3.1.1 Analytical Methods

The following analytical suites were used for the sample analyses in this RFI report: cyanide, high explosives (HE), TPH, VOCs, semivolatile organic compounds (SVOCs), target analyte list (TAL) metals, herbicides/pesticides/polychlorinated biphenyls (PCBs), gamma spectrometry, isotopic thorium, isotopic uranium, gross alpha radiation, gross gamma radiation, and gross beta radiation. 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, 1278). The allowed methods are current Environmental Protection Agency (EPA) SW-846 and Contract Laboratory Program (CLP) methods or equivalent for cyanide, HE, TPH, VOCs, SVOCs, TAL metals, herbicides/pesticides/PCBs, gamma spectrometry, isotopic thorium, isotopic uranium, gross alpha radiation, gross gamma radiation, and gross beta radiation. Prior to analysis for inorganic chemicals, soil samples were digested according to EPA SW-846 Method 3050 or equivalent (EPA 1992, 1207). The subcontracts specify LANL-approved methods for radiochemical analyses according to the technologies identified (e.g., americium-241 by alpha spectroscopy, tritium by liquid scintillation, or multiple gamma-emitting isotopes by gamma spectroscopy). Analytical method selection is described in Appendix IV of the ER Project Quality Assurance Project Plan Requirements for Sampling and Analysis (QAPP), which is included as Chapter 4 of the LANL IWP (LANL 1996, 1379). 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 QAPP along with the target analytes for each analytical suite.

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 contain the information necessary to determine data sufficiency for decision-making. For analytical data used for decisions discussed in this RFI report, baseline data validation under the ER protocol was performed as described in the QAPP (LANL 1996, 1379).

Baseline data validation produced validation reports with data qualifiers designating potential deficiencies for affected results. Each data qualifier is accompanied by a reason code that provides information about the deficiency which 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.

Data were qualified (i.e., a marker was attached to the data results) for a variety of reasons during the baseline validation process. The baseline validation procedure used for routine analytical services provides information about the reason the qualifier was applied and its potential impact on the affected data. 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 LANL ER Project baseline validation process are as follows.

- "A" signifies that the data required for data review and evaluation are not available.
- "U" signifies that the analyte was not positively identified in the sample, and the associated value is the sample-specific EQL/EDL.
- "J" signifies that 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+" signifies that the analyte was positively identified, and the result is likely to be biased high.
- "J-" signifies that the analyte was positively identified, and the result is likely to be biased low.
- "UJ" signifies that the analyte was not positively identified in the sample, and the associated value is an estimate of the sample-specific EQL/EDL.
- "RPM" signifies that without further review of the raw data, the sample results are unusable due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. Presence or absence cannot be verified. Any results qualified as RPM must be evaluated for relevance to data use.
- "P" signifies that professional judgment should be applied to using the data in decision-making.

- "PM" signifies that 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.
- "R" signifies that the data are rejected as a result of major problems with quality assurance/quality control (QA/QC) parameters.

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 1) the variability or uncertainty of the reported data, or 2) data quality prior to 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 RFI 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 provided 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.

Laboratory Contaminants

Laboratory contaminants are sometimes found in method blanks used by the analytical laboratories during organic analyses. When this occurs, there is a potential for samples to also be contaminated. To account for method blank contamination in samples, the "10 times" and "5 times" rules are applied. The "10 times" rule states that when a common laboratory contaminant is found in the method blank, any values of that analyte detected in the samples at levels less than 10 times the method blank concentration should be considered nondetected and a "U" qualifier should be added to the data. Common laboratory contaminants for VOC analysis include acetone, methylene chloride, and 2-butanone. Common laboratory contaminants

for SVOC analysis include the common phthalates. The "5 times" rule states that when an analyte that is not a common laboratory contaminant is found in the method blank, any values of that analyte detected in the samples at levels less than 5 times the method blank concentration should be considered nondetected and a "U" qualifier should be added to the data (EPA 1994, 1205).

Soil Heterogeneity

Heterogeneity is a common characteristic of soils in this region, and the LANL data validation guidelines do not require that qualifiers be added when differences between samples and their duplicates can be attributed to heterogeneity. No qualifiers are added because heterogeneity is not a QA/QC problem with the analytical process, but a physical limitation of the sample. Since duplicate values often differ by more than 20%, in order to be conservative, the higher of the sample and duplicate values is used in the screening assessment.

3.2 Process for the Identification of COPCs

3.2.1 Inorganic Chemicals

Detected inorganic chemicals are compared with natural background distributions to determine whether they should be retained as chemicals of potential concern (COPCs) or eliminated from further consideration. The inorganic background data used in this RFI report are from the following source:

- soil samples collected throughout Los Alamos County for which chemical analyses were performed for certain inorganic (metal) chemicals (Longmire et al. 1995, 1142 and 1266).

The RFI data considered in this report were collected from sediment fill material and either the Unit 3 or Unit 4 Tshirege Member of the Bandelier Tuff (referred to as either Unit 3 or Unit 4). The ER Project procedure is to make comparisons of PRS data to the most geologically relevant subset of the LANL-wide background data. 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), the maximum reported concentration, or, in the case of nondetected chemicals, the detection limit. These background screening values are derived from LANL-wide soil background data, and details on the calculation of these values are presented in Longmire et al. (1995, 1266). Certain inorganic chemicals in certain media have no LANL-wide background data. For these exceptions,

PRS sample-specific detection limits are used as nominal background screening values. In this report, silver is the only inorganic chemical that lacks background data.

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, are used for these evaluations. The Gehan test is better suited for assessing complete shifts in distribution in a statistically robust manner, whereas the Quantile test is better suited for assessing shifts of a subset of the data. Between the two tests, most types of differences between distributions can be captured. 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, 1210; Ryti et al. 1996, 1298). Observed significance levels (p-values) for these tests are presented in Appendix C of this report. If a p-value is less than a specified probability, typically 0.05 or 5%, then there is some reason to suspect that there is a difference between the background and site distributions; otherwise, no difference is indicated. The results of these statistical tests, when available, are used in addition to the results of the comparison with background screening values to determine whether a chemical is considered greater than 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 naturally occurring radionuclides.

The LANL 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 RFI report are from the following sources:

- soil samples collected throughout Los Alamos County for which chemical analyses were performed for certain naturally occurring radioactive chemicals (Longmire et al. 1995, 1142 and 1266).
- background concentrations of radioactive chemicals associated with global fallout from atmospheric nuclear testing (e.g., plutonium, cesium, strontium, and tritium) reported in LANL Environmental Surveillance reports (Purtymun et al. 1987, 0211; ESG 1988, 0408; ESG 1989, 0308; Environmental Protection Group 1990, 0497; Environmental Protection Group 1992, 0740).
- background concentrations of radionuclides in soils, sediments, and tuff (Environmental Restoration Project Decision Support Council and Earth Science Council 1997, 1414).

3.2.3 Organic Chemicals

Background data are not available for organic chemicals. Organic chemicals positively identified in one or more samples are carried forward in the screening assessment process. Chemicals not detected in any sample are 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. 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 whether 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, 1297). 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, a no further action (NFA) recommendation may be proposed based on human health concerns.

If COPCs remain after the screening assessment, several options exist for the PRS. 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 may be associated with exposure to inorganic chemicals that occur naturally 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 3.3.1-1 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, 1307). 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 (UTLs and maximum concentration values are identical to those described in Section 3.2.1, Inorganic Chemicals).

The background risks based on the LANL SAL residential exposure model are provided in Table 3.3.1-1. Risks due to background concentrations 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.

Three of the background inorganic chemicals provided in Table 3.3.1-1 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, 0559).

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.

TABLE 3.3.1-1

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}	1×10^{-5}
Barium	130	315	0.03	0.06	NC	NC
Beryllium	0.895	1.95	0.003	0.006	6×10^{-8}	1×10^{-5}
Cadmium[g]	0.2	2.6[d]	0.005	0.07	1×10^{-10}	2×10^{-9}
Chromium[f]	8.6	19.3	9.0×10^{-5}	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 Longmire et al. all-soil-horizons data set (1995, 1142).
[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.

3.3.2 Risk Assessment

A risk assessment may be conducted after a screening assessment if COPCs were identified by the screening assessment. A risk assessment can be used to determine what, if any, further action is necessary. The risk assessment may be qualitative, semi-quantitative, or quantitative (deterministic or probabilistic) depending on the amount and quality of data as well as the results of screening. A semi-quantitative human health risk assessment was performed for PRS 3-014(c).

3.4 Ecological Assessment

In cooperation with the New Mexico Environment Department and EPA Region 6, the LANL 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 QUALITY ASSURANCE/QUALITY CONTROL ACTIVITIES

4.1 Quality Assurance/Quality Control Results for PRSs 3-004(c,d)

4.1.1 Inorganic Analysis

Nine samples were analyzed in request 3413R for TAL metals. There was one QC deficiency for this request: arsenic (72%) and zinc (37%) had low recoveries in the matrix spike sample. Matrix spike samples are used to assess the quality of the sample digestion, extraction and analysis procedures. A low recovery suggests that either there was incomplete recovery of an analyte in these procedures or there was sample heterogeneity. To address this problem, post-digestion spikes, which are used to assess the sample extraction and analysis procedures, were performed for arsenic and zinc. The recoveries for the post-digestion spikes were within the limits allowed in USEPA SW846 guidelines. As required in LANL data validation guidelines, UJ and J- qualifiers were added to all arsenic and zinc data in this request. All data for this request are valid and usable as qualified.

Seven samples (one water and six solid media) were analyzed in request 3415R for TAL metals. There were two QC deficiencies for this request. The first QC deficiency was that antimony (63%) and manganese (73%) had low recoveries in the tuff matrix spike sample. To address this problem, post-digestion spikes, which are used to assess the sample extraction and analysis procedures, were performed for antimony and manganese The recoveries for the post-digestion spikes were within the limits allowed in USEPA SW846 guidelines. As required in LANL data validation guidelines, UJ and J- qualifiers were added to all manganese and antimony data in this request. The second QC issue with this request was that two analytes (aluminum and sodium) had duplicate sample results that differed from the original samples by greater than 20%. The 20% variance suggest that the samples were heterogeneous, because all other QC parameters for these analytes were within allowed limits (see Subsection 3.1.2). No qualifiers need to be added to the data as a result of the possible heterogeneity, which is a common characteristic of tuff samples in Los Alamos. All data for this request are valid and usable as qualified.

4.1.2 Organic Analysis

VOCs. One sample was analyzed in request 3412R for VOCs. All QC parameters were met for this request. All VOC data for this request are valid and usable and no qualifiers were added.

One sample was analyzed in request 3414R for VOCs. The only QC problem with this request was that acetone (5 ug/kg) and methylene chloride (2 ug/kg) were found in the method blank. Because acetone and methylene chloride are common laboratory contaminants, the "10 times" rule was applied as described in Section 3.1.2 of this report. Based on this rule, U qualifiers were added to all acetone and methylene chloride values detected at less than 50 ug/kg and 20 ug/kg respectively, for all samples in this request. All VOC data in this request are valid and usable as qualified.

SVOCs. Nine samples were analyzed in request 3412R for SVOCs. There were two QC deficiencies with this request. The first QC deficiency was that sample 0109-97-0207 had a recovery for the sixth internal standard outside ranges allowed by USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review. Internal standards are used to assess instrument performance during the analytical procedure and standards outside the range indicate an interference from a sample or a change in the response of the instrument. A UJ qualifier was added to all analytes associated with the internal standard (there were no detects). Associated analytes are those analytes which are in close proximity to the internal standard on the chromatogram. The other QC deficiency was that bis(2-ethylhexyl)phthalate (56 ug/kg) was found in the method blank. Because bis(2-ethylhexyl)phthalate is a common laboratory contaminant, the "10 times" rule was applied as described in Section 3.1.2 of this report. Based on this rule, U qualifiers were added to all bis(2-ethylhexyl)phthalate values detected at less than 560 ug/kg, for all samples in this request. All SVOC data in this request are valid and usable as qualified.

Seven samples (one water and six soil media) were analyzed in request 3414R for SVOCs. The one QC problem with this request was that the holding time for the water sample was exceeded by five days. The reason for the holding time is the possibility of degradation of SVOCs in the water after sample collection. However, because the sample was kept refrigerated until the time of analysis and no analytes were found in the analysis, it is unlikely that the exceeded holding time affected the sample results. Because the holding time was exceeded, all of the analytes for the water sample 0109-97-0336 are qualified UJ, but are still considered valid and usable as discussed above. All other SVOC data for this request are valid and usable and no qualifiers were added.

4.1.3 Radiochemical Analysis

Five samples were analyzed in request 3416R for isotopic uranium and plutonium using alpha spectroscopy. All QC parameters were met for this request. All radiochemistry data for this request are valid and usable and no qualifiers were added.

4.2 Quality Assurance/Quality Control Results for PRS 3-007

4.2.1 Inorganic Analysis

Five samples were analyzed in request 3410R for TAL metals. There were two QC deficiencies for this request. The first deficiency was that arsenic (71%) and antimony (38%) had low recoveries and manganese (163%) had a high recovery in the matrix spike sample. To address this problem, post-digestion spikes, which are used to assess the sample extraction and analysis procedures, were performed for arsenic, antimony, and manganese. The recoveries for the post-digestion spikes were within the limits allowed in USEPA SW846 guidelines. As required in LANL data validation guidelines, UJ and J- qualifiers were added to all arsenic and antimony data and J+ qualifiers were added for manganese detects in this request. The second QC issue with this request was that three analytes (barium, lead, and calcium) had duplicate sample results that differed from the original samples by greater than 20%. The 20% variances suggest that the samples were heterogeneous because all other QC parameters for these analytes were within allowed limits (see Subsection 3.1.2). No qualifiers were added to the data as a result of the possible heterogeneity, which is a common characteristic of soil samples in Los Alamos. All data for this request are valid and usable as qualified.

4.2.2 Organic Analysis

VOCs. Three samples were analyzed for VOCs in request 3408R. The only QC problem with this request was that acetone (2 ug/kg) and methylene chloride (4 ug/kg) were found in the method blank. Because acetone and methylene chloride are common laboratory contaminants, the "10 times" rule was applied as described in Section 3.1.2 of this report. Based on this rule, U qualifiers were added to all acetone and methylene chloride values detected at less than 20 ug/kg and 40 ug/kg, respectively, for all samples in this request. All VOC data in this request are valid and usable as qualified.

SVOCs. Five samples were analyzed in request 3408R for SVOCs. All QC parameters were met for this request. All SVOC data for this request are valid and usable and no qualifiers were added.

HE. Five samples were analyzed in request 3409R for high explosives. All QC parameters were met for this request. All HE data for this request are valid and usable and no qualifiers were added.

4.2.3 Radiochemical Analysis

Five samples were analyzed in request 3411R for isotopic thorium using alpha spectroscopy. One sample was analyzed for gross alpha and beta, and gamma isotopes. All QC parameters were met for this request. All radiochemistry data for this request are valid and usable and no qualifiers were added.

4.3 Quality Assurance/Quality Control Results for PRS 3-014(k,l,o)

4.3.1 Inorganic Analysis

Six samples were analyzed for TAL metals in request 3376R. There were two minor QC deficiencies in this request. The first QC deficiency was that chromium (72%) and manganese (148%) had low and high recoveries respectively in the matrix spike sample. A second matrix spike was performed and all analytes were within allowed limits according to USEPA SW846 guidelines. The second QC issue was that two analytes (lead and chromium) had duplicate sample results that differed from the original samples by greater than 20% (22% and 28%), suggesting that the samples were heterogeneous (see Subsection 3.1.2). No qualifiers were added to the data as a result of the possible heterogeneity, which is a common characteristic of Los Alamos soil and tuff samples, because the second matrix spike sample had all analytes within allowed limits and all other QC parameters were met. Therefore, all data for TAL metals in Request 3376R are valid and usable, with no added qualifiers.

Nine samples were analyzed for TAL metals in request 3445R. There were two QC deficiencies that affected the data in this request. The first QC deficiency was that chromium had a high recovery (139%) in the matrix spike sample. To address this problem, a post-digestion spike, which is used to assess the sample extraction and analysis procedures, was performed for chromium. The recovery for the post-digestion spike was within the limits allowed in USEPA SW846 guidelines. As required in LANL data validation guidelines, J+ qualifiers were added to all chromium detects in this request. The second problem was that aluminum (66%) and iron (72%) had low recoveries in the laboratory control sample (LCS). The LCS is an indicator of the completeness of the digestion process. The low recoveries indicate a less than complete

digestion for aluminum and iron. All aluminum and iron are qualified J- for the low LCS recovery as required by the LANL data validation guidelines. All metals data in this request are valid and usable as qualified.

4.3.2 Organic Analysis

VOCs. Two samples were analyzed for VOCs in request 3375R. There were two QC deficiencies in this request. One QC deficiency was that sample 0100-97-0016 had one high surrogate recovery (bromofluorobenzene, 122%) and the last internal standard was outside ranges allowed by USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review. Internal standards are used to assess instrument performance during the analytical procedure, and standards outside the range indicate an interference from a sample or a change in the response of the instrument. A UJ qualifier was added to all analytes associated with the internal standard (there were no detects). Associated analytes are those analytes which are in close proximity to the internal standard on the chromatogram. Since there were no detects in the sample, the high surrogate recovery does not require any qualification. The other QC deficiency was that acetone (4 ug/kg) and methylene chloride (14 ug/kg) were found in the method blank. Because acetone and methylene chloride are common laboratory contaminants, the "10 times" rule was applied as described in Section 3.1.2 of this report. Based on this rule, U qualifiers were added to all acetone and methylene chloride values detected at less than 40 ug/kg and 140 ug/kg respectively, for all samples in this request. All VOC data in this request are valid and usable as qualified.

Three samples were analyzed for VOCs in request 3444R. The only QC problem with this request was that acetone (8 ug/kg) and methylene chloride (3 ug/kg) were found in the method blank. Because acetone and methylene chloride are common laboratory contaminants, the "10 times" rule was applied as described in Section 3.1.2 of this report. Based on this rule, U qualifiers were added to all acetone and methylene chloride values detected at less than 80 ug/kg and 30 ug/kg, respectively, for all samples in this request. All VOC data in this request are valid and usable as qualified.

SVOCs. Six samples were analyzed for SVOCs in request 3375R. The only QC deficiency in this request was that the recovery for the sixth internal standard for sample 0103-97-0016 was below the lower limit allowed by USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review. Internal standards are used to assess instrument performance during the analytical procedure and standards outside the range indicate an

interference from a sample matrix or a change in the response of the instrument. A UJ qualifier was added to all analytes associated with the internal standard (there were no detects). Associated analytes are those analytes which are in close proximity to the internal standard on the chromatogram. All SVOC data for this request are valid and usable as qualified.

Nine samples were analyzed for SVOCs in request 3444R. The only QC deficiency in this request was that bis(2-ethylhexyl)phthalate (230 ug/kg) and di-n-butylphthalate (220 ug/kg) were found in the method blank. Because bis(2-ethylhexyl)phthalate and di-n-butylphthalate are common laboratory contaminants, the "10 times" rule was applied as described in Section 3.1.2 of this report. Based on this rule, U qualifiers were added to all bis(2-ethylhexyl)phthalate and di-n-butylphthalate values detected at less than 2 300 ug/kg and 2 200 ug/kg respectively, for all samples in this request. All SVOC data for this request are valid and usable as qualified.

PCBs. Six samples were analyzed for PCBs in request 3375R. All QC parameters were met for this request. All PCB data for this request are valid and usable, and no qualifiers were added.

Nine samples were analyzed for pesticides/PCBs in request 3444R. All QC parameters were met for this request. All PCB data for this request are valid and usable, and no qualifiers were added.

Herbicides. Six samples were analyzed for phenoxy acid herbicides in request 3375R. All QC parameters were met for this request. All herbicide data for this request are valid and usable, and no qualifiers were added.

Nine samples were analyzed for herbicides in request 3444R. There was one QC problem with this request. The surrogate (dichloroacetic acid) for sample 0103-97-0030 had a high recovery (148%). The EPA-allowed range for this surrogate is 30-126%. Because of the high recovery, all herbicide detects for this sample are qualified J+ for possible high bias. All herbicide data for this request are valid and usable as qualified.

4.3.3 Radiochemical Analysis

Six samples were analyzed in request 3377R for isotopic uranium and isotopic plutonium using alpha spectroscopy, strontium-90 using gas proportional counting, and tritium using liquid scintillation. All QC parameters were met for this request. All radiochemistry data for this request are valid and usable, and no qualifiers were added.

Nine samples were analyzed in request 3445R for isotopic uranium and isotopic plutonium using alpha spectroscopy, strontium-90 using gas proportional counting, and tritium using liquid scintillation. All QC parameters were met for this request. All radiochemistry data for this request are valid and usable, and no qualifiers were added.

4.4 Quality Assurance/Quality Control Results for PRS 3-021

4.4.1 Inorganic Analysis

Twelve samples were analyzed in request 3429R for TAL metals. There were two QC deficiencies for this request. The first deficiency was that manganese (64%) had a low recovery in the soil matrix spike sample. To address this problem, a post-digestion spike, which is used to assess the sample extraction and analysis procedures, was performed for manganese. The recovery for the post-digestion spike was within the limits allowed in USEPA SW846 guidelines. As required in LANL data validation guidelines, UJ and J- qualifiers were added to all manganese data in this request. The second QC issue with this request was that two analytes (lead and manganese) had duplicate sample results that differed from the original samples by greater than 20%. This variance suggests that the samples were heterogeneous, since all other QC parameters for these analytes were within allowed limits (see Subsection 3.1.2). No qualifiers were added to the data as a result of the possible heterogeneity, which is a common characteristic of soil and tuff samples in Los Alamos. All data for this request are valid and usable as qualified.

4.4.2 Organic Analysis

VOCs. One sample was analyzed in request 3427R for VOCs. There were several QC problems with this sample. The first problem was that the second internal standard was outside ranges allowed by USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review. Internal standards are used to assess instrument performance during the analytical procedure and standards outside the range indicate an interference from a sample or a change in the response of the instrument. The second QC problem was that there was a low surrogate recovery for bromofluorobenzene (74%). Low surrogate recoveries suggest that the sample matrix is interfering with the analysis or that there was a problem with the sample extraction or digestion. The sample was analyzed a second time with the same results, indicating that the sample matrix may have been the reason for both QC problems. Based on these two QC problems, UJ qualifiers were added to all analytes (there were no detects). All VOC data in this request are valid and usable as qualified.

SVOCs. Twelve samples were analyzed in request 3428R for SVOCs. All QC parameters were met for this request. All SVOC data in this request are valid and usable without added qualifiers.

4.4.3 Radiochemical Analysis

No radiochemical analyses were performed for this PRS because radionuclides are not a COPC at this site.

4.5 Quality Assurance/Quality Control Results for PRS 3-040(a)

4.5.1 Inorganic Analysis

Twelve samples (three water, nine soil/sediment) were analyzed in request 3363R for TAL metals and cyanide. The nine soil/sediment samples were also analyzed for hexavalent chromium. There were two QC deficiencies for this request. The first deficiency was that chromium (57%), cyanide (45%), and manganese (30%) had low recoveries in the matrix spike sample. To address this problem, post-digestion spikes, which are used to assess the sample extraction and analysis procedures, were performed for chromium and manganese. The recoveries for the post-digestion spikes were within the limits allowed in USEPA SW846 guidelines. As required in LANL data validation guidelines, UJ and J- qualifiers were added to all manganese, chromium, and cyanide data in this request. The second QC issue with this request was that four analytes (iron, lead, manganese, and nickel) had duplicate sample results that differed from the original samples by greater than 20%. These variances suggest that the samples were heterogeneous, because all other QC parameters for these analytes (except matrix spike for manganese which also shows heterogeneity) were within allowed limits (see Subsection 3.1.2). No qualifiers were added to the data as a result of the possible heterogeneity, which is a common characteristic of soil samples in Los Alamos. All data for this request are valid and usable as qualified.

4.5.2 Organic Analysis

VOCs. Two samples were analyzed for VOCs in request 3262R. The only QC problem with this request was that acetone (5 ug/kg) was found in the method blank. Because acetone is a common laboratory contaminant, the "10 times" rule was applied as described in Section 3.1.2 of this report. Based on this rule, U qualifiers were added to all acetone values detected at less than 50 ug/kg, for all samples in this request. All VOC data in this request are valid and usable as qualified.

4.5.3 Radiochemical Analysis

Twelve samples (three water, nine soil/sediment) were analyzed in request 3364R for isotopic uranium using alpha spectroscopy. All QC parameters were met for this request. All radiochemistry data for this request are valid and usable, and no qualifiers were added.

4.6 Quality Assurance/Quality Control Results for PRS 3-052(b), 3-056(k)

4.6.1 Inorganic Analysis

Twenty-two samples were analyzed in request 3410R for TAL metals. There were two QC deficiencies for this request. The first was that arsenic (71%) and antimony (38%) had low recoveries, and manganese (163%) had a high recovery in the matrix spike sample. To address this problem, post-digestion spikes, which are used to assess the sample extraction and analysis procedures, were performed for arsenic, antimony, and manganese. The recoveries for the post-digestion spikes were within the limits allowed in USEPA SW846 guidelines. As required in LANL data validation guidelines, UJ and J- qualifiers were added to all arsenic and antimony data and J+ qualifiers were added for manganese detects in this request. The second QC issue with this request was that three analytes (barium, lead, and calcium) had duplicate sample results that differed from the original samples by greater than 20%. These variances suggest that the samples were heterogeneous because all other QC parameters for these analytes were within allowed limits (see Subsection 3.1.2). No qualifiers were added to the data as a result of the possible heterogeneity, which is a common characteristic of soil samples in Los Alamos. All data for this request are valid and usable as qualified.

4.6.2 Organic Analysis

VOCs. Two samples were analyzed for VOCs in request 3408R. The only QC problem with this request was that acetone (2 ug/kg) and methylene chloride (4 ug/kg) were found in the method blank. Because acetone and methylene chloride are common laboratory contaminants, the "10 times" rule was applied as described in Section 3.1.2 of this report. Based on this rule, U qualifiers were added to all acetone and methylene chloride values detected at less than 20 ug/kg and 40 ug/kg respectively, for all samples in this request. All VOC data in this request are valid and usable as qualified.

4.6.3 Radiochemical Analysis

Twenty-six samples (twenty-two soil and four asphalt) were analyzed in request 3411R for isotopic uranium using alpha spectroscopy. Two soil samples were analyzed for gross alpha and beta and gamma isotopes. All QC parameters were met for this request. All radiochemistry data for this request are valid and usable, and no qualifiers were added.

4.7 Quality Assurance/Quality Control Results for PRS C-3-014

4.7.1 Inorganic Analysis

No inorganic analyses were performed for this PRS because inorganic chemicals are not a COPC at this site.

4.7.2 Organic Analysis

No organic analyses were performed for this PRS because organic chemicals are not a COPC at this site.

4.7.3 Radiochemical Analysis

Five samples were analyzed in request 3370R for isotopic uranium using alpha spectroscopy. All QC parameters were met for this request. All radiochemistry data for this request are valid and usable, and no qualifiers were added.

5.0 SPECIFIC RESULTS, CONCLUSIONS, AND RECOMMENDATIONS

5.1 PRSs 3-004(c,d), Dumpster Storage Area

PRS 3-004(c) is a dumpster storage area located at the main loading dock for the Chemistry and Metallurgical Research (CMR) building, TA-3-29. PRS 3-004(d) is a former dumpster storage area located at the west end of wing 9 of TA-3-29. Analytical results from asphalt, surface and near surface soil samples collected at each PRS indicate that contamination is not present above SALs. Based on these results, PRSs 3-004(c,d) are recommended for NFA.

5.1.1 History

PRSs 3-004(c,d) are discussed in detail in Subsection 5.23 of the RFI Work Plan for Operable Unit 1114, Addendum 1 (LANL 1995, 1291). PRSs 3-004(c,d) are located at TA-3 within the fenced area around the CMR building. PRS 3-004(c) is located at the main loading dock for TA-3-29. The dock and dumpster area has been active since 1952. Two dumpsters, one receiving compactible waste and the other receiving non-compactible waste, received low-level radioactive waste (with an assay range from 0 to 100 nCi/g) from radioactive material handling areas. The waste material consists of gloves, paper products, glass, plastic, and metal. PRS 3-004(d) consists of a dumpster storage area located at the west end of TA-3-29, wing 9. One dumpster formerly occupied this area and received waste that consisted of rags, hardware, machine shop waste, and occasional items from the hot cell located in wing 9. The hot cell items were low-level radioactive waste that were containerized in plastic bags, then taped well enough to avoid any leakage during handling, and placed in 1 ft. x 1 ft. x 2 ft. cardboard boxes prior to being discarded in the dumpster. Occasionally, some of the hot cell waste was low-level contaminated equipment and was containerized in plastic bags prior to being placed in the dumpster. Note that the dumpster was moved inside wing 9 in 1992 and is no longer considered a potential source of contamination. Potential contamination for PRS 3-004(c) includes metals, SVOCs, and radionuclides. Potential contamination for PRS 3-004(d) includes metals and SVOCs.

5.1.2 Description

PRSs 3-004(c,d) are located in paved areas within the security fence around the CMR building. The area has been noticeably disturbed during construction and operation of the site. For further information, refer to Section 2.0 of this report.

5.1.3 Previous Investigation

No previous investigations have been performed at this site.

5.1.4 Field Investigations

The conceptual model for PRSs 3-004(c,d) assumes that inhalation, ingestion, and dermal contact with soil or surficial contamination are the primary exposure pathways. The objective of the RFI was to determine the nature and extent of contamination, if any, associated with each PRS.

Field activities were conducted in July 1997 in accordance with the RFI Work Plan for OU 1114, Addendum 1 (LANL 1995, 1291). As discussed in Section 1.3, field activities included a site survey, geodetic survey, field screening, and sample collection. Details of the field activities are presented below.

Random Sampling Strategy. For PRSs 3-004(c,d), a random sampling strategy was used to select sample locations. However, for PRS 3-004(c) each grid node was screened for radioactivity to help determine sample locations while at PRS 3-004(d) radiological screening was performed only for health and safety purposes as described in Section 1.3.

The sampling grid for PRS 3-004(c) was established within the paved loading dock/dumpster area at TA-3-29. Eight grid nodes (see Figure 5.1.4-1 for grid spacing) were screened for alpha and beta/gamma activity. Screening for alpha radiation was performed using a Ludlum™ Model 139 survey meter with an air proportional alpha detector. Screening for beta/gamma radiation was performed using an Eberline™ ESP-1 rate meter with an HP260 pancake probe. No alpha activity was detected with the alpha radiation detector. Beta/gamma screening results were grouped into three categories, low (0–49 counts/minute), medium (50–79 counts/minute), and high (greater than 80 counts/minute) and were compared to background screening results. Using a random digits table, two high, one medium, and one low beta/gamma reading were selected for PRS 3-004(c). The corresponding grid locations were selected as sample locations (RAND 1983, 03-1312).

The sampling grid for PRS 3-004(d) was established along the west wall of TA-3-29, wing 9. Eight grid nodes were screened for alpha and beta/gamma activity for health and safety purposes prior to sample collection. Screening for alpha radiation was performed using a Ludlum™ Model 139 survey meter with an air proportional alpha detector. Screening for

beta/gamma radiation was performed using an Eberline™ ESP-1 rate meter with an HP260 pancake probe. No alpha activity was detected with the alpha radiation detector. Beta/gamma screening results were within background measurements. Using a random digits table, four of the eight grid node locations were selected as sample locations for PRS 3-004(d).

Field Screening. Radiological and organic vapor field screening was performed during sampling activities as described in Section 1.3. All radiological field screening results were at or below the average background radiological levels for the site. Organic vapor monitoring was performed using a PID to monitor samples and the workers' breathing zone. All organic vapor screening results for this site were 0.0 ppm.

Surface and Subsurface Sampling. Twelve random and biased locations were selected for sampling at PRSs 3-004 (c,d) (Fig. 5.1.4-1). At PRS 3-004(c), samples were collected from four random locations (Location IDs 03-03302 through 03-03305) and one biased location (Location ID 03-03301). One duplicate sample was also collected from a random location (Location ID 03-03302). At each location, asphalt was chipped using an electric rotary hammer and samples were collected from the chipped material. After base course was removed, a hand auger was used to collect samples from the interval encountering tuff. Generally, moist, reddish-brown tuff was encountered either directly beneath asphalt or within the 0-to 12-in. interval beneath asphalt.

At PRS 3-004(d), samples were collected from four random locations (Location IDs 03-03294 through 03-03297) and two biased locations (Location IDs 03-03298 and 03-03299). One collocated site (03-03300) was also sampled. After chipping asphalt and removing base course from each location, a hand auger was used to collect samples from underlying sediments. Two samples were collected at each location: the 0-to 12-in. interval directly beneath asphalt and the 0-to 12-in. interval where tuff was encountered. At locations where tuff was directly beneath asphalt only one interval was sampled. Moist, reddish-brown tuff was generally encountered directly beneath the asphalt or within the 0-to 12-in. interval. Tuff was not encountered at location 03-03294 or 03-03246; the soil/crushed tuff backfill material encountered is associated with the building basement and/or the nearby underground water main. Sampling information is summarized in Table 5.1.4-1.

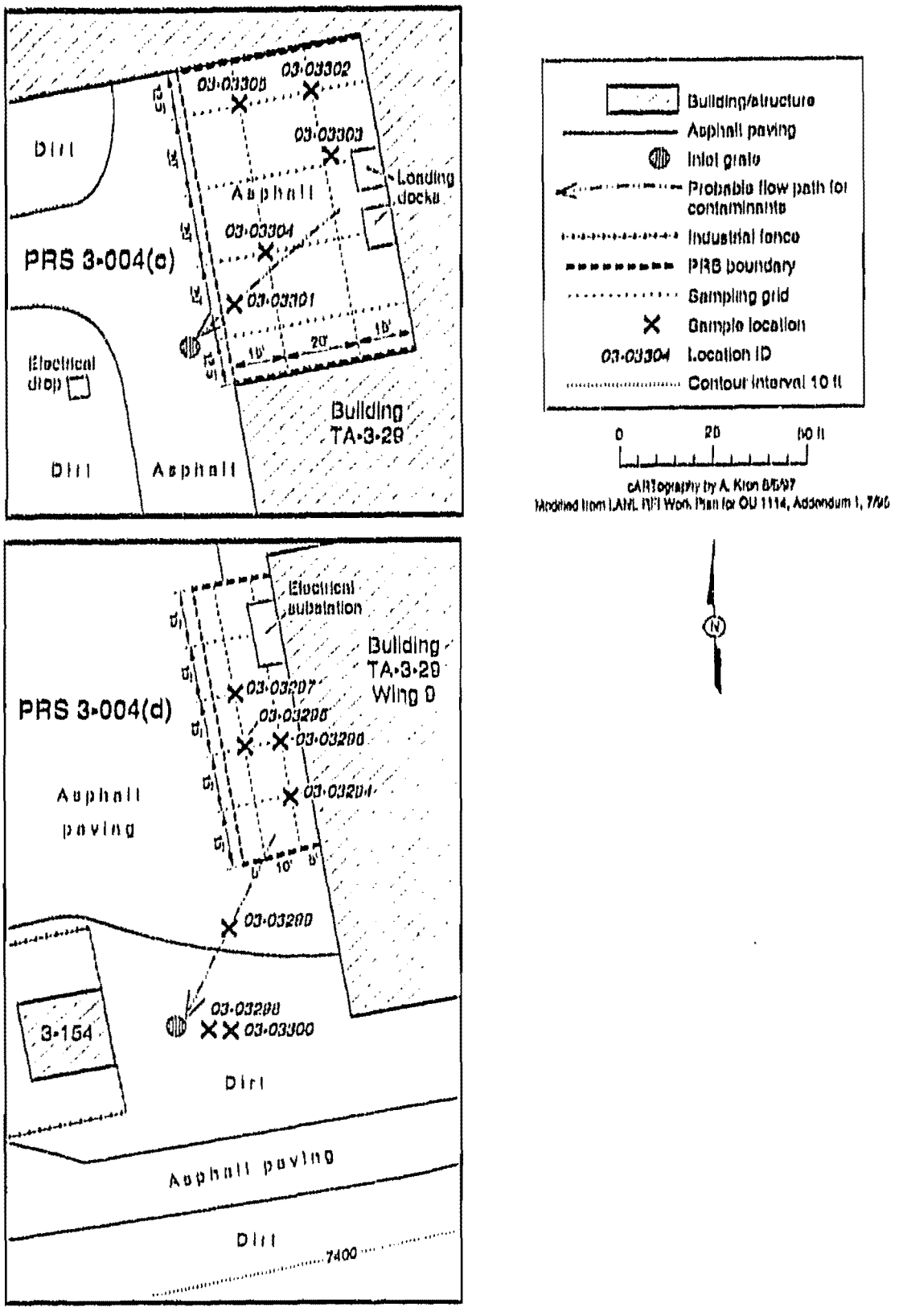


Fig. 5.1.4-1 Locations of samples collected at PRSs 3-004(c and d).

Deviations.

- The number of sample locations were reduced for PRS 3-004(c) after a statistical re-evaluation of the sampling and analyses plan (SAP) was completed.

  The SAP was written in 1995, and used a binomial sampling strategy described in the Installation Work Plan (IWP), Appendix H, Subsection 4.2. By using the binomial sampling strategy, the original sampling plan did not account for the containerized nature of the waste, and thus the low probability of having releases from operations at these PRSs. The original plan did not take advantage of field screening approaches to delineate potential releases at PRS 3-004(c), in the event that they did occur. Therefore, the SAP was reassessed to evaluate if improvements could be made by implementing lessons learned during sampling events occurring after the 1995 SAP was prepared.

  Recent experience has shown that field screening for elevated radioactivity can be an effective tool in biasing sample locations. Therefore, to increase the chances of detecting significant releases on the dumpster storage area, eight locations were field screened at PRS 3-004(c) for elevated radioactivity. Of the eight locations screened, four sample locations were chosen, as described in Subsection 5.1.4 of this RFI, under Random Sampling Strategy. Even though the four sample locations is a reduction from the eight locations proposed in the 1995 SAP, the four biased locations will provide equal or greater probability of detecting contamination if it exists, as the eight sample locations previously proposed. This method is effective at detecting and quantifying releases while minimizing resource expenditures.

- For PRS 3-004(d), the number of sample locations was reduced from ten to seven. The number was reduced to avoid the underground utilities and the newly sited above ground electrical substation. Due to the small surface area the dumpster resided over, the four random sample locations selected were statistically appropriate given supplemental information would be gained from biased samples collected from the drainage leading from the dumpster storage area. However, an additional downgradient biased location was sampled to further increase the chance of detecting and bounding releases of contaminants at this PRS.

TABLE 5.1.4-1.

SUMMARY OF SAMPLES COLLECTED AT PRS 3-004(c,d)

PRS #	LOCATION ID	SAMPLE ID	DEPTH (in.)	MEDIA	RADIO-NUCLIDES[a]	VOCs	SVOCs	METALS
					REQUEST NUMBER			
3-004(c)	03-03301	0103-97-0270	0-5	asphalt	3416R	N/A[b]	N/A	N/A
3-004(c)	03-03301	0103-97-0275	15-16	tuff	N/A	N/A	3414R	3415R
3-004(c)	03-03302	0103-97-0272	0-5	asphalt	3416R	N/A	N/A	N/A
3-004(c)	03-03302	0103-97-0279	14-16	tuff	N/A	N/A	3414R	3415R
3-004(c)	03-03302	0103-97-0320	14-16	tuff (dup)	N/A	N/A	3414R	3415R
3-004(c)	03-03303	0103-97-0273	0-5	asphalt	3416R	N/A	N/A	N/A
3-004(c)	03-03303	0103-97-0280	14-16	tuff	N/A	N/A	3414R	3415R
3-004(c)	03-03304	0103-97-0274	0-5	asphalt	3416R	N/A	N/A	N/A
3-004(c)	03-03304	0103-97-0278	14-17	tuff	N/A	N/A	3414R	3415R
3-004(c)	03-03305	0103-97-0276	0-5	asphalt	3416R	N/A	N/A	N/A
3-004(c)	03-03305	0103-97-0277	14-17	tuff	N/A	3414R	3414R	3415R
3-004(c)	NA[c]	0103-97-0330	NA	water (rinse)	N/A	N/A	3414R	3415R
3-004(d)	03-03294	0103-97-0281	0-12	soil/fill	N/A	N/A	3412R	3413R
3-004(d)	03-03294	0103-97-0282	36-48	soil/fill	N/A	3412R	3412R	3413R
3-004(d)	03-03295	0103-97-0283	3-15	soil/tuff	N/A	N/A	3412R	3413R
3-004(d)	03-03296	0103-97-0284	0-12	soil/fill	N/A	N/A	3412R	3413R
3-004(d)	03-03296	0103-97-0285	36-48	soil/fill	N/A	N/A	3412R	3413R
3-004(d)	03-03297	0103-97-0286	3-6	tuff	N/A	N/A	3412R	3413R
3-004(d)	03-03298	0103-97-0288	0-10	soil/tuff	N/A	N/A	3412R	3413R
3-004(d)	03-03299	0103-97-0287	3-6	tuff	N/A	N/A	3412R	3413R
3-004(d)	03-03300	0103-97-0289	0-10	soil/tuff	N/A	N/A	3412R	3413R

[a] Radionuclides include isotopic plutonium and isotopic uranium.
[b] N/A = Not analyzed.
[c] NA = Not applicable.

Background Comparison Sections

Data from each PRS was evaluated separately for comparison to background and are presented in Subsections 5.1.6 through 5.1.10 below.

5.1.6 Evaluation of Inorganics for PRS 3-004(c)

Six samples collected at PRS 3-004(c) were analyzed for TAL metals. These six samples were collected in Unit 4 of the Tshirege Member of the Bandelier Tuff. Each inorganic result was compared to the Unit 4 background screening value (Longmire et al. 1995, 1142 and 1266).

Five inorganics (barium, calcium, cobalt, lead, and selenium) were detected above background screening values in at least one Unit 4 sample. Further background comparisons were not performed for these metals because the number of background site samples for these metals

are inadequate to support other statistical tests due to an insufficient frequency of detects. Therefore, barium, calcium, cobalt, lead, and selenium are carried forward to the human health screening assessment. The data for each sample that had at least one concentration above the background screening value for these five inorganics are shown in Table 5.1.5-1.

TABLE 5.1.5-1

INORGANIC CHEMICALS WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT PRS 3-004(c)

SAMPLE ID	UNIT 4 UTL	0103-97-0275	0103-97-0277		0103-97-0278		0103-97-0279	0103-97-0280	0103-97-0329
Analyte									
Barium	56.6	58.3	62.2		55.2		70.2	150	62.8
Calcium	2770	1150	1630		1320		2470	13900	1780
Cobalt	3.14	3.1	4.3		3.2		4.0	3.4	3.0
Lead	11	5.5	6.2		0.6		7.8	8.6	11.1
Selenium	n/a	0.20	0.16	U	0.16		0.30	0.17	0.16

Values in BOLD are above the background screening value (see Subsection 3.2.1)
Units are in mg/kg.
U = Signifies that the analyte was not positively identified in the sample, and the associated value is the sample-specific EQL/EDL (see Subsection 3.1.2).
n/a = Not available. Detection limit used as background screening value.

5.1.6 Evaluation of Radionuclides for PRS 3-004(c)

Five asphalt samples collected at PRS 3-004(c) were analyzed for isotopic plutonium and isotopic uranium.

Background screening values are not available for isotopic plutonium and isotopic uranium in asphalt material. Therefore, any of those isotopes detected above the minimum detectable activity will be carried forward to the human health screening assessment for further evaluation. When minimum detectable activities are not reported, 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 employed in the same manner as a detection limit. This methodology is similar to Currie's method of determining radionuclide maximum detectable activity (Currie1968, 0792).

Plutonium-239, uranium-234, uranium-235, and uranium-238 were all detected in at least one asphalt sample. Therefore, these four radionuclides are carried forward to the human health screening assessment.

It is important to note that none of these isotopic uranium and plutonium values exceed the LANL soil background UTLs. If the samples had been collected from soil they would not have been carried forward to the human health screening assessment.

The data for each sample that had at least one concentration above the minimum detectable activity for these four radionuclides are shown in Table 5.1.6-1.

TABLE 5.1.6-1

RADIONUCLIDES WITH CONCENTRATIONS EXCEEDING MINIMUM DETECTABLE ACTIVITY AT PRS 3-004(c)

SAMPLE ID	0103-97-0270		0103-97-0272		0103-97-0273[a]		0103-97-0274		0103-97-0276
Analyte									
Pu-239	0.02	U	0.002	U	0.028	U	0.013	U	0.034
U-234	0.6		0.67		0.53		0.56		0.51
U-235	0.064		0.04		0.03		0.04		0.036
U-238	0.62		0.62		0.62		0.64		0.61

Values in BOLD are above the minimum detectable activity (see Section 3.2.2).
Units are in pCi/g.
[a] Value shown is the greater of either the original sample or its laboratory duplicate.
U = Signifies that the analyte was not positively identified in the sample, and the associated value is the sample-specific EQL/EDL (see Subsection 3.1.2).

5.1.7 Evaluation of Organic Chemicals for PRS 3-004(c)

Five samples collected at PRS 3-004(c) were analyzed for a suite of SVOCs. One of these samples were also analyzed for a suite of VOCs. These five samples were collected in Unit 4 of the Tshirege Member of the Bandelier Tuff.

Five organics were detected in these samples. The data for each sample that had at least one detected concentration of these organic chemicals are presented below in Table 5.1.7-1. These five organic chemicals [benzo(b&k)fluoranthene, fluoranthene, phenanthrene, and pyrene] are polycyclic aromatic hydrocarbons (PAHs).

TABLE 5.1.7-1

DETECTED PAHS AT PRS 3-004(c)

SAMPLE ID	0103-97-0280	
Analyte		
Phenanthrene	0.083	J
Fluoranthene	0.100	J
Pyrene	0.120	J
Benzo[b&k]fluoranthene	0.080	J

Values in BOLD are detected.
Units are mg/kg.
J = Data qualifier (see Subsection 5.1.2).

The qualifiers in Table 5.1.7-1 have been assigned during data validation. However, the data are usable for site-specific decisions. The J qualifiers in sample 0103-97-0280 were assigned to indicate that the results were reported between the method detection limit and the EQL, and are estimated values.

PAHs detected in samples from PRS 3-004(c) were not included in the screening assessment because they are not believed to be associated with a release from the PRS. PAHs were detected in one sample collected from beneath asphalt paving. The levels of PAHs detected are likely to be associated with the asphalt because there are no known sources of PAHs associated with the processes conducted at this PRS.

Although it is not appropriate to evaluate the potential human health risks associated with these chemicals within the same framework as chemicals potentially released from a PRS, it is appropriate to provide some estimate of potential health risks so that the need for action can be assessed either within or outside of the RCRA Corrective Action process. These risk estimates are screening-level in nature, and were calculated using the Region 9 Preliminary Remediation Goals (PRGs) for residential soil as shown in Appendix C, of this document. The total carcinogenic risk or hazard index (for noncarcinogenic chemicals) was estimated by summing the risk or hazard quotient for each detected chemical.

The estimated carcinogenic risk for these detected organic chemicals is 1×10^{-7} for the PRS 3-004(c) sample. This risk level is less than the acceptable risk range of 10^{-4} to 10^{-6} for carcinogens specified in the National Contingency Plan (EPA 1990, 0559) and in proposed RCRA Subpart S (EPA 1990, 0432). The hazard index for PAHs from the sample at PRS 3-004(c) is 0.0001. This hazard index is considerably less than one, indicating no adverse health effects would be associated with these concentrations.

5.1.8 Evaluation of Inorganics for PRS 3-004(d)

Nine samples collected at PRS 3-004(d) were analyzed for TAL metals. Seven of these samples were collected in either soil, a soil and tuff mixture, or a soil and fill material mixture. The other two samples were collected from Unit 4 of the Tshirege Member of the Bandelier Tuff. Each inorganic result was compared to the appropriate background screening value (Longmire et al, 1995, 1142 and 1266).

Five inorganics (calcium, chromium, lead, silver, and zinc) were detected above background screening values in at least one soil sample. One inorganic (silver) was detected above background screening values in at least one Unit 4 sample. Further background comparisons were not performed for these metals. The number of background site samples for these metals are inadequate to support other statistical tests due to an insufficient frequency of detects. All inorganics that were detected above background screening values in at least one of the geologic units are carried forward to the human health screening assessment. Therefore, calcium, chromium, lead, silver, and zinc are carried forward to the human health screening assessment. The data for each sample that had at least one concentration above the background screening value for these five inorganics are shown in Table 5.1.8-1.

The qualifiers in Table 5.1.8-1 have been assigned during data validation. However, the data are usable for site-specific decisions, as stated in the rationale below.

As discussed in Section 4.1 (Inorganic Analyses), the J- qualifiers for zinc were assigned because zinc had low recoveries in the matrix spike sample. To address this problem, post-digestion spikes were performed for zinc, and these recoveries were within the limits allowed in USEPA SW846 guidelines. The J- qualifiers indicate that results may be biased low. Because zinc is still detected above its background screening value, it is further evaluated in the human health screening assessment.

TABLE 5.1.8-1

INORGANIC CHEMICALS WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT PRS 3-004(d)

SAMPLE ID	ALL SOIL DATA UTL	0103-97-0261[a]		0103-97-0262		0103-97-0263		0103-97-0264		0103-97-0265		0103-97-0266		0103-97-0269	
Analyte															
Calcium	6120	7840		3900		2470		5290		909		3400		1200	
Chromium	19.3	33.1		3.9		1.5		4.4		3.0		3.5		0.91	U[b]
Lead	23.3	56.6		4.7		4.8		17		1.8		6.4		4.6	
Silver	n/a[c]	1.3		0.93		0.59		0.63		0.66		0.67		0.69	
Zinc	50.6	211	J-[d]	37.4	J-	28.7	J-	51.2	J-	32.0	J-	37.7	J-	33.2	J-

SAMPLE ID	UNIT 4 UTL	0103-97-0267		0103-97-0268	
Analyte					
Calcium	2770	777		2490	
Chromium	10.9	6.0		1.5	
Lead	11	1.5		4.9	
Silver	n/a	0.98		0.61	
Zinc	75.4	33.1	J-	29.3	J-

Values in BOLD are above the background screening value (see Subsection 3.2.1).
Units are in mg/kg.

[a] Value shown is the greater of either the original sample or its laboratory duplicate.
[b] U = Signifies that the analyte was not positively identified in the sample, and the associated value is the sample-specific EQL/EDL (see Subsection 3.1.2).
[c] n/a = Not Available. Detection limit used as background screening value.
[d] J- = Data qualifier (see Subsection 3.1.2).

5.1.9 Evaluation of Radionuclides for PRS 3-004(d)

Samples collected at PRS 3-004(d) were not analyzed for radionuclides because radionuclides are not a COPC for this PRS.

5.1.10 Evaluation of Organic Chemicals for PRS 3-004(d)

Nine samples collected at PRS 3-004(d) were analyzed for a suite of SVOCs. One of these samples were also analyzed for a suite of VOCs. Seven of these samples were collected in either soil, a soil and tuff mixture, or a soil and fill material mixture. The other two samples were collected from the Unit 4 of the Tshirege Member of the Bandelier Tuff.

Twelve organics were detected in these samples. The data for each sample that had at least one detected concentration of these organic chemicals are presented below in Table 5.1.10-1. Eleven of 12 organic chemicals (anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene) are PAHs and are discussed below. Carbazole is carried forward to the human health screening assessment.

The qualifiers in Table 5.1.10-1 were assigned during data validation. However, the data are usable for site-specific decisions. The J qualifiers in sample 0103-07-0264 were assigned to indicate that the results were reported between the method detection limit and the EQL, and are estimated values.

Eleven PAHs detected in samples from PRS 3-004(d) were not included in the screening assessment because they are not believed to be associated with a release from the PRS. PAHs were detected in one sample collected from beneath asphalt paving. The levels of PAHs detected are likely to be associated with the asphalt since there is no known source of PAHs associated with the processes conducted at this PRS. Carbazole, which is not a PAH, will be carried forward to the human health screening assessment.

Although it is not appropriate to evaluate the potential human health risks associated with these chemicals within the same framework as chemicals potentially released from a PRS, it is appropriate to provide some estimate of potential health risks so that the need for action can be assessed either within or outside of the RCRA Corrective Action process. These risk estimates are screening-level in nature, and were calculated using the Region 9 Preliminary Remediation Goals (PRGs) for residential soil as shown in Appendix C, of this report. The total

carcinogenic risk or hazard index (for noncarcinogenic chemicals) was estimated by summing the risk or hazard quotient for each detected chemical.

The estimated carcinogenic risk for detected organic chemicals at PRS 3-004(d) is 1 x 10^{-7}. This risk level is within the acceptable risk range of 10^{-4} to 10^{-6} for carcinogens specified in the National Contingency Plan (EPA 1990, 0559) and in proposed RCRA Subpart S (EPA 1990, 0432). The hazard index for PAHs is 0.0004 for the sample at PRS 3-004(d). This hazard index is considerably less than one, indicating no adverse health effects would be associated with these concentrations.

5.1.11 Risk-Based Screening Assessment

This subsection discusses the comparison with SALs for COPCs detected at levels greater than background screening levels. A screening assessment was conducted on the RFI data for PRSs 3-004(c,d) following methodology presented in *Risk-Based Corrective Action Process* (Environmental Restoration Project Decision Support Council 1995, 1271).

TABLE 5.1.10-1

DETECTED ORGANIC CONCENTRATIONS AT PRS 3-004(d)

SAMPLE ID	0103-97-0204	
Analyte		
Anthracene	0.051	J
Benzo(a)anthracene	0.210	J
Benzo(a)pyrene	0.180	J
Benzo(b)fluoranthene	0.230	J
Benzo(g,h,i)perylene	0.095	J
Benzo(k)fluoranthene	0.100	J
Carbazole	0.055	J
Chrysene	0.230	J
Fluoranthene	0.510	
Indeno(1,2,3-cd)pyrene	0.110	J
Phenanthrene	0.270	J
Pyrene	0.400	

Values in **BOLD** are detected.
Units are mg/kg.
J = Data qualifier (see Subsection 3.1.2).

PRS 3-004(c)

Barium, calcium, cobalt, lead, and selenium were carried forward from the background evaluation of inorganics. Radionuclides detected in asphalt (plutonium-239, uranium-234, uranium-235 and uranium-238) are carried forward, as there is no presumed background level for those inorganics or radionuclides in asphalt.

These chemicals and radionuclides were compared to their respective SALs in Tables 5.1.11-1 and 5.1.11-2.

Greater than SAL. No chemicals were detected at concentrations greater than their respective SALs.

No SAL. One essential nutrient, calcium, does not have a SAL and was detected at levels greater than background. Calcium is essentially non-toxic and is well within nutritional intake levels.

Less than SAL. Barium, cobalt, lead, selenium, and radionuclides (plutonium-239, uranium-234, uranium-235 and uranium-238) were detected at concentrations less than SAL.

To evaluate multiple chemical effects for this data set, COPCs detected at concentrations less than their SALs were grouped according to their toxicological effects (carcinogenic effects of radionuclides, carcinogenic or noncarcinogenic effects of chemicals). A multiple chemical effect for chemical carcinogens was not needed because none of the chemical COPCs have carcinogenic effects. Sample values for all chemicals and radionuclides were normalized (sample value divided by SAL) and summed as described in the policy document "Risk-Based Corrective Action Process" (Dorries, 1996, 1297). The results of the analysis are shown in Tables 5.1.11-1 and 5.1.11-2. The results of the multiple chemical evaluations are both less than one, indicating that potential adverse human health effects resulting from those chemical or radionuclide exposures are unlikely. Therefore, all chemicals and radionuclides detected at values less than SALs are eliminated as COPCs.

TABLE 5.1.11-1

MULTIPLE CHEMICAL EVALUATION FOR PRS 3-004(c)

BASED ON NONCARCINOGENIC EFFECTS				
CHEMICAL	SAMPLE ID	CONCENTRATION (mg/kg)	SAL (mg/kg)	NORMALIZED VALUE
Barium	0103-97-0280	150	5 300	0.03
Cobalt	0103-97-0279	4.3	4 600	0.0009
Lead	0103-97-0329	11.1	400	0.03
Selenium	0103-97-0275	0.30	380	0.0008
Normalized Sum				0.06

TABLE 5.1.11-2

MULTIPLE RADIONUCLIDE EVALUATION FOR PRS 3-004(c)

RADIONUCLIDE	SAMPLE ID	MAXIMUM ACTIVITY pCi/g	SAL (pCi/g)	NORMALIZED VALUE
Plutonium-239	0103-97-0270	0.034	24	0.001
Uranium-234	0103-97-0272	0.67	13	0.05
Uranium-235	0103-97-0270	0.004	10	0.000
Uranium-238	0103-97-0274	0.64	07	0.01
Normalized Sum				0.07

At the conclusion of this human health screening assessment, there are no chemicals or radionuclides that remain as COPCs at PRS 3-004(c).

PRS 3-004(d)

Calcium, chromium, lead, silver, and zinc were carried forward from the background evaluation of inorganics, and carbazole was carried forward from the evaluation of organics.

These chemicals were compared to their respective SALs in Table 5.1.11-3.

Greater than SAL. No chemicals were detected at concentrations greater than their respective SALs.

No SAL. Calcium is an essential nutrient that does not have a SAL. The detected levels are well within nutritional intake concentrations.

Less than SAL. Carbazole, chromium, lead, silver, and zinc were detected at concentrations less than SAL.

To evaluate multiple chemical effects for this data set, COPCs detected at concentrations less than their SALs were grouped according to their toxicological effects (carcinogenic effects of radionuclides, carcinogenic or noncarcinogenic effects of chemicals). Sample values for all chemicals and radionuclides were normalized (sample value divided by SAL) and summed as described in the policy document "Risk-Based Corrective Action Process," (Dorries, 1996, 1297). The results of the analysis are shown in Table 5.1.11-3. The results of the multiple chemical evaluations are both less than one, indicating that potential adverse human health effects resulting from these chemical exposures are unlikely. Therefore, all chemicals detected at values less than SALs are eliminated as COPCs.

TABLE 5.1.11-3

MULTIPLE CHEMICAL EVALUATION FOR PRS 3-004(d)

BASED ON NONCARCINOGENIC EFFECTS				
CHEMICAL	SAMPLE ID	CONCENTRATION (mg/kg)	SAL[a] (mg/kg)	NORMALIZED VALUE
Carbazole	0103-97-0264	0.055 J[b]	22	0.003
Lead	0103-97-0261	56.6	400	0.14
Silver	0103-97-0261	1.3	380	0.003
Zinc	0103-97-0261	211	23 000	0.009
Normalized Sum				0.2
BASED ON CARCINOGENIC EFFECTS				
CHEMICAL	SAMPLE ID	CONCENTRATION (mg/kg)	SAL (mg/kg)	NORMALIZED VALUE
Chromium	0103-97-0261	33.1	210	0.16
Normalized Sum				0.2

[a] SAL = Screening action level
[b] J = Data qualifier (see Subsection 3.1.2).

At the conclusion of this human health screening assessment, there are no chemicals or radionuclides that remain as COPCs from PRS 3-004(d).

5.1.12 Human Health Risk Assessment

No human health risk assessment was conducted for PRSs 3-004(c,d) because no chemicals were carried forward from the screening assessment.

5.1.13 Preliminary 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 ecological risk assessment at PRSs 3-004(c,d) will be deferred until the site can be assessed as part of the ecological exposure unit methodology currently being developed.

5.1.14 Conclusions and Recommendations

Based on the results of the background comparisons of inorganic chemicals, radionuclides, and organic chemicals, and the risk-based screening assessment, no analytes are retained as COPCs at PRSs 3-004(c,d). PRSs 3-004(c,d) is recommended for NFA based on NFA Criterion 5. *This criterion states that the PRSs have been characterized or remediated in* accordance with current applicable state or federal regulations, and the available data indicate that contaminants of concern are either not present or are present in concentrations that would pose an acceptable level of human health risk under the projected future land use.

5.2 PRS 3-007, Decommissioned Firing Site

PRS 3-007 consists of a decommissioned firing site located within the Sigma Complex. Analytical results from surface and near surface samples indicate that contamination is not present at levels that present an unacceptable level of risk to human health. Based on these results, PRS 3-007 is recommended for NFA.

5.2.1 History

PRS 3-007 is discussed in detail in Subsection 5.22 of the RFI Work Plan for Operable Unit 1114, Addendum 1 (LANL 1995, 1291). PRS 3-007 is located at TA-3 within the Sigma Complex and consists of a decommissioned firing site. The site includes two structures, TA-3-159, *a containment building for explosive experiments, and TA-3-160, a personnel safety barrier.* From 1970 to 1975 approximately 50–75 explosive shot experiments were detonated within TA-3-159. After each shot, the building was rinsed out with water and the water was allowed to drain outside through a gap between the floor and wall. The site was cleaned in the late 1970s, with no HE detected. In the mid-1980s, TA-3-159 was modified to serve as a storage building for thorium oxide and thorium. Both thorium oxide and thorium were containerized within the building. Potential contamination for PRS 3-007 includes thorium, metals, and HE.

5.2.2 Description

PRS 3-007 is located within the security fence at the Sigma Complex. Wash down water from structure TA-3-159 was allowed to drain directly to the surrounding soil. Small erosion channels were noted draining the site towards Mortandad Canyon. Sample sites were biased at the drainage paths. For further information, refer to Section 2.0 of this report.

5.2.3 Previous Investigation

The firing site was cleaned up in the late 1970s, with no HE contamination detected. However, no formal documentation of the clean-up criteria has been found (Mitchell 1993, 17-947).

5.2.4 Field Investigations

The conceptual model for PRS 3-007 assumes that inhalation, ingestion, and dermal contact with soil and surficial contaminants are the primary exposure pathways. The objective of the RFI was to determine the nature and extent of contamination, if any, associated with each PRS.

Field activities were conducted in July 1997 in accordance with the RFI Work Plan for OU 1114, Addendum 1 (LANL 1996, 1201). As discussed in Section 1.3, field activities included a site survey, geodetic survey, field screening, and sample collection. Details of the field activities are presented below.

Field Screening. Radiological and organic vapor field screening was performed during sampling activities as described in Section 1.3. All radiological field screening results were at or below the average background radiological levels for the site with the exception of location 03-03313, which exhibited beta readings slightly above background. Organic vapor monitoring was performed using a PID to monitor samples and the workers' breathing zone. All organic vapor screening results for this site were 0.0 ppm.

Surface and Subsurface Sampling. Based on site drainage and topography, four biased locations were selected (Location IDs 03-03311 through 03-03314) for sampling at PRS 3-007 (Fig. 5.2.4-1). One collocated site (Location ID 03-03315) was also sampled. Samples were collected from the 0- to 12-in. interval using a hand auger. Sample media consisted of a dry, medium brown, crushed tuff underlain by brown, clayey soil. In addition to the standard analytical suite for this PRS, the sample collected from Location ID 03-03313 was submitted for fixed laboratory analysis of gross alpha and beta radiation and gamma spectroscopy after exhibiting slightly elevated field screening readings. Sampling information is summarized in Table 5.2.4-1.

Deviations

- The number of sample locations was reduced for this PRS after a statistical re-evaluation of the 1995 sampling and analyses plan (SAP) was completed. The SAP was reassessed to determine what improvements could be made by implementing lessons learned during sampling events since the 1995 SAP was prepared.

  Originally the 1995 SAP proposed six samples be collected adjacent to building TA-3-159, because rinse water would have flowed from gaps between the concrete floors and walls to the surrounding soil. However, after re-evaluating the SAP, statisticians suggested reducing the number of samples to four, but biasing the locations based on the site survey. Collecting samples from four biased locations in drainage pathways provided equal probability of detecting contaminants as collecting samples from the six samples proposed in the 1995 SAP. Biasing sample locations is effective at detecting releases and quantifying concentrations of releases while minimizing resource expenditures.

TABLE 5.2.4-1

SUMMARY OF SAMPLES COLLECTED AT PRS 3-007

LOCATION ID	SAMPLE ID	DEPTH (in.)	MEDIA	GROSS ALPHA, BETA & GAMMA	ISOTOPIC THORIUM	VOCs	SVOCs	HE	METALS
				REQUEST NUMBER					
03-03311	0103-97-0221	0-12	soil	N/A[a]	3411R	3408R	3408R	3409R	3410R
03-03312	0103-97-0222	0-12	soil	N/A	3411R	N/A	3408R	3409R	3410R
03-03313	0103-97-0223	0-12	soil	3426R	3411R	N/A	3408R	3409R	3410R
03-03314	0103-97-0224	0-12	soil	N/A	3411R	3408R	3408R	3409R	3410R
03-03315	0103-97-0225	0-12	soil	N/A	3411R	3408R	3408R	3409R	3410R

[a] N/A = Not analyzed.

5.2.5 Evaluation of Inorganics

Five samples collected at PRS 3-007 were analyzed for TAL metals. These five samples were collected from a soil and fill mixture that was used as backfill around the building. Each inorganic result was compared to the all soil data background screening value (Longmire et al. 1995, 1142 and 1266).

One inorganic, copper, was detected above background screening values in at least one sample. Further background comparisons were not performed for copper. The number of background site metals samples are inadequate to support other statistical tests due to an insufficient frequency of detects. Therefore, copper is carried forward to the human health screening assessment. The data for each sample that had at least one concentration above the background screening value for copper are shown in Table 5.2.5-1.

5.2.6 Evaluation of Radionuclides

Five samples collected at PRS 3-007 were analyzed for isotopic thorium. These five samples were collected in soil. One of these samples was also analyzed by gamma spectroscopy.

EQLs and minimum detectable activities are often not available for radionuclides by gamma spectroscopy. 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 employed in the same manner as a detection limit. This methodology is similar to Currie's method of determining radionuclide maximum detectable activity (Currie 1968, 0792). This 3-sigma screening value takes into account variability due to counting statistics, but does not account for spectral peak identification problems. Thus, the 3-sigma screening is conservative, and may include radionuclides whose presence is spuriously reported due to spectral interferences or misidentifications. Thirty-three radionuclides were eliminated from further consideration based on this criteria.

Potassium-40 is a naturally occurring radionuclide that is also routinely reported by the analyst because it is used as an internal standard to measure such things as equipment performance, and laboratory background (or contamination). There is no process knowledge of the use of potassium-40 at TA-3, and reported concentrations are generally within known background ranges for potassium-40 (Longmire et al. 1995, 1142 and 1266). Therefore, potassium-40 will not be considered further.

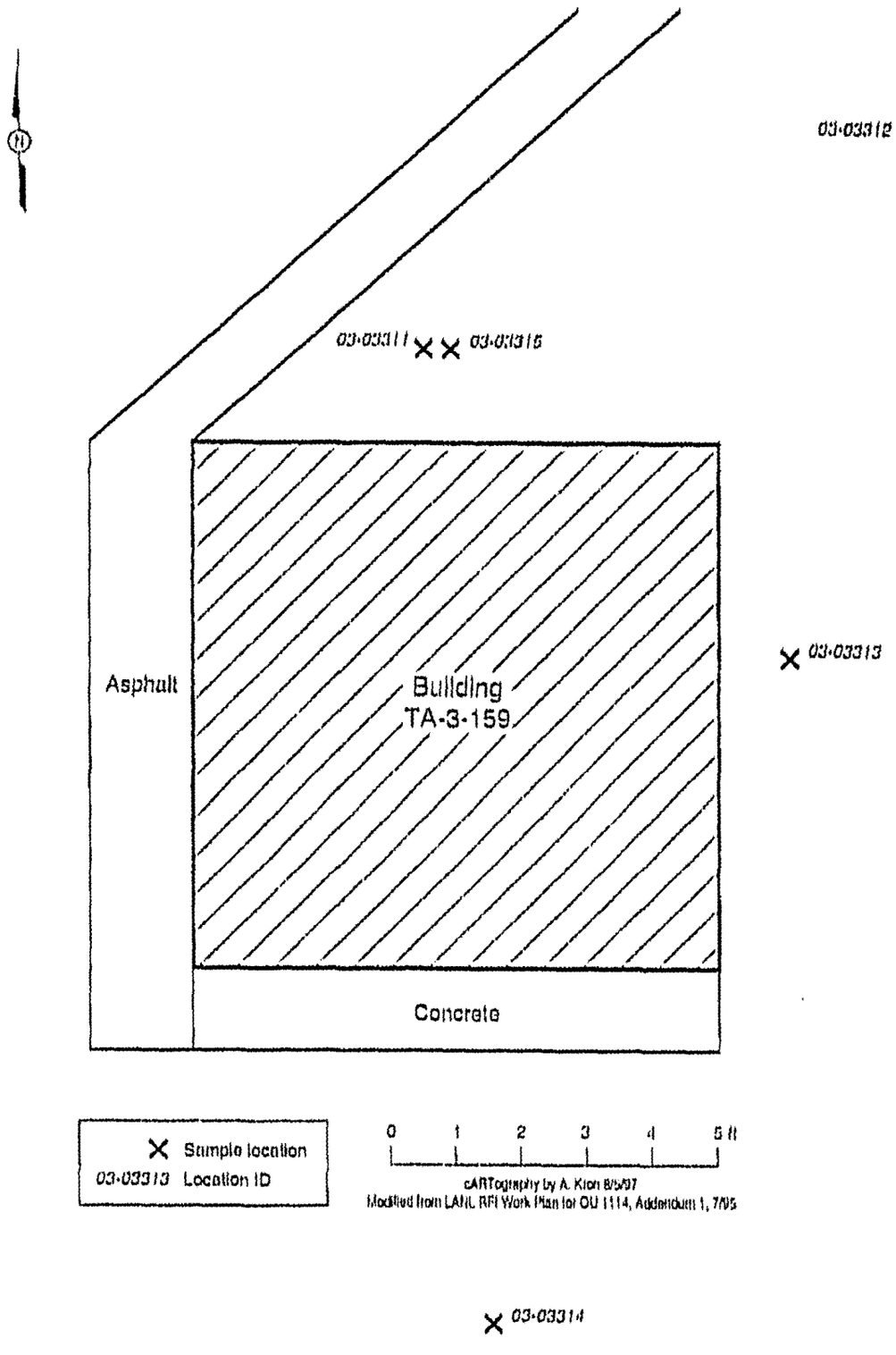


Fig. 5.2.4-1 Locations of samples collected at PRS 3-007.

TABLE 5.2.5-1

INORGANIC CHEMICALS WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT PRS 3-007

SAMPLE ID	ALL SOIL DATA UTL	0103-97-0225
Analyte		
Copper	15.5	**31.6**

Values in BOLD are above the background screening value (see Subsection 3.2.1).
Units are in mg/kg.

Because the LANL-wide background soil data do not include isotopic thorium measured by alpha spectroscopy, the LANL sediment background data was used as a surrogate background data set. This substitution of the sediment background data in such cases is recommended in the radionuclide background policy paper (Environmental Restoration Project Decision Support Council and Earth Science Council 1997, 1414). The sediment background data represents a reasonably conservative background for the mixture of fill with soil sampled at this PRS. None of the site isotopic thorium values exceeded the sediment background UTLs (the highest isotopic thorium value overall was 1.37 pCi/g, measured for thorium-232, which is far less than the sediment UTL of 2.33 pCi/g). Thus, isotopic thorium is eliminated from further consideration.

Table 5.2.6-1 presents the detected radionuclides reported by gamma spectroscopy. These detected radionuclides are short-lived daughters of uranium or thorium, with the exception of cesium-137. Table 5.2.6-1 presents a quantitative evaluation for most of these nuclides by comparing the detected quantities to a background UTL. For all cases where a quantitative comparison to the UTL is possible, the detected quantity is less than the UTL. For the remaining isotopes (bismuth-211, bismuth-212, and radium-224), the detected activity is consistent with the expected secular equilibrium concentrations for these uranium daughters. If, for some reason, these nuclides were not in secular equilibrium with a parent radionuclide, their short half-lives would assure their rapid natural removal from the environment. Thus, none of these radionuclides will be carried forward for further evaluation.

TABLE 5.2.6-1

RADIONUCLIDES DETECTED FROM GAMMA SPECTROSCOPY ANALYSIS FROM SAMPLES COLLECTED AT PRS 3-007

SAMPLE ID	HALF-LIFE	BACKGROUND UTL	0103-97-0223
Analyte			
Bismuth-211	2.1 minutes	n/a[a]	1.30
Bismuth-212	60.6 minutes	n/a	1.25
Bismuth-214	19.9 minutes	1.61[b]	0.67
Cesium-137	30.2 years	1.05[c]	0.08
Lead-212	10.6 hours	2.30[b]	0.8
Lead-214	26.8 minutes	1.97[b]	0.73
Radium-224	3.6 days	n/a	1.52
Thallium-208	3.1 minutes	0.900[b]	0.75

[a] n/a = Not available.
[b] Sediment background UTL
[c] Surface UTL for fallout radionuclides
Units are in pCi/g.

5.2.7 Evaluation of Organic Chemicals

Five samples collected at PRS 3-007 were analyzed for a suite of SVOCs and HE. Three of these samples were also analyzed for a suite of VOCs.

One organic was detected in these samples. The data for each sample that had at least one detected concentration of benzoic acid are presented below in Table 5.2.7-1. Benzoic acid is carried forward to the human health screening assessment.

TABLE 5.2.7-1

DETECTED ORGANIC CONCENTRATIONS AT PRS 3-007

SAMPLE ID	0103-97-0223	
Analyte		
Benzoic Acid	0.710	J[a]

Units are mg/kg.
[a] J = Data qualifier (see Subsection 3.1.2)

The qualifier in Table 5.2.7-1 has been assigned during data validation. However, the data are usable for site-specific decisions. The J qualifiers in sample 0103-97-0223 was assigned to indicate that the results were reported between the method detection limit and the EQL, and are estimated values. This organic is still considered detected and is further evaluated in the human health screening assessment.

5.2.8 Risk-Based Screening Assessment for PRS 3-007

This subsection discusses the comparison with SALs for COPCs detected at levels greater than background screening levels in the investigation at PRS 3-007, the decommissioned firing site. A screening assessment was conducted on the RFI data for this PRS following methodology presented in "Risk-Based Corrective Action Process," (Dorries 1996, 1297).

The chemicals benzoic acid and copper were carried forward from the background comparison and evaluation of organics. These two COPCs were compared to their respective SALs in Table 5.2.8-1.

Greater than SAL. No chemical was detected at concentrations greater than its respective SAL.

Less than SAL. Copper and benzoic acid were detected at concentrations less than their respective SALs.

To evaluate multiple chemical effects for this data set, COPCs detected at concentrations less than their SALs were grouped according to their toxicological effects (carcinogenic effects of radionuclides, carcinogenic or noncarcinogenic effects of chemicals). Because the COPCs at this site do not exhibit carcinogenic effects, only a noncarcinogenic MCE is conducted. The maximum concentrations for all chemicals were normalized (sample value divided by SAL) and summed, as described in the policy document "Risk-Based Corrective Action Process," (Dorries, 1996, 1297). The results of the analysis are less than one, indicating that potential adverse human health effects resulting from these exposures are unlikely (Table 5.2.8-1).

At the conclusion of this human health screening assessment, there are no COPCs retained for PRS 3-007.

5.2.9 Human Health Risk Assessment

No human health risk assessment was conducted for PRS 3-007 because no chemicals were carried forward from the screening assessment.

5.2.10 Preliminary 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 ecological risk assessment at PRS 3-007 will be deferred until the site can be assessed as part of the ecological exposure unit methodology currently being developed.

TABLE 5.2.8-1

MULTIPLE CHEMICAL EVALUATION FOR PRS 3-007

BASED ON NONCARCINOGENIC EFFECTS				
CHEMICAL	SAMPLE ID	CONCENTRATION (mg/kg)	SAL (mg/kg)	NORMALIZED VALUE
Benzoic Acid	0103-97-0223	0.71 J[a]	10 000	0.00007
Copper	0103-97-0225	31.5	2 800	0.01
NORMALIZED SUM				0.01

[a] J = Data qualifier (see Subsection 3.1.2).

5.2.11 Conclusions and Recommendations

Based on the results of the evaluations of inorganic chemicals, radionuclides, and organic chemicals, and the risk-based screening assessment, no analytes are retained as COPCs at PRS 3-007. PRS 3-007 is recommended for NFA based on NFA Criterion 5. This criterion states that the PRS has been characterized or remediated in accordance with current applicable state or federal regulations, and the available data indicate that contaminants of concern are either not present or are present in concentrations that would pose an acceptable level of human health risk under the projected future land use.

5.3 PRS 3-014(k,l,o), Sludge Drying Beds

PRSs 3-014(k,l) consist of two of the four upper sludge drying beds and PRS 3-014(o) consists of the three lower sludge drying beds at the TA-3 decommissioned waste water treatment plant. Based on analytical results, PRSs 3-014(k,l,o) are recommended for NFA.

5.3.1 History

PRSs 3-014(k,l,o) are discussed in detail in the "RFI Report for 53 Potential Release Sites in TAs 3, 59, 60, 61," (Environmental Restoration Project 1996, 1352). The upper drying beds, PRSs 3-014(k,l), were in use from 1964 to 1992. The lower beds, PRS 3-014(o), were used from the early 1980s to 1992, when the Sanitary Waste Consolidation System came on line. All beds received sludge from the waste water treatment plant, which received sanitary waste from TA-3. Potential contamination for PRSs 3-014(k,l,o) includes VOCs, SVOCs, pesticides/PCBs, herbicides, radionuclides, and metals.

5.3.2 Description

PRSs 3-014(k,l) are unlined sludge drying beds dug directly into the tuff. The 3-ft-high soil berms separating the beds are covered with 2 in. of asphalt. The asphalt is broken and cracked

In various places exposing the underlying soil/tuff. PRS 3-014(o) consists of three polypropylene-lined sludge drying beds dug directly into the tuff. The berms separating the beds are covered with asphalt and are in very good condition. For further information, refer to Section 2.0 of this report.

5.3.3 Previous Investigation

From 1990 to 1992, dry sludge from PRSs 3-014(k,l,m,n,o) sludge beds was field screened for radioactivity and analyzed at a contract laboratory for hazardous components [including toxicity characteristic leaching procedure (TCLP) and total metals, VOCs, SVOCs, herbicides, and pesticides] before disposal. Alpha/beta screening results were less than 25 pCi/g and gamma results ranged from 0.24 to 0.89 pCi/g. All analyzed metals were below regulatory limits (40 CFR 261 and 503). Herbicides, pesticides, VOCs, and SVOCs were below the detection limits. An associated Phase I RFI investigation was completed in 1994 at the TA-3 waste water treatment plant to characterize the most likely release areas along outfalls and storm drain trenches leading into Sandia Canyon. Metals, PCBs, and radionuclides exceeded background UTLs, and lead exceeded SALs. A Phase II RFI will be performed at PRS 3-014(c2), the outfall associated with PRSs 3-014(k,l,o) to determine extent of contamination at the outfall and storm drain areas.

5.3.4 Field Investigations

The conceptual model for PRSs 3-014(k,l,o) assumes that inhalation, ingestion and dermal contact with soil and sludge are the primary exposure pathways. The objective of the RFI was to determine the nature and extent of contamination, if any, associated with each PRS.

Field activities were conducted in July 1997 in accordance with the "RFI Report for 53 Potential Release Sites in TAs 3, 59, 60, and 61," (Environmental Restoration Project 1996, 1352). As discussed in Section 1.3, field activities included a site survey, geodetic survey, field screening, and sample collection. Details of the field activities are presented below.

Field Screening. Radiological and organic vapor field screening was performed during sampling activities as described in Section 1.3. All radiological field screening results were at or below the average background radiological levels for the site. Organic vapor monitoring was performed using a PID to monitor samples and the workers' breathing zone. All organic vapor screening results for these sites were 0.0 ppm.

Surface and subsurface sampling. Based on typical settling and deposition processes, one biased location was selected for sampling at each bed for PRSs 3-014(k,l), and three biased

locations (one per bed) were selected for sampling at PRS 3-014(o) (Fig. 5.3.4-1). At PRS 3-014(k) and two beds at PRS 3-014(o), samples were collected from locations near the inlet pipes on the south sides of the drying beds (Location IDs 03-03264, 03-03203, and 03-03205) while samples from PRS 3-014(l) and one bed at PRS 3-014(o) were collected from the middle of the drying beds (Location IDs 03-03265 and 03-03204). Three samples were collected from each location; one from filter material within the bed and two successive one-foot intervals (in tuff) beneath the bed. The material within each bed consisted of non-cohesive silty sand, which required a spade and scoop for sampling. The depth of this material was 12 and 14 in. below ground surface (bgs) at PRSs 3-014 (k,l), and ranged from 6 to 10 in. bgs at PRS 3-014(o). Within each bed, the sand was underlain by a gravel layer (6 to 12 in. thick); additionally, a polypropylene liner was present beneath the gravel layer at PRS 3-014(o). Samples were collected beneath each bed using a hand auger and consisted of pinkish-gray to medium-gray, competent tuff. Sampling information is summarized in Table 5.3.4-1.

Deviations.

- The number of sample locations was reduced for this PRS after a statistical re-evaluation of the 1995 SAP was completed. The SAP was re-evaluated to determine if improvements could be made by implementing lessons learned during sampling events occurring after the 1995 SAP was prepared.

  One sample location per bed, instead of the originally proposed two locations in the 1995 SAP, is considered to be adequate to detect contamination if it exits. One location will provide equal probability of finding contamination because of the expected uniform distribution of potential contamination from the deposition and settling process of the sludge and associated waste water.

  The sludge was applied over a filter material consisting of a 1 ft layer of medium grain sand and a 9 inch layer of pea gravel (thickness' are approximate) and the waste water drained through the filter material towards the bottom of the bed. The bottom of the bed is designed in a gentle sloping "V" pattern to drain the waste water towards the center of the bed and into a perforated drain pipe leading to the Imhoff tank (see Fig. 5.3.4-1). This sampling strategy has proven effective at detecting releases at other sludge drying beds and quantifying concentrations of releases while minimizing resource expenditures.

- The original work plan called for samples to be collected from two intervals: the soil/tuff interface, and the horizon (or interval) directly below the soil/tuff interface. Additionally, a third sample was collected from each sample location from the sandy media within each sludge bed to provide waste characterization data.

- PRS 3-014(m) was sampled as part of this RFI; however, analyses indicate further action will have to be completed at this site. Analytical results from the RFI effort for PRS 3-014(m) will be included in a future VCA report.

- PRS 3-014(n), the eastern upper bed, was also scheduled for sampling under this RFI; however, oil was discovered in the bed. The oil spill was reported to the LANL Environment, Safety and Health (ESH) Division. ESH reported the spill to the appropriate LANL groups and regulatory agencies. The user group had responsibility for sampling and clean up of this PRS. The PRS was remediated in early September of 1997. Confirmatory sample analyses results will be included in a future RFI report.

Background Comparison Sections

Data from each PRS were evaluated separately for comparison to background. The analyses are presented in Subsections 5.3.5 through 5.3.13 below.

5.3.5 Evaluation of Inorganics for PRS 3-014(k)

Three samples collected at PRS 3-014(k) were analyzed for TAL metals. One sample was collected in soil. The other two samples were collected in Unit 4 of the Tshirege Member of the Bandelier Tuff. Each inorganic result was compared to the appropriate background screening value (Longmire et al. 1995, 1142 and 1266).

Two inorganics (mercury and silver) were detected above background screening values in at least one soil sample. Six inorganics (arsenic, chromium, copper, nickel, silver, and zinc) were detected above background screening values in at least one Unit 4 sample. Further background comparisons were not performed for these metals. The number of background site samples for these metals are inadequate to support other statistical tests because of an insufficient frequency of detects. Therefore, arsenic, chromium, copper, mercury, nickel, silver, and zinc are carried forward to the human health screening assessment. The data for each sample that had at least one concentration above the background screening value for these seven inorganics are shown in Table 5.3.5-1.

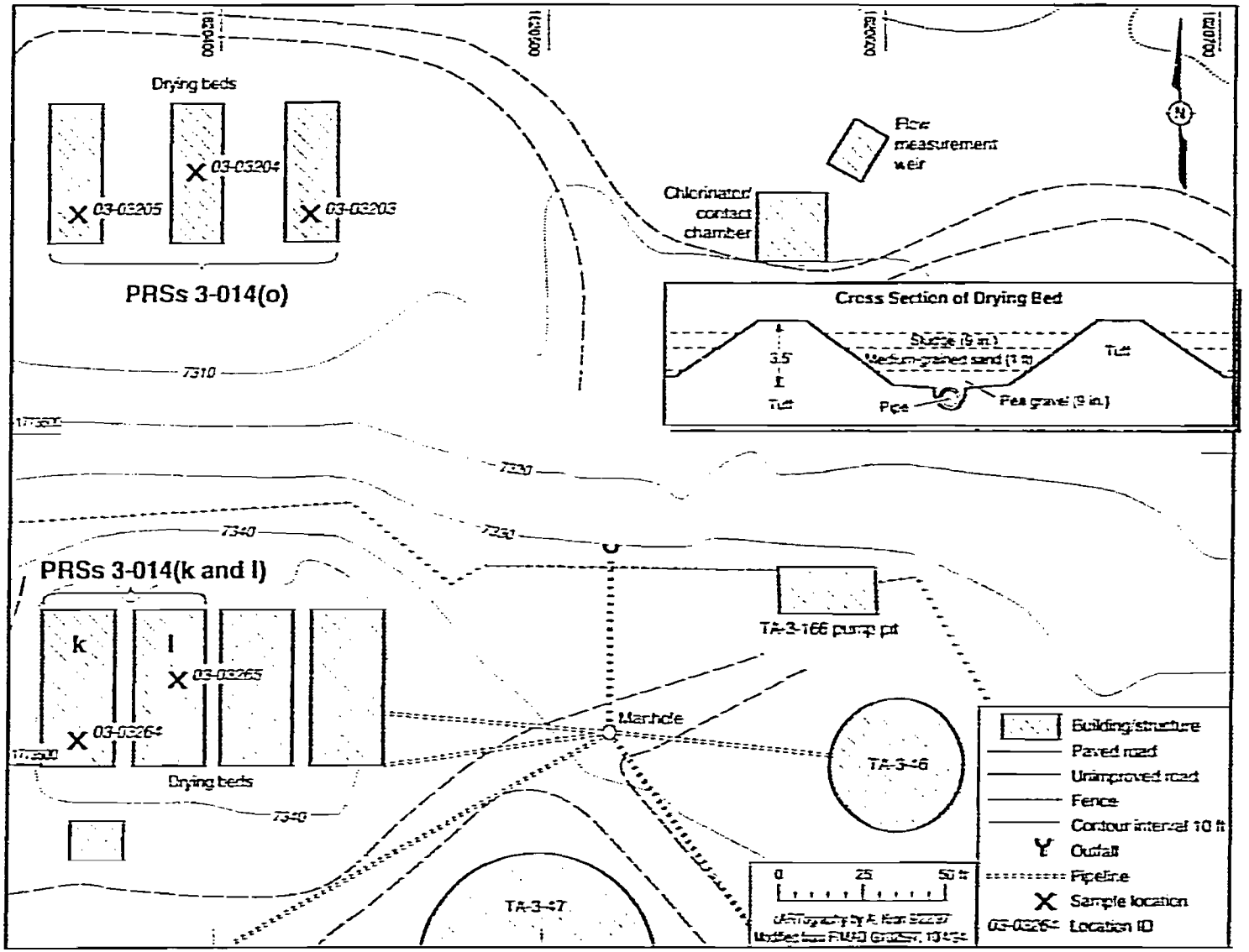


Fig. 5.3.4-1 Locations of samples collected at PRSs 3-014(k,l,o).

TABLE 5.3.4-1

SUMMARY OF SAMPLES COLLECTED AT PRSs 3-014(k,l,o)

PRS #	LOCATION ID	SAMPLE ID	DEPTH (ft.)	MEDIA	HERBICIDES, PESTICIDES & PCBs	RADIONUCLIDES[a]	VOCs	SVOCs	METALS
					REQUEST NUMBER				
3-014(k)	03-03204	0103-97-0011	0-12	soil	3375R	3377R	N/A[b]	3375R	3376R
3-014(k)	03-03204	0103-97-0012	16-28	tuff	3375R	3377R	N/A	3375R	3376R
3-014(k)	03-03204	0103-97-0013	28-40	tuff	3375R	3377R	3375R	3375R	3376R
3-014(l)	03-03205	0103-97-0014	0-14	soil	3375R	3377R	N/A	3375R	3376R
3-014(l)	03-03205	0103-97-0015	20-32	tuff	3375R	3377R	N/A	3375R	3376R
3-014(l)	03-03205	0103-97-0016	32-44	tuff	3375R	3377R	3375R	3375R	3376R
3-014(o)	03-03203	0103-97-0024	0-8	soil	3444R	3446R	N/A	3444R	3445R
3-014(o)	03-03203	0103-97-0025	18-30	tuff	3444R	3446R	N/A	3444R	3445R
3-014(o)	03-03203	0103-97-0026	30-42	tuff	3444R	3446R	3444R	3444R	3445R
3-014(o)	03-03204	0103-97-0027	0-10	soil	3444R	3446R	N/A	3444R	3445R
3-014(o)	03-03204	0103-97-0028	21-33	tuff	3444R	3446R	N/A	3444R	3445R
3-014(o)	03-03204	0103-97-0029	33-45	tuff	3444R	3446R	3444R	3444R	3445R
3-014(o)	03-03205	0103-97-0030	0-9	soil	3444R	3446R	N/A	3444R	3445R
3-014(o)	03-03205	0103-97-0031	15-27	tuff	3444R	3446R	N/A	3444R	3445R
3-014(o)	03-03205	0103-97-0032	27-39	tuff	3444R	3446R	3444R	3444R	3445R

[a] Radionuclides include tritium, isotopic plutonium, isotopic uranium, and strontium 90.
[b] N/A = Not analyzed.

TABLE 5.3.5-1

INORGANIC CHEMICALS WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT PRS 3-014(k)

SAMPLE ID	ALL SOIL DATA UTL	0103-97-0011	UNIT 4 UTL	0103-97-0012		0103-97-0013	
ANALYTE							
Arsenic	2.18	0.6	2.18	1.4		2.3	
Chromium	19.3	10.1	10.9	19.3		24	
Copper	15.5	10	6.43	4.6		6.9	
Mercury	0.1[a]	0.16	n/a[b]	0.056	U[c]	0.052	U
Nickel	15.2	3.8	8.73	8.6		11.9	
Silver	n/a	2.7	n/a	0.60		0.57	
Zinc	60.8	21.5	75.4	154		164	

Values in BOLD are above the background screening value (see Subsection 3.2.1).
Units are in mg/kg.
[a] Value represents the maximum reported background concentration in soil.
[b] n/a = Not available. Detection limit is used as a background screening value.
[c] U = Signifies that the analyte was not positively identified in the sample, and the associated value is the sample-specific EQL/EDL (see Subsection 3.1.2).

LA-UR-97-4173

5.3.6 Evaluation of Radionuclides for PRS 3-014(k)

Three samples collected at PRS 3-014(k) were analyzed for isotopic plutonium, isotopic uranium, strontium-90, and tritium. One sample was collected in soil. The other two samples were collected in Unit 4 of the Tshirege Member of the Bandelier Tuff. Each radionuclide result was compared to the appropriate background screening value. Because background screening values are not available for isotopic plutonium, strontium-90, and tritium in Unit 4, the minimum detectable activity was used as a background screening value.

When minimum detectable activities are not reported, 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 employed in the same manner as a detection limit. This methodology is similar to Currie's method of determining radionuclide maximum detectable activity (Currie1968, 0792).

Isotope Plutonium, strontium-90, and tritium were not detected in any sample. Therefore, no radionuclides are carried forward to the human health screening assessment.

5.3.7 Evaluation of Organic Chemicals for PRS 3-014(k)

Three samples collected at PRS 3-014(k) were analyzed for a suite of SVOCs. One of these samples were also analyzed for a suite of VOCs. One sample was collected in soil. The other two samples were collected in Unit 4 of the Tshirege Member of the Bandelier Tuff.

No organics were detected in these samples. Therefore, no organics are carried forward to the human health screening assessment.

5.3.8 Evaluation of Inorganics for PRS 3-014(l)

Three samples collected at PRS 3-014(l) were analyzed for TAL metals. One sample was collected in soil. The other two samples were collected in Unit 4 of the Tshirege Member of the Bandelier Tuff. Each inorganic result was compared to the appropriate background screening value (Longmire et al. 1995, 1142 and 1266).

Three inorganics (copper, mercury, and silver) were detected above background screening values in at least one soil sample. Three inorganics (chromium, mercury, and silver) were detected above background screening values in at least one Unit 4 sample. Further background comparisons were not performed for these metals because the number of background site samples for these metals are inadequate to support other statistical tests due to an insufficient frequency of detects. Therefore, chromium, copper, mercury, and silver, are carried forward to the human health screening assessment. The data for each sample that had at least one concentration above the background screening value for these four inorganics are shown in Table 5.3.8-1.

TABLE 5.3.8-1

INORGANIC CHEMICALS WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT PRS 3-014(l)

SAMPLE ID	SOIL UTL	0103-97-0014	Unit 4 UTL	0103-97-0015	0103-97-0016	
ANALYTE						
Chromium	19.3	13.1	10.0	9.7	11.4	
Copper	16.6	**30**	6.43	4.7	3.6	
Mercury	0.1[a]	0.15	n/a[b]	0.057	0.048	U[c]
Silver	n/a	5.7	n/a	0.68	0.5	U

Values in BOLD are above the background screening value (see Subsection 3.2.1).
Units are in mg/kg.

[a] Value represents the maximum reported background concentration in soil.
[b] n/a = Not available. Detection limit is used as a background screening value.
[c] U = Signifies that the analyte was not positively identified in the sample, and the associated value is the sample-specific EQL/EDL (see Subsection 3.1.2).

LA-UR-98-4494

5.3.9 Evaluation of Radionuclides for PRS 3-014(l)

Three samples collected at PRS 3-014(l) were analyzed for isotopic uranium, isotopic plutonium, and tritium. One sample was collected in soil. The other two samples were collected in Unit 4 of the Tshirege Member of the Bandelier Tuff. Each radionuclide result was compared to the appropriate background screening value. Because background screening values are not available for some radionuclides in Unit 4, the minimum detectable activity was used as a background screening value.

When minimum detectable activities are not reported, 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 employed in the same manner as a detection limit. This methodology is similar to Currie's method of determining radionuclide maximum detectable activity (Currie1988, 0792).

Tritium was detected in two Unit 4 samples. Therefore, tritium is carried forward to the human health screening assessment. The data for each sample that had at least one concentration above the minimum detectable activity for tritium are shown in Table 5.3.9-1.

TABLE 5.3.9-1

RADIONUCLIDES WITH CONCENTRATIONS EXCEEDING MINIMUM DETECTABLE ACTIVITY AT PRS 3-014(l)

SAMPLE ID	0103-97-0015	0103-97-0016
ANALYTE		
Tritium	0.04	0.04

Values in **BOLD** are above the minimum detectable activity (see Subsection 3.2.2).
Units are in pCi/g.

5.3.10 Evaluation of Organic Chemicals for PRS 3-014(l)

Three samples collected at PRS 3-014(l) were analyzed for a suite of SVOCs. One of these samples was also analyzed for a suite of VOCs. One sample was collected in soil. The other two samples were collected in Unit 4 of the Tshirege Member of the Bandelier Tuff.

Two organics were detected in these samples. The data for each sample that had at least one detected concentration of these organic chemicals are presented below in Table 5.3.10-1. Aroclor 1254 and toluene are carried forward to the human health screening assessment.

TABLE 5.3.10-1

DETECTED ORGANIC CONCENTRATIONS AT PRS 3-014(l)

SAMPLE ID	0103-97-0014		0103-97-0016	
ANALYTE				
Aroclor 1254	0.078	U[a]	0.037	U
Toluene	N/A[b]		0.004	J[c]

Values in BOLD are detected organics.
Units are mg/kg.
[a] U = Signifies that the analyte was not positively identified in the sample, and the associated value is the sample-specific EQL/EDL (see Subsection 3.1.2).
[b] N/A = Not analyzed.
[c] J = Data qualifier (see Subsection 3.1.2).

The qualifiers in Table 5.3.10-1 were assigned during data validation. However, the data are usable for site-specific decisions. The J qualifier in sample 0103-97-0016 was assigned to indicate that the results were reported between the method detection limit and the EQL and is an estimated value. This organic is still considered detected and is further evaluated in the human health screening assessment.

5.3.11 Evaluation of Inorganics for PRS 3-014(o)

Nine samples collected at PRS 3-014(o) were analyzed for TAL metals. Three sample were collected in soil. The other six samples were collected in Unit 3 of the Tshirege Member of the Bandelier Tuff. Each inorganic result was compared to the appropriate background screening value (Longmire et al. 1995, 1142 and 1266).

Six inorganics (chromium, copper, lead, mercury, silver, and zinc) were detected above background screening values in at least one soil sample. Four inorganics (chromium, copper, mercury, and nickel) were detected above background screening values in at least one Unit 3 sample. Further background comparisons were not performed for these metals. The background site data for these metals are inadequate to support other statistical tests due to an insufficient frequency of detects. Therefore, chromium, copper, lead, mercury, nickel, silver, and zinc are carried forward to the human health screening assessment. The data for each sample that had at least one concentration above the background screening value for these nine inorganics are shown in Tables 5.3.11-1 and 5.3.11-2.

TABLE 5.3.11-1

INORGANIC CHEMICALS WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES IN SOIL AT PRS 3-014(o)

SAMPLE ID	ALL SOIL UTL	0103-97-0024		0103-97-0027		0103-97-0030	
ANALYTE							
Chromium	19.3	40.6	J+[a]	14.3	J+	136	J+
Copper	15.5	46.8		18.8		122	
Lead	23.3	17.1		5.90		46.1	
Mercury	0.1	1.43		0.22		3.8	
Nickel	15.2	4.9		5.2		11.4	
Silver	n/a[b]	19.7		0.48		71.3	
Zinc	50.8	53.7		29		131	

Values in BOLD are above the background screening value (see Subsection 3.2.1).
Units are in mg/kg.
[a] J+ = Data qualifier (see Subsection 3.1.2).
[b] n/a = Not available. Detection limit is used as a background screening value.

TABLE 5.3.11-2

INORGANIC CHEMICALS WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES IN TUFF AT PRS 3-014(o)

SAMPLE ID	UNIT 3 UTL	0103-97-0025		0103-97-0026		0103-97-0028		0103-97-0029		0103-97-0031		0103-97-0032	
ANALYTE													
Chromium	2.1	12.8	J+[a]	9.88	J+	8.60	J+	12	J+	25	J+	19.2	J+
Copper	2	5.04		1.3		1.28		1.05		2.94		0.768	
Lead	18.2	3.05		2.29		2.46		2.12		1.46		1.26	
Mercury	n/a[b]	0.06		0.02	U[c]	0.02	U	0.02	U	0.033		0.02	U
Nickel	2.8	0.7		5.29		0.41		0.41		11.4		10.1	
Silver	1.9	1.34		0.479	U	0.486	U	0.509	U	1.13		0.482	U
Zinc	59	19.1		17.4		14.8		14.8		20.8		16.7	

Values in BOLD are above the background screening value (see Subsection 3.2.1).
[a] J+ = Data qualifier (see Subsection 3.1.2).
[b] n/a = Not available. Detection limit is used as a background screening value.
[c] U = Signifies that the analyte was not positively identified in the sample, and the associated value is the sample-specific EQL/EDL (see Subsection 3.1.2).

The qualifiers in Tables 5.3.11-1 and 5.3.11-2 were assigned during data validation. However, the data are usable for site-specific decisions. As discussed in Section 4.1 (Inorganic Analyses), the J+ qualifiers for chromium were assigned because chromium had high recoveries in the matrix spike sample. To address this problem, post-digestion spikes were performed for chromium, and these recoveries were within the limits allowed in USEPA SW846 guidelines. The J+ qualifiers indicate that results may be biased high. Because chromium is still detected above its background screening value, it is further evaluated in the human health screening assessment.

5.3.12 Evaluation of Radionuclides for PRS 3-014(o)

Nine samples collected at PRS 3-014(o) were analyzed for isotopic uranium, isotopic plutonium, strontium-90, and tritium. Three samples were collected in soil. The other six samples were collected in Unit 3 of the Tshirege Member of the Bandelier Tuff. Each radionuclide result was compared to the appropriate background screening value.

Minimum detectable activities were not reported for these data, so a value of three times the measurement uncertainty (3 sigma or three standard deviations) was used to calculate a sample-specific minimum detectable activity, which was then employed in the same manner as a detection limit. This methodology is similar to Currie's method of determining radionuclide maximum detectable activity (Currie1968, 0792).

Plutonium-239, strontium-90, tritium, uranium-234, and uranium-235 were all detected above background in at least one soil sample. Plutonium-239 and strontium-90 were also detected above the sample specific minimum detectable activity in the Unit 3 samples. Therefore, these five radionuclides are carried forward to the human health screening assessment.

The data for each sample that had at least one concentration of plutonium-239, strontium-90, tritium, uranium-234, or uranium-235 above background for soils and above the sample specific minimum detectable activity for Unit 3, are shown in Table 5.3.12-1.

5.3.13 Evaluation of Organic Chemicals for PRS 3-014(o)

Nine samples collected at PRS 3-014(o) were analyzed for a suite of SVOCs, volatile organic chemicals, pesticides, PCBs, and herbicides. Three samples were collected in soil, the other seven samples were collected in Unit 3 of the Tshirege Member of the Bandelier Tuff.

Nineteen organics were detected in these samples. The data for each sample that had at least one detected concentration of these organic chemicals are presented in Table 5.3.13-1. The organic chemicals listed in Table 5.3.13-1 are carried forward to the human health screening assessment.

TABLE 5.3.12-1

RADIONUCLIDES WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT PRS 3-014(o)

SAMPLE ID	ALL SOIL DATA UTL	0103-97-0024		0103-97-0030		UNIT 3 UTL		0103-97-0028		0103-97-0031	
Analyte											
Plutonium-239	0.054	0.088		0.131		n/a[a]		0.007	U	0.186	
Strontium-90	1.31	3		8.01		n/a		3.2		-0.25	U
Tritium	0.050[c]	0.734		2.91		n/a	U	-0.036	U	0.064	U
Uranium-234	1.94	1.05		2.68		1.55		0.442		0.447	
Uranium-235	0.084	0.048		0.093		0.067		0.017		0.024	

Values in BOLD are above the background screening value (see Subsection 3.2.2).
Units are in pCi/g.

[a] n/a = Not available. Minimum detectable activity used as a background screening value (see Subsection 3.2.2).
[b] U = Signifies that the analyte was not positively identified in the sample, and the associated value is the sample-specific EQL/EDL (see Subsection 3.1.2).
[c] Background screening value for tritium is based on a background screening value of 0.70pCi/ml, which was converted to pCi/g using the moisture content of the only detected tritium sample at PRS 3-014(o) of 0.9 %.

TABLE 5.3.13-1

DETECTED ORGANIC CONCENTRATIONS AT PRS 3-014(o)

SAMPLE ID	0103-97-0024		0103-97-0027		0103-97-0028		0103-97-0030	
Acenaphthylene	0.34	U[a]	0.34	U	0.37	U	0.34	U
Anthracene	0.34	U	0.34	U	0.37	U	0.056	J[b]
Aroclor-1260	0.693		0.0975		0.015	U	1.22	
Benzo(a)anthracene	0.16	J	0.34	U	0.37	U	0.61	
Benzo(a)pyrene	0.22	J	0.34	U	0.37	U	0.67	
Benzo(b)fluoranthene	0.39		0.34	U	0.37	U	1.3	
Benzo(g,h,i)perylene	0.16	J	0.34	U	0.37	U	0.25	J
Benzo(k)fluoranthene	0.12	J	0.34	U	0.37	U	0.46	
Benzoic Acid	3.4	U	3.4	U	3.7	U	0.15	J
Butylbenzylphthalate	0.34	U	0.34	U	0.37	U	0.036	J
Carbazole	0.34	U	0.34	U	0.37	U	0.036	J
Chrysene	0.26	J	0.34	U	0.37	U	0.66	
Dibenzo(a,h)anthracene	0.34	U	0.34	U	0.37	U	0.074	J
Fluoranthene	0.26	J	0.34	U	0.37	U	0.84	
Ideno(1,2,3-cd)pyrene	0.10	J	0.34	U	0.37	U	0.26	J
MCPA[c]	0.411	U	0.412	U	0.451	U	0.950	J+
MCPP[d]	0.411	U	0.993		0.451		0.408	U
Phenanthrene	0.036	J	0.34	U	0.37	U	0.26	J
Pyrene	0.23	J	0.34	U	0.37	U	0.71	

Values in BOLD are detected.
Units are in mg/kg.

[a] U = Signifies that the analyte was not positively identified in the sample, and the associated value is the sample-specific EQL/EDL (see Subsection 3.1.2).
[b] J, J+ = Data qualifiers (see Subsection 3.1.2).
[c] MCPA: 2-methyl-4-chlorophenoxyacetic acid
[d] MCPP: 2-(2-methyl-4-chlorophenoxy)propionic acid

The qualifiers in Table 5.3.13-1 were assigned during data validation. However, the data are usable for site-specific decisions. As stated in Section 4.3 (Organic Analyses), sample 0103-97-0030 was qualified J+ for 2-methyl-4-chlorophenoxyacetic acid (MCPA) because the surrogate had a high recovery. The J+ qualifier indicates that the result is estimated and may be biased high. Because MCPA is still detected, it is carried forward to the human health screening assessment for further evaluation.

The J qualifiers in samples 0103-97-0024 and 0103-97-0030 were assigned to indicate that the results were reported between the method detection limit and the EQL and are estimated values. These organics are still considered detected and are further evaluated in the human health screening assessment.

5.3.14 Risk-Based Screening Assessment for PRSs 3-014(k,l,o)

This subsection discusses the comparison with SALs for COPCs detected at levels greater than background screening levels. A screening assessment was conducted on the RFI data for PRSs 3-014(k,l,o) following methodology presented in "Risk-Based Corrective Action Process," (Dorries 1996, 1297).

PRS 3-014(k)

The chemicals arsenic, chromium, copper, mercury, nickel, silver, and zinc were carried forward from the background evaluation and evaluation of organics. No radionuclides were carried forward from the background evaluation.

Greater than SAL. No chemical was detected at concentrations greater than its respective SAL.

No SAL. Arsenic does not have a LANL SAL because LANL background concentrations are greater than the risk-based SAL. Because arsenic is greater than background, it would also be greater than a risk-based SAL. Therefore, arsenic is carried forward as a COPC.

Less than SAL. Chromium, copper, mercury, nickel, silver, and zinc were all detected at concentrations less than their respective SALs (Table 5.3.14-1).

To evaluate multiple chemical effects for this data set, COPCs detected at concentrations less than their SALs were grouped according to their toxicological effects (carcinogenic or noncarcinogenic effects of chemicals). The maximum concentrations for all chemicals were normalized (sample value divided by SAL) and summed as described in the policy document

"Risk-Based Corrective Action Process," (Dorries, 1996, 1297). The results of the analysis are shown in Tables 5.3.14-1. The results of the multiple chemical evaluations are each less than one, indicating that potential adverse human health effects resulting from those exposures are unlikely. Therefore, all chemicals detected at values less than SALs are eliminated as COPCs.

TABLE 5.3.14-1

MULTIPLE CHEMICAL EVALUATION FOR PRS 3-014(k)

BASED ON NONCARCINOGENIC EFFECTS				
CHEMICAL	SAMPLE ID	CONCENTRATION (mg/kg)	SAL (mg/kg)	NORMALIZED VALUE
Copper	0103-97-0011	10	2800	0.004
Mercury	0103-97-0011	0.10	23	0.007
Nickel	0103-97-0013	11.9	1500	0.008
Silver	0103-97-0011	2.7	380	0.007
Zinc	0103-97-0013	164	23000	0.007
Normalized Sum				0.06
BASED ON CARCINOGENIC EFFECTS				
CHEMICAL	SAMPLE ID	CONCENTRATION (mg/kg)	SAL (mg/kg)	NORMALIZED VALUE
Chromium	0103-97-0013	24	210	0.11
Normalized Sum				0.1

At the conclusion of this human health screening assessment, only arsenic is carried forward as a COPC for PRS 3-014(k).

Discussion of COPCs

Arsenic was retained as a COPC based on the screening assessment. One sample, 0103-97-0013, at 2.3 mg/kg, exceeded the background concentration of arsenic for Unit 4 (2.18 mg/kg). This concentration is not considered indicative of a potential health risk for the following reasons:

- This sample is located in the tuff beneath the sludge beds. This location is inaccessible for residential land use since it is located on lab property in an area that will remain under the control of LANL.
- The arsenic concentration of 2.3 mg/kg (about 10% greater than the UTL for this unit) is less than the industrial SAL of 2.4 mg/kg. There are no other COPCs that would contribute more than 0.1 to an industrial MCE.

- The area associated with this contamination would be less than 10% of an industrial or residential exposure unit.
- Risks associated with the sitewide background concentrations of arsenic (Section 3.4) are greater than those associated with residential or industrial use of this area.

For these reasons, arsenic will not be retained as a COPC, and there are no COPCs identified for PRS 3-014(k).

PRS 3-014(l)

The chemicals Aroclor 1254, chromium, copper, mercury, and silver, and toluene were carried forward from the background evaluation and evaluation of organics. Tritium was carried forward from the background evaluation of radionuclides.

These seven COPCs were compared to their respective SALs in Tables 5.3.14-3 and 5.3.14-4.

Greater than SAL. No chemical was detected at concentrations greater than its respective SAL.

No SAL. All COPCs have SALs.

Less than SAL. Aroclor 1254, chromium, copper, mercury, silver, toluene, and tritium, were all detected at concentrations less than their respective SALs.

To evaluate multiple chemical effects for this data set, COPCs detected at concentrations less than their SALs were grouped according to their toxicological effects (carcinogenic effects of radionuclides, carcinogenic or noncarcinogenic effects of chemicals). The maximum concentrations for all chemicals were normalized (sample value divided by SAL) and summed as described in the policy document "Risk-Based Corrective Action Process" (Dorries, 1996, 1297). The results of the analysis are shown in Tables 5.3.14-3 and 5.3.14-4. The results of the multiple chemical and radionuclide evaluations are each less than one, indicating that potential adverse human health effects resulting from these exposures are unlikely. Therefore, all chemicals detected at values less than SALs are eliminated as COPCs.

155-05545-4-94

At the conclusion of this human health screening assessment, there are no COPCs for PRS 3-014(l).

PRS 3-014(o)

The chemicals Aroclor-1260, benzoic acid, butyl benzyl phthalate, carbazole, chromium, copper, lead, mercury, MCPA, 4-(2-methyl-4-chlorophenoxy) propionic acid (MCPP), nickel, silver, zinc, and 12 PAHs were carried forward from the background evaluation and evaluation of organics. Plutonium-239, strontium-90, tritium, uranium-234, and uranium-235 were carried forward from the background evaluation of radionuclides.

These COPCs were compared to their respective SALs in Table 5.3.14-5.

Greater than SAL. Aroclor-1260, strontium-90, and PAHs benzo(b)fluoranthene, benzo(a)pyrene, and dibenzo(a,h)anthracene were detected at concentrations greater than their respective SALs as shown in Table 5.3.14-5.

TABLE 5.3.14-3

MULTIPLE CHEMICAL EVALUATION FOR PRS 3-014(l)

BASED ON NONCARCINOGENIC EFFECTS				
CHEMICAL	SAMPLE ID	CONCENTRATION (mg/kg)	SAL (mg/kg)	NORMALIZED VALUE
Copper	0103-97-0014	30	2800	0.01
Mercury	0103-97-0014	0.15	23	0.007
Silver	0103-97-0014	5.7	380	0.02
Toluene	0103-97-0010	0.004 J[a]	700	.000006
Normalized Sum				0.04
BASED ON CARCINOGENIC EFFECTS				
CHEMICAL	SAMPLE ID	CONCENTRATION (mg/kg)	SAL (mg/kg)	NORMALIZED VALUE
Aroclor 1254	0103-97-0014	0.078	0.1	0.78
Chromium	0103-97-0014	13.1	210	0.06
Normalized Sum				0.8

[a] J = Data qualifiers (see Subsection 3.1.2).

TABLE 5.3.14-4

MULTIPLE RADIONUCLIDE EVALUATION FOR PRS 3-014(l)

RADIONUCLIDE	SAMPLE ID	MAXIMUM ACTIVITY (pCi/g)	SAL (pCi/g)	NORMALIZED VALUE
Tritium	0103-97-0015	0.04	200	0.0002
Normalized Sum				0.0002

TABLE 5.3.14-5

COPCS EXCEEDING SAL AT PRS 3-014(c)

CHEMICAL	SAMPLE ID	CONCENTRATION (mg/kg)	SAL (mg/kg)
Aroclor-1260	0103-97-0330	1.22	0.1
Benzo(a)pyrene	0103-97-0030	0.67	0.061
Benzo(b)fluoranthene	0103-97-0030	1.3	0.61
Dibenzo(a,h)anthracene	0103-97-0030	0.074 J[a]	0.061
Strontium-90	0103-97-0030	8.01	4.4

[a] J = Data qualifiers (see Subsection 5.1.2).

Less than SAL The chemicals anthracene, benzo(a)anthracene, benzo(g,h,i)perylene, benzoic acid, benzo(k)fluoranthene, butyl benzyl phthalate, carbazole, chrysene, chromium, copper, fluoranthene, indeno(1,2,3-cd)pyrene, lead, mercury, MCPA, MCPP, nickel, phenanthrene, pyrene, silver, and zinc were all detected at concentrations less than their respective SALs. Radionuclides plutonium-239, tritium, uranium-234, and uranium-235 were also detected at activities less than their respective SALs.

To evaluate multiple chemical effects for this data set, COPCs detected at concentrations less than their SALs were grouped according to their toxicological effects (carcinogenic effects of radionuclides, carcinogenic or noncarcinogenic effects of chemicals). The maximum concentrations for all chemicals were normalized (sample value divided by SAL) and summed as described in the policy document "Risk-Based Corrective Action Process," (Dorries, 1996, 1297). The results of the analysis are shown in Tables 5.3.14-6 and 5.3.14-7. The results of the multiple chemical evaluations for noncarcinogens and radionuclides are each less than one, indicating that potential adverse human health effects resulting from these exposures are unlikely. However, because the carcinogenic MCE exceeds one, all carcinogenic COPCs with a SAL ratio greater than 0.1 will be retained as COPCs. Additionally, because the radionuclide strontium-90 is greater than SAL, the less-than-SAL radionuclide uranium-234 will be retained as a COPC for potential dose additivity.

TABLE 5.3.14-6

MULTIPLE CHEMICAL EVALUATION FOR PRS 3-014(o)

BASED ON NONCARCINOGENIC EFFECTS				
CHEMICAL	SAMPLE ID	CONCENTRATION (mg/kg)	SAL (mg/kg)	NORMALIZED VALUE
Anthracene	0103-97-0030	0.055 J	18 000	0.000003
Benzo(g,h,i)perylene	0103-97-0030	0.25 J	1 900	0.0001
Benzoic Acid	0103-97-0030	0.15 J	100 000	0.000002
Butyl benzyl phthalate	0103-97-0030	0.035 J	13 000	0.000003
Copper	0103-97-0030	122	2 800	0.04
Fluoranthene	0103-97-0030	0.84	2 600	0.0003
Lead	0103-97-0030	45.1	400	0.11
MCPA	0103-97-0030	0.956	33	0.03
MCPP	0103-97-0027	0.093	65	0.02
Mercury	0103-97-0030	3.8	23	0.17
Nickel	0103-97-0030	11.4	1500	0.008
Phenanthrene	0103-97-0030	0.26 J	18 000	0.00001
Pyrene	0103-97-0030	0.71	1 900	0.0004
Silver	0103-97-0030	71.3	380	0.19
Zinc	0103-97-0030	131	23 000	0.006
Normalized Sum				0.6
BASED ON CARCINOGENIC EFFECTS				
CHEMICAL	SAMPLE ID	CONCENTRATION (mg/kg)	SAL (mg/kg)	NORMALIZED VALUE
Benzo(a)anthracene	0103-97-0030	0.51	0.61	0.84
Benzo(k)fluoranthene	0103-97-0030	0.460	6.1	0.075
Carbazole	0103-97-0030	0.030 J	22	0.002
Chromium	0103-97-0030	136	210	0.65
Chrysene	0103-97-0030	0.68	61	0.011
Indeno(1,2,3-cd)pyrene	0103-97-0030	0.25 J	0.61	0.41
Normalized Sum				2.0

TABLE 5.3.14-7

MULTIPLE RADIONUCLIDE EVALUATION FOR PRS 3-014(o)

RADIONUCLIDE	SAMPLE ID	MAXIMUM ACTIVITY pCi/g	SAL pCi/g	NORMALIZED VALUE
Plutonium-239	0103-97-0031	0.186	24	0.008
Tritium	0103-97-0030	2.91	260	0.011
Uranium-234	0103-97-0030	2.08	13	0.21
Uranium-235	0103-97-0030	0.093	10	0.009
NORMALIZED SUM				0.2

At the conclusion of this human health screening assessment chromium, Aroclor-1260, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, strontium-90, and uranium-234 are carried forward as COPCs.

5.3.15 Human Health Risk Assessment

No human health risk assessment was conducted for PRSs 3-014(k,l) because no chemicals were carried forward from the screening assessment. However, a semi-quantitative human health risk assessment was conducted for PRS 3-014(o) and is presented as follows.

PRS 3-014(o) consists of three sludge drying beds located at the bottom of the hill from the TA-3 wastewater treatment plant. Each bed was sampled at three depths from one augering location. Four chemical carcinogens and the radionuclide strontium-90 were detected at concentrations greater than residential SALs in one sample (0103-97-0030):

- benzo(a)pyrene was detected at a concentration ten times SAL,
- benzo(b)fluoranthene was detected at a concentration two times SAL,
- dibenzo(a,h)anthracene was detected at a concentration one times SAL,
- Aroclor-1260 was detected at a concentration 12 times SAL, and
- strontium-90 was detected at a concentration two times SAL.

Additionally, benzo(a)anthracene, chromium, and indeno(1,2,3)pyrene contributed to a carcinogenic MCE greater than one (1.9 from these three COPCs) due to concentrations detected in this same sample. These COPCs were not detected at levels greater than SAL in any other sample except Aroclor-1260. With two exceptions, the organic COPCs were only detected in this sample, which was taken from the top nine inches of the sludge bed. Aroclor-1260 was also detected in the top six and ten inches of adjacent sludge beds, and benzo(b)fluoranthene which was also detected in the top six inches of one sludge bed. No organic COPCs were detected in samples taken at greater depths at all three locations.

Chromium was detected at levels greater than background in all samples except one (0103-97-0027). The three samples at location 03-03203 decreased in concentration with depth (40.6, 12.8, and 9.88 mg/kg), as did the samples at location 03-03205 (136, 25, and 18.2 mg/kg). At the third location, the top 10-in. soil sample was not greater than background, but the two samples beneath it (6.66 and 12 mg/kg) exceeded the Unit 3 UTL. None of these concentrations exceed SAL, and the data do not indicate substantial transport beneath the beds.

Strontium-90 was detected above SAL in sample 0103-97-0030 (0-0 in.), which also had a uranium-234 detection less than SAL (0.2 times the SAL). Strontium-90 was not detected above SAL and uranium-234 was not detected above background levels in any other sample. Strontium-90 was detected at levels greater than background in samples 0103-97-0024 (0-6 in.) and 0103-97-0028 (21-33 in.). However, strontium-90 was not detected at elevated levels in the next deeper samples at those locations.

The risk from the carcinogenic COPCs can be estimated by summing their ratios to EPA Region 9 PRGs and multiplying by 1×10^{-6} (see Appendix C of this report for risk calculations). The summed carcinogenic risk associated with the maximum concentrations is 3×10^{-6} assuming residential land use and a lifetime exposure. The dose for strontium-90 and uranium-234 is 20 mrem/yr, as estimated by calculating a ratio to radionuclide SALs and multiplying by 10 mrem/yr (Appendix C). However, because these sludge beds are associated with an active LANL facility at which land use is likely to remain under DOE control, it is more appropriate to compare these COPC concentrations to industrial SALs. Table 5.3.15-1 is a comparison of COPC concentrations with industrial SALs.

The RME dose estimate of 20 mrem/yr for residential land use is less than the 100 mrem/yr dose guideline in DOE Order 5400.5. Additionally, if the average concentrations of strontium-90 and uranium-234 across the PRS are compared to SALs, the combined dose is less than the screening value of 10 mrem/yr (Appendix C). Industrial SALs were calculated for strontium-90 and uranium-234 based on the default assumptions described in "Risk-Based Corrective Action Process," (Dorries 1996, 1297). These industrial SALs (1 700 pCi/g for strontium-90 and 440 pCi/g for uranium-234) were not exceeded in the sludge beds.

TABLE 5.3.15-1

INDUSTRIAL SAL COMPARISON FOR COPCS AT PRS 3-014(a)

CHEMICAL	SAMPLE ID	CONCENTRATION (mg/kg)	INDUSTRIAL SAL[a] (mg/kg)
Aroclor-1260	0103-97-0030	1.22	1.0
Benzo(a)anthracene	0103-97-0030	0.51	2.6
Benzo(a)pyrene	0103-97-0030	0.67	0.26
Benzo(b)fluoranthene	0103-97-0030	1.3	2.6
Chromium	0103-97-0030	136	450
Dibenzo(a,h)anthracene	0103-97-0030	0.074	0.26
Indeno(1,2,3-cd)pyrene	0103-97-0030	0.25 J[b]	2.6

[a] US EPA Region 9 industrial land use PRGs are used as industrial SALs.
[b] J = Data qualifier (See Section 3.1.2).

All chemical COPCs pass industrial screening except benzo(a)pyrene, with a concentration about three times its industrial SAL, and Aroclor-1260, with a concentration about 20% above industrial SAL. If these maximum values are compared to EPA Region 9 PRGs to estimate risk, as shown in Appendix C, the lifetime excess carcinogenic risk is 5×10^{-6}.

Both the residential reasonable maximum exposure (RME) risk estimate (3×10^{-5}) and the industrial RME risk estimate (5×10^{-6}) are within the risk range (10^{-4} to 10^{-6}) considered acceptable by EPA in the National Contingency Plan (NCP) (EPA 1990, 0559). Additionally, the PCB (Aroclor-1260) concentrations at this site are less than the cleanup levels specified by the Toxic Substances Control Act (TSCA), which state that the stringent spill cleanup level for soil is 10 mg/kg. This cleanup level applies to nonrestricted access sites provided the soil is excavated to a minimum depth of 10 in. and replaced with clean soil (defined as containing less than 1 mg/kg of PCBs) (EPA 1986, 1366).

Based on the results of this semi-quantitative risk assessment, no COPCs are identified for this site.

5.3.16 Preliminary 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 ecological risk assessment at PRSs 3-014(k,l,o) will be deferred until the site can be assessed as part of the ecological exposure unit methodology currently being developed.

5.3.17 Conclusions and Recommendations

Based on the results of the evaluations of inorganic chemicals, radionuclides, and organic chemicals, and the risk-based screening assessment, no analytes are retained as COPCs at PRSs 3-014(k,l,o). PRSs 3-014(k,l,o) are recommended for NFA based on NFA Criterion 5. This criterion states that the PRSs have been characterized or remediated in accordance with current applicable state or federal regulations, and the available data indicate that contaminants of concern are either not present or are present in concentrations that would pose an acceptable level of risk under the projected future land use.

5.4 PRS 3-021, Decommissioned Outfall

PRS 3-021 is a decommissioned outfall and the associated daylight channel north of TA-3-70 at the compressed gas facility. Analytical results from sediments above the backfilled channel, within the former channel at the soil/tuff contact, and from tuff beneath the channel, indicate

that contamination is not present above SALs. Based on the analytical results, PRS 3-021 is recommended for NFA.

5.4.1 History

PRS 3-021 is discussed in detail in Subsection 5.14 of the RFI Work Plan for Operable Unit 1114, Addendum 1 (LA-UR-96-731). PRS 3-021 is located at the compressed gas facility within TA-3 and consists of a former outfall and the associated daylight channel north of TA-3-170. From 1964 to 1976 the outfall discharged caustic wash and rinse water from compressed gas cylinder cleaning operations. Potential contamination associated with PRS 3-021 includes SVOCs and metals.

5.4.2 Description

The exact location of the outfall and associated daylight channel at PRS 3-021 is unknown due to grading and construction work for TA-3-1650 (the gas cylinder storage building), the addition of utilities in the area, and the placement of 5 to 10 ft of fill material over the outfall and up to 3 ft over the daylight channel. The channel is assumed to have run over and possibly out into the tuff. For further information refer to Section 2.0 of this report.

5.4.3 Previous Investigation

No previous investigations have been performed at this site.

5.4.4 Field Investigations

The conceptual model for PRS 3-021 assumes that inhalation, ingestion, and dermal contact with soil and surficial contamination are the primary exposure pathways. The objective of the RFI was to determine the nature and extent of contamination, if any, associated with this PRS.

Field activities were conducted in July 1997 in accordance with the RFI Work Plan for OU 1114, Addendum 1 (LANL 1995, 1291). As discussed in Section 1.3, field activities included a site survey, geodetic survey, field screening, and sample collection. Details of the field activities are presented below.

Field Screening. Radiological and organic vapor field screening was performed during sampling activities, as described in Section 1.3. All radiological field screening results were at or below the average background radiological levels for the site. Organic vapor monitoring was performed using a PID to monitor samples and the workers' breathing zone. All organic vapor screening results for this site were 0.0 ppm.

Surface and Subsurface Sampling. Six biased locations were sampled at PRS 3-021 based on the trend of the existing NPDES daylight channel, the approximate channel location as identified by a former site worker, and the presence of underground utilities (Fig. 5.4.4-1). Samples were collected from one location within the former NPDES outfall area (Location ID 03-03326) and at five locations along two transects positioned across the former location of the channel. Samples were collected at two locations along Transect 1 (Location IDs 03-03327 and 03-03328) and three locations along Transect 2 (Location IDs 03-03329 through 03-03331). A third sample location was planned for Transect 1; however, auger refusal (thought to be an underground sewer main, based on utility personnel information) precluded a third location. One duplicate sample was also collected along Transect 2 (Location ID 03-03330). One sample was collected from the 0- to 12-in. interval within the former outfall area, and consisted of a dry, brown, silty clay. Two samples were collected from successive intervals across the soil/tuff horizon along each transect. The soil/tuff horizon was characterized by moist, brown, weathered tuff underlain by moist, brown, competent tuff. The depth of the soil/tuff horizon was approximately 6–12 in. deeper at locations 03-03328 and 03-03329 than in the surrounding auger locations, indicating the presence of the former channel. The sample locations also line up with the daylight channel outside of the fence, as indicated by a former site worker. Sampling information is summarized in Table 5.4.4-1.

Deviations.

- Due to the safety hazards associated with backhoe trenching near underground utilities, hand augering along transects was conducted to collect samples. Transect locations were also modified to avoid the underground utilities. Additionally, only two locations were sampled along Transect 1 due to auger refusal at the third planned location. Auger refusal was likely the result of encountering an unmarked sewer line. Johnson Control, Inc. utility personnel described the approximate location of the line during a site visit but could not verify the exact location because the pipe was vitrified clay and metal detectors could not be used to locate it.
- An additional sample location was chosen in the NPDES outfall channel because it was a deposition area when PRS 3-021 was active.

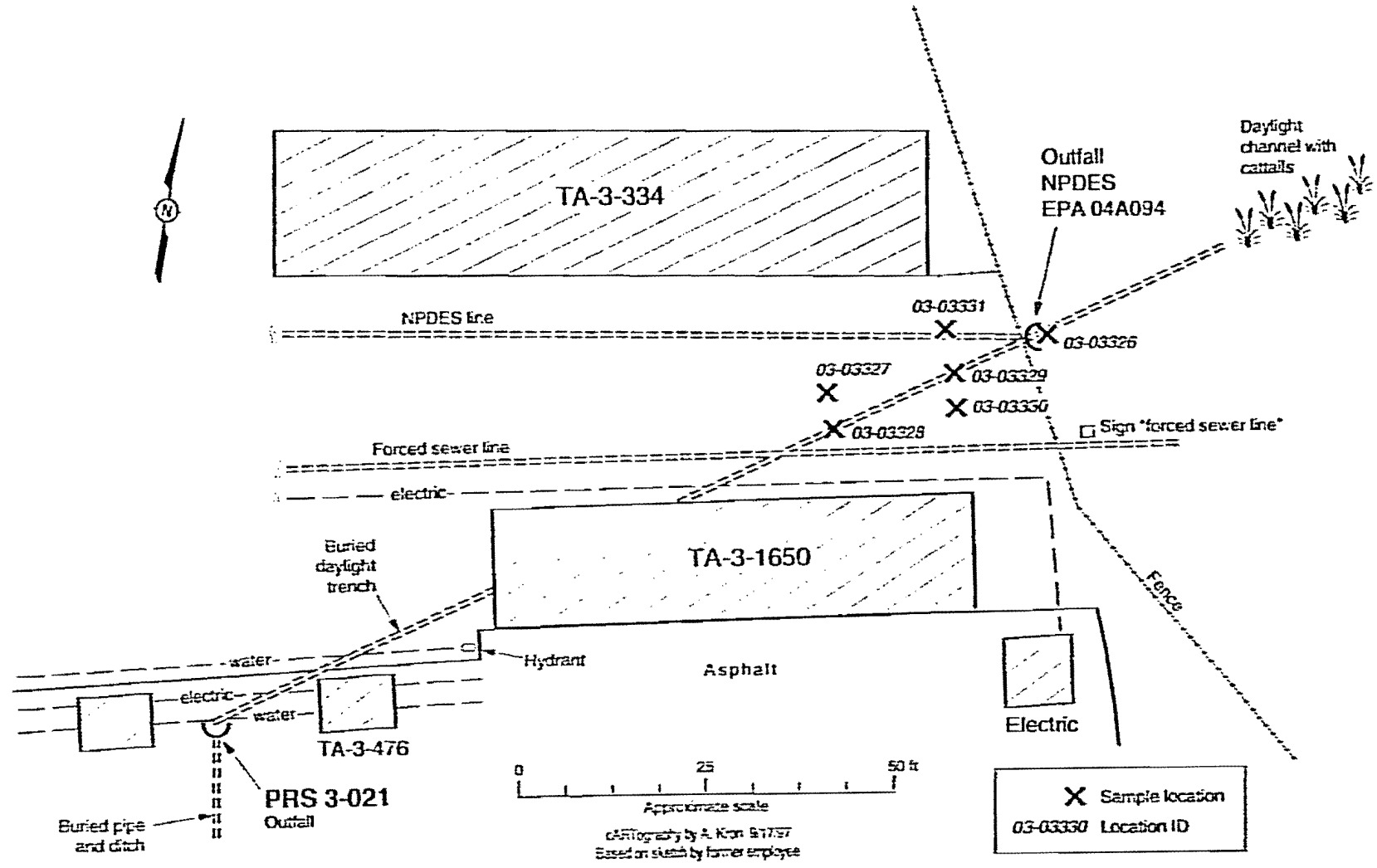


Fig. 5.4.4-1 Locations of samples collected at PRS 3-021.

TABLE 5.4.4-1.

SUMMARY OF SAMPLES COLLECTED AT PRS 3-021

LOCATION ID	SAMPLE ID	DEPTH (ft.)	MEDIA	VOCs	SVOCs	METALS
				REQUEST NUMBER		
03-03326	0103-97-0241	0-12	soil/tuff	N/A[a]	3428R	3429R
03-03327	0103-97-0242	24-36	soil/tuff	N/A	3428R	3429R
03-03327	0103-97-0243	36-48	tuff	N/A	3428R	3429R
03-03328	0103-97-0244	36-48	soil/tuff	3427R	3428R	3429R
03-03328	0103-97-0245	48-60	tuff	N/A	3428R	3429R
03-03329	0103-97-0246	24-36	soil/tuff	N/A	3428R	3429R
03-03329	0103-97-0247	36-48	tuff	N/A	3428R	3429R
03-03330	0103-97-0248	33-45	soil/tuff	N/A	3428R	3429R
03-03330	0103-97-0249	36-48	soil/tuff	N/A	3428R	3429R
03-03330	0103-97-0250	48-60	tuff	N/A	3428R	3429R
03-03331	0103-97-0251	45-47	tuff	N/A	3428R	3429R
03-03331	0103-97-0256	33-45	soil/tuff (dup)	N/A	3428R	3429R

[a] N/A = Not analyzed.

5.4.5 Evaluation of Inorganics

Twelve samples collected at PRS 3-021 were analyzed for TAL metals. Seven of these samples were collected in a soil and tuff mixture. The other five samples were collected from Unit 4 of the Tshirege Member of the Bandelier Tuff. Each inorganic result was compared to the appropriate background screening value (Longmire et al. 1995, 1142 and 1266).

Fourteen inorganics were detected above background screening values. Background data for three of these fourteen inorganics (mercury, selenium, and thallium) are inadequate for further statistical testing because background data does not contain a sufficient frequency of detects (Longmire et al. 1995, 1142 and 1266). Therefore, these three inorganics are carried forward to the human health screening assessment. Based on statistical evaluations of the remaining eleven inorganics, six inorganics (chromium, copper, iron, lead, nickel, and zinc) detected above background screening values were carried forward to the human health screening assessment. The remaining five inorganics (aluminum, arsenic, barium, calcium, and vanadium) will not be carried forward to the human health screening assessment (based on statistical tests described in Appendix C of this report). The Appendix C statistical evaluations compare the PRS 3-021 data and the LANL background data. Graphical comparisons of concentrations by media; formal statistical tests including the Slippage test, the Gehan test, and the Quantile test; and graphical presentations showing the relationship of inorganics to concentration of aluminum are included in Appendix C.

Therefore, nine inorganics (chromium, copper, iron, lead, mercury, nickel, selenium, thallium, and zinc) are carried forward to the human health screening assessment for further evaluation. The data for each sample that had at least one concentration above the background screening values for these nine inorganics are shown in Table 5.4.5-1.

TABLE 5.4.5-1

INORGANIC CHEMICALS WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT PRS 3-021

SAMPLE ID	ALL SOIL DATA UTL	0103-97-0241		0103-97-0242		0103-97-0244		0103-97-0246		0103-97-0248		0103-97-0250	
Analyte													
Chromium	19.3	7.9		20.1		9		11.8		5.9		5.8	
Copper	15.5	22.9		9.4		5.6		7.5		3.8		3.9	
Iron	21 300	12 800		12 100		14 800		12 700		11 900		11 200	
Lead	23.3	24.7		84.7		20.7		31.4		103		83.3	
Mercury	0.1[a]	0.02	U[b]	0.02	U	0.02		0.05		0.02	U	0.02	U
Nickel	15.2	24.5		7.4	U	6.6		7.5		6.2		5.7	
Selenium	1.7[a]	0.96		0.78		0.66	U	0.66		0.59	U	0.6	U
Thallium	1[a]	2.1		2		0.54	U	0.5	U	0.48	U	0.49	U
Zinc	50.8	53		39.9		28		52.5		40.3		48.3	

TABLE 5.4.5-1 (CONTINUED)

INORGANIC CHEMICALS WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT PRS 3-021

SAMPLE ID	UNIT 4 UTL	0103-97-0243		0103-97-0245		0103-97-0247		0103-97-0250		0103-97-0251	
Analyte											
Chromium	10.9	101		8.8		56.6		13.5		4.6	
Copper	6.43	12		2.9		9.4		4.5		2.6	
Iron	19 500	33 200		16 100		13 800		10 900		11 200	
Lead	11	33.7		8.7		358		41.6		67.1	
Mercury	n/a[c]	0.02	U[b]	0.02	U	0.02	U	0.03		0.02	U
Nickel	8.73	9.8		11.4		13.1		12.5		6.6	
Selenium	<0.22	1		0.68	U	0.61		0.63	U	0.60	
Thallium	0.49	1.3		0.55	U	0.49	U	0.51	U	0.48	U
Zinc	75.4	4.6		19.5		193		74.9		49.3	

Values in BOLD are above the background screening value (see Subsection 3.2.1).
Units are in mg/kg.

[a] Value represents the maximum reported background concentration in soil.

[b] U = Signifies that the analyte was not positively identified in the sample, and the associated value is the sample-specific EQL/EDL (see Subsection 3.1.2).

[c] n/a = Not available.

5.4.6 Evaluation of Radionuclides

Samples collected at PRS 3-021 were not analyzed for radionuclides because radionuclides are not a COPC at this site.

5.4.7 Evaluation of Organic Chemicals

Twelve samples collected at PRS 3-021 were analyzed for a suite of SVOCs. One of these samples were also analyzed for a suite of VOCs. Seven of these samples were collected in a soil and tuff mixture. The other five samples were collected from Unit 4 of the Tshirege Member of the Bandelier Tuff.

No organics were detected in these samples. Therefore, no organic chemicals are carried forward to the human health screening assessment.

5.4.8 Risk-Based Screening Assessment for PRS 3-021

This subsection discusses the comparison with SALs for COPCs detected at levels greater than background screening levels. A screening assessment was conducted on the RFI data for PRS 3-021 following methodology presented in "Risk-Based Corrective Action Process," (Dorrler 1996, 1207).

The chemicals chromium, copper, iron, lead, mercury, nickel, selenium, thallium, and zinc were carried forward from the background evaluation.

These COPCs were compared to their respective SALs in Table 5.4.8-1.

Greater than SAL. No chemicals were detected at concentrations greater than SAL.

No SAL. Iron is an essential nutrient that has no SAL. The greatest concentration of iron detected at PRS 3-021 was 33 200 mg/kg. At a standard soil ingestion rate of 100 mg/day for an adult, the amount ingested per day would be approximately 3 mg. This amount is less than the recommended daily allowances (RDAs) of 10 mg/day for adult males and 18 mg/day for adult females. Therefore, iron is eliminated as a COPC.

Less than SAL. Chromium, copper, lead, mercury, nickel, selenium, thallium, and zinc were all detected at concentrations less than their respective SALs.

To evaluate multiple chemical effects for this data set, COPCs detected at concentrations less than their SALs were grouped according to their toxicological effects (carcinogenic effects of radionuclides, carcinogenic or noncarcinogenic effects of chemicals). The maximum concentrations for all chemicals were normalized (sample value divided by SAL) and summed

as described in the policy document "Risk-Based Corrective Action Process," (Dorries, 1996, 1297). The results of the analysis are shown in Table 5.4.8-1. The result of the multiple chemical evaluation is greater than one for noncarcinogens, indicating a potential for adverse human health effects. Therefore, lead and thallium are retained as COPCs because they contribute more than 0.1 to the MCE.

At the conclusion of this human health screening assessment, lead and thallium remain as COPCs because they are greater than 0.1 and they account for 99% of the MCE.

5.4.8.1 Discussion of COPCs

Thallium and lead compose roughly 99% of the noncarcinogen MCE. The maximum lead concentration was detected at the 36-48-in. interval of sample 0103-97-0247. This sample location is assumed to be at the previous gas cylinder washing discharge trench. Lead was also detected at levels two to four times the background UTL in nearby samples, although none were greater than 0.3 times the SAL. The maximum thallium concentration was detected just outside the fence at the 0-10-in. interval of the sample at the NPDES outfall (0103-97-0241). Thallium was detected above background in one other sample; however, it was not detected in the next deeper sample at that location.

Because the land use at this PRS is industrial and is likely to remain under lab control, it is appropriate to compare the detected concentrations to industrial SALs. US EPA Region 9 industrial land PRGs are used as industrial SALs. The industrial SAL for lead is 1 000 mg/kg and the industrial SAL for thallium is 120 mg/kg. The industrial MCE would be 0.4. Because this site is and will remain in native industrial land use by the lab, and because it passes industrial screening, no COPCs are identified for this site.

TABLE 5.4.8-1

MULTIPLE CHEMICAL EVALUATION FOR PRS 3-021

BASED ON NONCARCINOGENIC EFFECTS				
CHEMICAL	SAMPLE ID	CONCENTRATION (mg/kg)	SAL (mg/kg)	NORMALIZED VALUE
Copper	0103-97-0241	22.9	2 800	0.008
Lead	0103-97-0247	358	400	0.90
Mercury	0103-97-0240	0.05	23	0.002
Nickel	0103-97-0241	24.5	1 500	0.016
Selenium	0103-97-0243	1	380	0.003
Thallium	0103-97-0241	2.1	5.4	0.39
Zinc	0103-97-0247	193	23 000	0.008
Normalized Sum				1.3
CARCINOGENIC EFFECTS				
Chromium	0103-97-0243	101	210	0.48
Normalized Sum				0.5

5.4.9 Human Health Risk Assessment

No human health risk assessment was conducted for PRS 3-021 because no chemicals were carried forward from the screening assessment.

5.4.10 Preliminary 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 ecological risk assessment at PRS 3-021 will be deferred until the site can be assessed as part of the ecological exposure unit methodology currently being developed.

5.4.11 Conclusions and Recommendations

Based on the results of the evaluations of inorganic chemicals and organic chemicals, and the risk-based screening assessment, no analytes are retained as COPCs at PRS 3-021. PRS 3-021 is recommended for NFA based on NFA Criterion 5. This criterion states that the PRS has been characterized or remediated in accordance with current applicable state or federal regulations, and the available data indicate that contaminants of concern are either not present or are present in concentrations that would pose an acceptable level of risk under the projected future land use.

5.5 PRS 3-049(a), Active Outfall

PRS 3-049(a) is an active NPDES outfall (EPA 03A022) located south of the Sigma Building. The outfall discharges effluent to Mortandad Canyon. Analytical results from sediment and water samples collected from the sediment catchment basins indicate that contamination is not present above SALs. Based on these results, PRS 3-049(a) is recommended for NFA.

5.5.1 History

PRS 3-049(a) is discussed in detail in Subsection 5.13 of the RFI Work Plan for Operable Unit 1114, Addendum 1 (LANL 1995, 1201). PRS 3-049(a) consists of an NPDES (EPA 03A022) permitted outfall that discharges treated cooling water from TA-3-127 at the Sigma Complex. TA-3-127 has been in operation since 1960. From 1964 to 1990 the outfall also received discharge from rinsate tanks associated with electroplating operations at TA-3-66. Potential contamination for PRS 3-049(a) includes uranium, metals, and cyanide.

5.5.2 Description

PRS 3-049(a) is located along the south slope of South Mesa and consists of an NPDES outfall and four associated sediment catchment basins. The point of discharge for the outfall is approximately 130 ft south of the security fence. The discharged cooling water follows a shallow channel down the slope of the mesa through four sediment catchment basins before draining into Mortandad Canyon. Wetlands have developed at the catchment basins. The small catchment basins consist mainly of traces of sediment within cattail matting. For further information, refer to Section 2 of this report.

5.5.3 Previous Investigation

No previous investigations of the sediment catchment basins have been performed at this site.

5.5.4 Field Investigations

The conceptual model for PRSs 3-049(a) assumes that inhalation, ingestion, and dermal contact with soil; and ingestion of and dermal contact with surface water are the primary exposure pathways. The objective of the RFI was to determine the nature and extent of contamination, if any, associated with this PRS.

Field activities were conducted in July 1997 in accordance with the RFI Work Plan for OU 1114, Addendum 1 (LANL 1995, 1291). As discussed in Section 1.3, field activities included a site survey, geodetic survey, field screening, and sample collection. Details of the field activities are presented below.

Field Screening. Radiological and organic vapor field screening was performed during sampling activities as described in Section 1.3. All radiological field screening results were at or below the average background radiological levels for the site. Organic vapor monitoring was performed using a PID to monitor samples and the workers' breathing zone. All organic vapor screening results for this site were 0.0 ppm.

Surface and Subsurface sampling. Eight random soil sample locations and two water sample locations were selected for sampling at PRS 3-049(a) (Fig. 5.5.4-1). Two random soil samples were collected from each of the four sediment catchment basins (Location IDs 03-03231, 03-03233, 03-03234, 03-03236, 03-03237, 03-03238, 03-03239 and 03-03240). A scoop was used to collect samples from the silty sediment (which also contained roots, gravels, and organics) at the upper and lower ends of each catchment basin. One duplicate sample was also collected from a random location (Location ID 03-03238).

Water sampling. Two unfiltered water samples were also collected. One water sample (Location ID 03-03232) was collected at the NPDES outfall pipe before it entered the sediment catchment basin. The other water sample (Location ID 03-03235) was collected from flowing water exiting the last sediment catchment basin before it entered Mortandad Canyon. In addition, a rinse blank (sample number 0103-97-0098) was collected from the sampling equipment. Sample information is summarized in Table 5.5.4-1.

Deviations.

- In order to provide increased coverage of each catchment basin and to locate sites where contamination is most likely to exist at PRS 3-049(a), random sampling sites were located at both the upper and lower end of each catchment basin (rather than just at the lower end).

5.5.5 Evaluation of Inorganics

Eleven samples collected at PRS 3-049(a) were analyzed for TAL metals. Nine of these samples were collected from sediment catchment basins. The other two samples were water samples collected at biased locations. Each inorganic result from samples collected in sediment catchment basins was compared to the all soil data background screening value (Longmire et al. 1995, 1142 and 1266). Because there are no background water data, the detection limit was used as the background screening value for the water samples.

Seven inorganics (chromium, copper, lead, manganese, nickel, thallium, and zinc) were detected above background screening values in at least one sample from the sediment catchment basins. Further background comparisons were not performed for these metals. Background site data for these metals are inadequate to support other statistical tests due to an insufficient frequency of detects (Longmire et al. 1995, 1142 and 1266). The data for each sample that had at least one concentration above the background screening value for these seven inorganics are shown in Table 5.5.5-1.

The samples from the sediment catchment basins were also analyzed for hexavalent chromium. No detects were reported from this analysis, and the reported detection limit was 20 mg/kg.

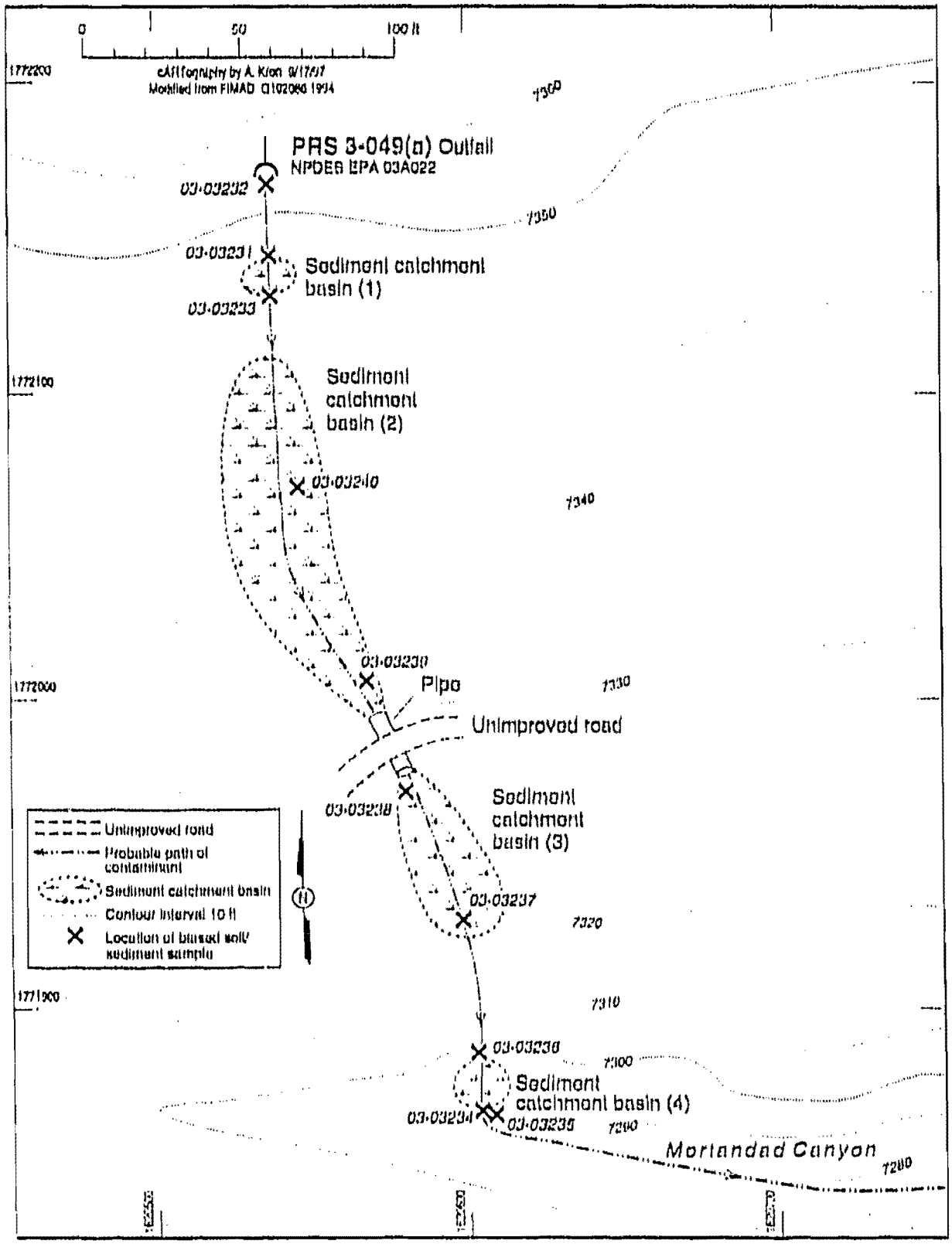


Fig. 5.5.4-1 Locations of samples collected at PRS 3-049(a).

TABLE 5.5.4-1

SUMMARY OF SAMPLES COLLECTED AT PRS 3-049(a)

LOCATION ID	SAMPLE ID	DEPTH (in.)	MEDIA	CHROMIUM VI	ISOTOPIC URANIUM	VOCs	CYANIDE	METALS
				REQUEST NUMBER				
03-03231	0103-97-0001	0-1	soil/sediment	3303R	3304R	3302R	3303R	3303R
03-03232	0103-97-0096	NA[a]	water	N/A[b]	3304R	N/A	3303R	3303R
03-03233	0103-97-0002	0-1	soil/sediment	3303R	3304R	3302R	3303R	3303R
03-03234	0103-97-0003	0-1	soil/sediment	3303R	3304R	N/A	3303R	3303R
03-03235	0103-97-0097	NA	water	N/A	3304R	N/A	3303R	3303R
03-03236	0103-97-0004	0-1	soil/sediment	3303R	3304R	N/A	3303R	3303R
03-03237	0103-97-0005	0-1	soil/sediment	3303R	3304R	N/A	3303R	3303R
03-03238	0103-97-0006	0-1	soil/sediment	3303R	3304R	N/A	3303R	3303R
03-03239	0103-97-0091	0-1	soil/sediment	3303R	3304R	N/A	3303R	3303R
03-03239	0103-97-0007	0-1	soil/sediment	3303R	3304R	N/A	3303R	3303R
03-03240	0103-97-0008	0-3	soil/sediment	3303R	3304R	N/A	3303R	3303R
NA	0103-97-0098	NA	water (rinse)	N/A	3304R	N/A	3303R	3303R

[a] NA = Not applicable.
[b] N/A = Not analyzed.

TABLE 5.5.5-1

INORGANIC CHEMICALS WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT PRS 3-049(a), SEDIMENT CATCHMENT BASINS

SAMPLE ID	ALL SOIL DATA UTL	0103-97-0001		0103-97-0002		0103-97-0003		0103-97-0004		0103-97-0005		0103-97-0006		0103-97-0091		0103-97-0007		0103-97-0008	
ANALYTE																			
Chromium	19.3	**66.2**	J-[a]	**152**	J-	**274**	J-	**204**	J-	**108**	J-	4.2	J-	17.7	J-	**86.3**	J-	**41.3**	J-
Copper	15.6	**450**		**603**		**68.2**		**60.7**		**310**		17.6		33.9		**161**		**155**	
Lead	23.3	**25.1**		**53.0**		**25.2**		**51.2**		**62.6**		5.2		11.4		**20.7**		**56.6**	
Manganese	714	**264**	J-	**173**	J-	**188**	J-	**249**	J-	**1 110**	J-	**125**	J-	**193**	J-	**504**	J-	**105**	J-
Nickel	15.2	**20.0**		**20.6**		**12.8**		**22.3**		**55.7**		1.9		3.7		**16.2**		**21.1**	
Thallium	1	**1.8**		**1.5**	U[b]	**0.61**	U	**0.75**	U	**2.1**	U	**0.61**	U	**0.63**	U	**1.5**	U	**0.64**	U
Zinc	50.8	**422**		**421**		**356**		**222**		**504**		**46.7**		**80.4**		**270**		**220**	

Values in **BOLD** are above the background screening value (see Subsection 3.2.1).
Units are in mg/kg.
[a] J- = Data qualifier (see Subsection 3.1.2).
[b] U = Signifies that the analyte was not positively identified in the sample, and the associated value is the sample-specific EQL/EDL (see Subsection 3.1.2).

The qualifiers in Table 5.5.5-1 were assigned during data validation. However, the data are usable for site-specific decisions. As discussed in Section 4.1 (Inorganic Analyses), the J- qualifiers for chromium and manganese were assigned because of low recoveries in the matrix spike sample. To address this problem, post-digestion spikes were performed for chromium and manganese, and these recoveries were within the limits allowed in USEPA SW846 guidelines. The J- qualifiers indicate that results may be biased low. Because chromium and manganese are still detected above background screening values, they are further evaluated in the human health screening assessment.

Fourteen inorganics (arsenic, barium, calcium, chromium, copper, iron, magnesium, manganese, nickel, potassium, sodium, thallium, vanadium, and zinc) were detected in at least one water sample. The data for each sample that had at least one detected concentration for these fourteen inorganics are shown in Table 5.5.5-2.

TABLE 5.5.5-2

INORGANIC CHEMICALS WITH DETECTED CONCENTRATIONS IN WATER SAMPLES AT PRS 3-049(a)

SAMPLE ID	0103-97-0006	0103-97-0007
Analyte		
Arsenic	2.8	2.6 U[a]
Barium	28.4	32.0
Calcium	11 400	12 900
Chromium	4.6	7.8
Copper	13.2	6.6
Iron	20.9	93.9
Magnesium	3 700	4 060
Manganese	1.1	5.6
Nickel	1.0 U	2.1
Potassium	1 950	1 970
Sodium	11 500	12 000
Thallium	0.5	5.6
Vanadium	10.3	8.5
Zinc	6.9	11.0

Values in **BOLD** are detected.
Units are in ug/L.
[a] U = Signifies that the analyte was not positively identified in the sample, and the associated value is the sample-specific EQL/EDL (see Subsection 3.1.2).

Arsenic, barium, calcium, chromium, copper, iron, lead, magnesium, manganese, nickel, potassium, sodium, thallium, vanadium, and zinc are carried forward to the human health screening assessment based on the evaluation of both water and soil samples.

5.5.6 Evaluation of Radionuclides

Eleven samples collected at PRS 3-049(a) were analyzed for isotopic uranium. Nine of these samples were collected from sediment catchment basins. The other two samples were water samples collected at biased locations. Each isotopic uranium result from samples collected in sediment catchment basins was compared to the all soil data background screening value (Longmire et al. 1995, 1142 and 1266). Each isotopic uranium result from water samples was compared to the detection limit, which was used as the background screening value for these samples.

Uranium-234, uranium-235, and uranium-238 were detected above background screening values in at least one sample from the sediment catchment basins. The data for each sample that had at least one concentration above the background screening value for these three radionuclides are shown in Table 5.5.6-1.

TABLE 5.5.6-1

RADIONUCLIDES WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT PRS 3-049(a), SEDIMENT CATCHMENT BASINS

SAMPLE ID	SOIL UTL	0103-07-0062		0103-07-0065
Analyte				
U-234	1.94	1.83		2.10
U-235	0.084	0.052	U[a]	0.14
U-238	1.82	2.36		3.36

Values in BOLD are above the background screening value (see Subsection 3.2.2).
Units are in pCi/g.
[a] U = Signifies that the analyte was not positively identified in the sample, and the associated value is the sample-specific EQL/EDL (see Subsection 3.1.2).

Uranium-234 and uranium-238 were detected in both water samples collected. The data for the samples that had at least one detected concentration for these two radionuclides are shown in Table 5.5.6-2.

TABLE 5.5.6-2

RADIONUCLIDES WITH DETECTED CONCENTRATIONS IN WATER SAMPLES AT PRS 3-049(a)

SAMPLE ID	0103-97-0096	0103-97-0097
Analyte		
U-234	0.26	0.11
U-238	0.08	0.06

Values in BOLD are detected.
Units are in pCi/L.
* U = Signifies that the analyte was not positively identified in the sample, and the associated value is the sample-specific EQL/EDL (see Subsection 3.2.2).

Therefore, uranium-234, uranium-235, and uranium-238 are carried forward to the human health screening assessment based on the evaluation of both water and soil samples.

5.5.7 Evaluation of Organic Chemicals

Two samples collected at PRS 3-049(a) were analyzed for a suite of VOCs. These two samples were collected from sediment catchment basins.

Two organics were detected in these samples. The data for each sample that had at least one detected concentration of these organic chemicals are presented below in Table 5.5.7-1. These two organic chemicals (methylene chloride and 2-butanone) are carried forward to the human health screening assessment.

TABLE 5.5.7-1

DETECTED ORGANIC CONCENTRATIONS AT PRS 3-049(a)

SAMPLE ID	0103-97-0061		0103-97-0062	
Analyte				
Methylene Chloride	0.011	J	0.012	
2-Butanone	0.013	J	0.042	U

Values in BOLD are detected.
Units are mg/kg.
U = Signifies that the analyte was not positively identified in the sample, and the associated value is the sample-specific EQL/EDL (see Subsection 3.1.2).
J = Data qualifier (see Subsection 3.1.2).

The qualifiers in Table 5.5.7-1 were assigned during data validation. However, the data are usable for site-specific decisions. The J qualifiers in sample 0103-97-0061 were assigned to indicate that the results were reported between the method detection limit and the EQL and are

estimated values. These organics are still considered detected and are further evaluated in the human health screening assessment. The water samples were not analyzed for VOCs.

5.5.8 Risk-Based Screening and Assessment for PRS 3-049(a)

This subsection discusses the comparison with SALs for COPCs detected at levels greater than background screening values. A screening assessment was conducted on the RFI data for this PRS following methodology presented in "Risk-Based Corrective Action Process," (Dorries 1996, 1297).

The chemicals 2-butanone (methyl ethyl ketone), chromium, copper, lead, manganese, methylene chloride, nickel, thallium, and zinc; and the radionuclides uranium-234, uranium-235, and uranium-238 were carried forward from the background evaluation of soils. Although antimony and selenium were not detected in a sample, their detection limits were greater than the UTL. Because antimony and selenium are metals that may have been present in the waste stream, these metals will be assumed present at concentrations of one-half the highest reported detection limits (EPA 1989, 0305).

These COPCs are compared to their respective soil SALs in Tables 5.5.8-1 and 5.5.8-2. Water sample COPCs are compared to their respective SALs in Table 5.5.8-3.

Greater than SAL. No chemical or radionuclide was detected at a level greater than its SAL. Although total chromium concentrations exceed the SAL for total chromium, these samples were further analyzed for hexavalent chromium. The SAL for total chromium is based on one part hexavalent chromium to six parts trivalent chromium. Trivalent chromium is the more stable valence and the form more prevalent in the environment. Hexavalent chromium is produced mainly through anthropogenic processes (Syracuse Research Corporation 1991, 1241). Hexavalent chromium was not detected in any sample. Therefore, the trivalent chromium SAL is appropriate for comparison to these data and is presented below in the less than SAL category.

Less than SAL. 2-Butanone, chromium, copper, lead, manganese, methylene chloride, nickel, thallium, and zinc and radionuclides uranium-234, uranium-235, and uranium-238 were all detected at concentrations less than their respective SALs. Although antimony and selenium were not detected in a sample, at least one detection limit was greater than the UTL. Antimony and selenium will be assumed present at concentrations of one-half the highest reported detection limits because these are metals that may have been present in the waste stream (EPA 1989, 0305).

To evaluate multiple chemical effects for this data set, COPCs detected at concentrations less than their SALs were grouped according to their toxicological effects (carcinogenic effects of radionuclides, carcinogenic or noncarcinogenic effects of chemicals). The maximum concentrations for all chemicals were normalized (sample value divided by SAL) and summed as described in the policy document "Risk-Based Corrective Action Process," (Dorries, 1996, 1997). The results of the analysis are shown in Tables 5.5.8-1 and 5.5.8-2.

The results of the multiple radionuclide and carcinogenic evaluations are each less than one, indicating that potential adverse human health effects resulting from these exposures are unlikely. The carcinogenic MCE includes hexavalent chromium since total chromium was detected and the detection limit for hexavalent chromium, 20 mg/kg, is a significant fraction of its SAL, 30 mg/kg. However, hexavalent chromium was not detected and the high detection limit is not associated with a significant contribution to the carcinogenic MCE.

The MCE for noncarcinogens is greater than one, indicating a potential for adverse health effects. Copper, lead, manganese, and thallium are carried forward for further evaluation because they contributed more than 0.1 to the MCE.

TABLE 5.5.8-1

MULTIPLE CHEMICAL EVALUATION FOR PRS 3-049(n)

BASED ON NONCARCINOGENIC EFFECTS				
CHEMICAL	SAMPLE ID	CONCENTRATION (mg/kg)	SAL (mg/kg)	NORMALIZED VALUE
Antimony	0103-97-0005	1.7[a]	31	0.05
2-Butanone	0103-97-0001	0.013 J[b]	7 100	0.000002
Chromium (trivalent)	0103-97-0003	274	7 7000	0.004
Copper	0103-97-0002	603	2 800	0.24
Lead	0103-97-0005	92.6	400	0.23
Manganese	0103-97-0005	1 110 J[b]	3 200	0.35
Nickel	0103-97-0005	55.7	1 600	0.04
Selenium	0103-97-0005	1.3[a]	380	0.003
Thallium	0103-97-0001	1.8	5.4	0.33
Zinc	0103-97-0005	504	23 000	0.02
Normalized Sum				1.3
BASED ON CARCINOGENIC EFFECTS				
CHEMICAL	SAMPLE ID	CONCENTRATION (mg/kg)	SAL (mg/kg)	NORMALIZED VALUE
Chromium (hexavalent)	0103-97-0003	20 (detection limit)	30	0.67
Methylene Chloride	0103-97-0002	0.012	7.8	0.002
Normalized Sum				0.7

[a] These concentrations represent one half the detection limit which was greater than UTL.
[b] J, J- = Data qualifiers (Section 3.1.2).

TABLE 5.5.8-2

MULTIPLE RADIONUCLIDE EVALUATION FOR PRS 3-049(n)

RADIONUCLIDE	SAMPLE ID	MAXIMUM ACTIVITY pCi/g	SAL pCi/g	NORMALIZED VALUE
Uranium-234	0103-97-0006	2.19	13	0.17
Uranium-235	0103-97-0006	0.14	10	0.01
Uranium-238	0103-97-0006	3.30	67	0.05
Normalized Sum				0.2

A screening of chemicals detected in surface water at the site is conducted by comparison of the maximum detected value to the human health water screening concentration as shown in Table 5.5.8-3. The water screening concentration is based on the most stringent or applicable value obtained from the following sources and footnoted accordingly.

TABLE 5.5.8-3

EVALUATION OF WATER SAMPLES FOR PRS 3-049(n)

ANALYTE	SAMPLE ID	MAXIMUM CONCENTRATION (ug/L)	WATER SCREENING LEVEL (ug/L)
Arsenic	0103-97-0098	2.8	50 [a,b]
Barium	0103-97-0097	32.0	1 000[b]
Calcium	0103-97-0007	12 900	NA[c]
Chromium	0103-97-0007	7.8	50[b]
Copper	0103-97-0006	13.2	1 000[d]
Iron	0103-97-0007	93.9	NA
Magnesium	0103-97-0007	4 060	NA
Manganese	0103-97-0007	5.8	1 700[e]
Nickel	0103-97-0097	2.1	100[e]
Potassium	0103-97-0007	1 970	NA
Sodium	0103-97-0007	12 900	NA
Thallium	0103-97-0098	6.5	2.0[a,d]
Vanadium	0103-97-0098	10.3	260[e]
Zinc	0103-97-0097	11.9	11 000[e]
Uranium-234 (pCi/L)	0103-97-0006	0.20	30[f,g]
Uranium-238 (pCi/L)	0103-97-0006	0.08	30[f,g]

[a] Maximum Contaminant Levels (MCL) concentration from Drinking Water Regulations, Title 20, Chapter 7, NMED, January 1995

[b] Domestic Water Supply Standard from Standards for Interstate and Intrastate Streams, Title 20 Chapter 6, NMED, January 1995

[c] NA = Not available.

[d] US EPA MCL from Drinking Water Regulations and Health Advisories, January 1996

[e] Risk-based water concentrations from EPA Region 9 PRGs assuming a cancer risk of 1×10^{-6}, or a hazard quotient of 1.

[f] US EPA Proposed MCLs for Radionuclides.

[g] The proposed MCL for uranium of 30 pCi/l is for all uranium isotopes summed.

Water screening levels are not available for the essential nutrients calcium, iron, magnesium, potassium, and sodium. The concentrations of these analytes correspond to intakes well within nutritional intake ranges. Thallium is the only surface water analyte that fails screening.

At the conclusion of this human health screening assessment, copper, lead, manganese, and thallium remain as COPCs in soil/sediment at the catchment basins, and thallium remains a COPC for surface water.

5.5.8.1 Discussion of COPCs

The screening assessment noncarcinogenic MCE exceeded one primarily due to the contributions of copper, lead, manganese, and thallium. The MCE of 1.3 for soil is not considered indicative of potential human health risk for the following reasons:

- SALs are based on residential soil exposure. Residential use of the catchment basins is not a feasible land use for the site. Occasional recreational use of the basins is possible, although not likely. Recreational use would involve considerably less exposure than routine residential use.
- The manganese and thallium maximum concentrations contribute about half of the MCE. However, only one of nine samples had levels that were greater than background. If these concentrations were averaged across an exposure unit, the MCE would be less than 1.0.
- Manganese concentrations are considered biased low due to low QA/QC matrix spike recoveries (30%). However, the average manganese concentration (322 mg/kg) is one tenth of SAL, which would not contribute significantly to risk even if the low bias is accounted for by a factor of three (0.3 times SAL).
- An MCE of 1.3 is not a significant exceedance of the soil MCE, even if residential land use is assumed possible. The locations of the maximum values contributing to the MCE are sediment basin one for copper and thallium, and sediment basin three for lead and manganese. Because these sediment basins are more than 200 ft apart, it is unlikely that residential exposure would occur concurrently at these locations.
- Because the sediment is only a few inches deep and the area of the basins is less than 500 m^2, the mass of sediment in the catchment basins does not

likely represent sufficient COPC mass to affect a residential exposure unit to levels greater than the MCE even if COPCs were to erode downstream or otherwise be relocated from the site.

- The site is permitted as an NPDES outfall, and it discharged cooling tower water potentially containing chromium. However, chromium was demonstrated to exist primarily, if not exclusively, in the trivalent state. Trivalent chromium is an essential nutrient with a SAL 200 times the maximum value found in the sediment. These releases are not associated with potential human health risks.

- The site does not provide sufficient water for residential exposure. Although the residential water MCLs are exceeded for thallium, the catchment basins could not be used for residential purposes as defined by the residential scenario because they could not be used as the sole source of potable water for a household. The potential exposure of occasional recreational use would be less than an order of magnitude below residential use. Incidental ingestion of surface water would only involve tens of milliliters ingested occasionally, as opposed to 2 liters per day ingested routinely for residential use (EPA 1989, 0305). Therefore, thallium is not carried forward as a COPC for water.

For these reasons, no COPCs are identified for the site.

5.5.9 Human Health Risk Assessment

No human health risk assessment was conducted for PRS 3-049(a) because no chemicals were carried forward from the screening assessment.

5.5.10 Preliminary Ecological Assessment

In cooperation with the New Mexico Environment Department and EPA Region 6, the LANL ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at PRS 3-049(a) will be deferred until the site can be assessed as part of the ecological exposure unit methodology currently being developed.

5.5.11 Conclusions and Recommendations

Based on the results of the evaluations of inorganic chemicals, radionuclides, and organic chemicals, and the risk-based screening assessment, no analytes are retained as COPCs at PRS 3-049(a). PRS 3-049(a) is recommended for NFA based on NFA Criterion 5. This criterion states that the PRS has been characterized or remediated in accordance with current applicable state or federal regulations, and the available data indicate that contaminants of concern are either not present or are present in concentrations that would pose an acceptable level of risk under the projected future land use.

5.6 PRS 3-052(b), Storm Drains, and 3-056(k), Outdoor Storage Area

PRS 3-052(b) consists of five storm drain access areas located north of TA-3-66. Three access areas are within the TA-3-66 fenced area and two are daylight channels outside the fenced area near Eniwetok Drive. The access areas allow storm water to drain from a storage area [PRS 3-056(k)]. PRS 3-056(k) is an outside storage area on the north side of TA-3-66. Based on the analytical results from asphalt, surface, and near surface soil/tuff samples PRSs 3-052(b) and 3-056(k) are recommended for NFA.

5.6.1 History

PRSs 3-052(b) and 3-056(k) are located within TA-3 at the north end of the Sigma Complex. PRS 3-052(b) consists of a surface storm drain system located on the north side of TA-3-66. The access area receives storm water from the surrounding roadways, loading docks, and storage areas [including PRS 3-056(k)]. PRS 3-056(k) is an outside storage area located at the north end of TA-3-66 that drains into PRS 3-052(b). The area was previously used to store excess equipment from the Sigma Building and is currently used to store graphite rods for molds and low-level radioactive waste inside sealed dumpsters. Four documented radiological releases have occurred in the area of PRS 3-056(k) (see RFI Work Plan for OU 1114, Addendum 1 for more information). Potential contamination for PRSs 3-052(b) and 3-056(k) includes uranium and metals.

5.6.2 Description

PRSs 3-052(b) and 3-056(k) are located north of TA-3-66 within the Sigma Complex. The area has been noticeably disturbed during construction and operation of the site. For further information, refer to Section 2.0 of this report.

5.6.3 Previous Investigation

No previous investigations have been performed at this site.

5.6.4 Field Investigations

The conceptual model for PRSs 3-052(b) and 3-056(k) assumes that inhalation, ingestion, and dermal contact with soil are the primary exposure pathways. The objective of the RFI was to determine the nature and extent of contamination, if any, associated with these PRSs.

Field activities were conducted in July 1997 in accordance with the RFI Work Plan for OU 1114, Addendum 1 (LANL 1995, 1201). As discussed in Section 1.3, field activities included a site survey, geodetic survey, field screening, and sample collection. Details of the field activities are presented below.

Random Sampling Strategy. For PRS 3-052(b), a random sampling strategy was used to select sampling locations. A sampling grid was established using the northwest corner of TA-3-66 as the zero point. A total of ten east-west grid lines (paralleling the north wall) and 13 north-south grid lines (paralleling the TA-3-66 building eastern extension) were established on 10-ft centers across PRS 3-052(k). All accessible grid nodes (grid line intersections) on the asphalt were marked. A total of 36 grid nodes were screened for alpha and beta/gamma activity (the loading dock and associated ramp, and areas inaccessible due to equipment and/or storage containers were not marked or screened). Screening for alpha radiation was performed using a Ludlum™ Model 139 survey meter with an air proportional alpha detector. Alpha screening indicated no detectable activity. Screening for beta/gamma radiation was performed using an Eberline™ ESP-1 rate meter with a HP260 pancake probe. Beta/gamma screening results were grouped into three categories, low (0–49 cpm), medium (50–80 cpm), and high (greater than 80 cpm). Using a random digits table, two high, one medium, and one low beta/gamma reading were selected. The corresponding grid locations were selected as sample locations (RAND 1983, 17-1312).

Field Screening. Radiological and organic vapor field screening was performed during sampling activities as described in Section 1.3. All radiological field screening results were at or below the average background radiological levels for the site with the exception of the asphalt sample at location 03-03282 [PRS 03-056(k)]. The background contamination criteria for the site was established at 360 cpm. Beta/gamma was slightly elevated with a reading of 430 cpm, and the alpha meter had no detectable activity. Organic vapor monitoring was performed using a PID to monitor samples and the workers' breathing zone. All organic vapor screening results for this site were 0.0 ppm.

Surface and subsurface sampling. Twelve random and biased locations were selected for sampling at PRSs 3-052(b), and 3-056(k) (Fig. 5.6.4-1). At PRS 3-52(b), samples were collected from five biased locations corresponding to the storm drain access areas (Location IDs 03-03285, 03-03286, 03-03288, 03-03291, and 03-03292). One collocated site (03-03287) was also sampled. Using a hand auger, two samples were collected at each location: the 0- to 12-in. interval, and the interval containing the soil/tuff interface.

At PRS 3-056(k), samples were collected from four random locations (Location IDs 03-03281 through 03-03284) and two biased locations (Location IDs 03-03289 and 03-03290). One duplicate sample was also collected from a random location (Location ID 03-03284). At each random sample location, asphalt was chipped using a breaker bar and then sampled. After base course was removed, a hand auger was used to collect samples from the 0- to 12-in. interval beneath asphalt and then the interval encountering tuff. Generally the 0- to 12-in. sample consisted of silty clay with gravels (backfill material). The tuff horizon was characterized by 2 to 4 in. of a soft, moist, clayey, weathered tuff underlain by a moist, brownish, competent tuff. At locations where tuff was encountered within the 0- to 12-in. interval, only one interval was sampled. The same soil and soil/tuff intervals were also collected from the two biased locations for PRS 3-056(k). In addition to the standard analytical suite, two samples (one asphalt at Location ID 03-03282 and one surface soil at Location ID 03-03289) were submitted to a fixed laboratory for analysis of gross alpha and beta radiation and gamma spectroscopy after exhibiting elevated field screening readings. Sampling information is summarized in Table 5.6.4-1.

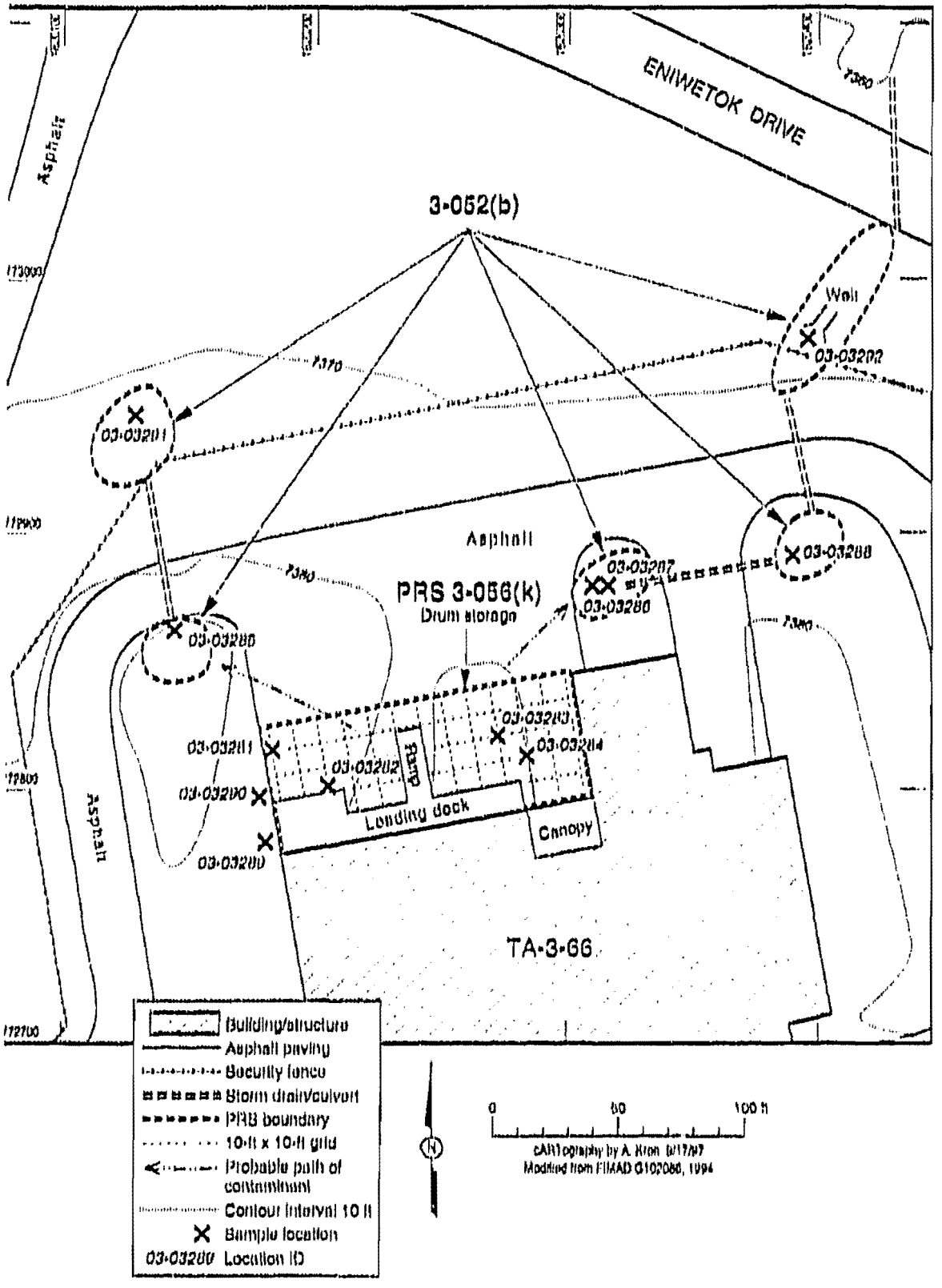


Fig. 5.6.4-1 Locations of samples collected at PRSs 3-056(k) and 3-052(b).

Deviations.

- The number of sample locations were reduced for this PRS after a statistical re-evaluation of the 1995 SAP was completed. The SAP was re-evaluated to determine if improvements could be made by implementing lessons learned during sampling events occurring after the 1995 SAP was prepared. The original SAP used a binomial sampling strategy described in the Installation Work Plan (IWP), Appendix H, Subsection 4.2 (LANL 1995, 1275). The source of contamination associated with historical releases at PRS 3-056(k) is known to be related to the loading dock at the west end of building TA-3-66. Thus, biased samples collected adjacent to the loading dock should provide the best information on the nature of releases at this PRS. All of the releases are known to have been at least partly, if not solely radioactive in nature, and radiological screening should be effective at detecting the current extent of contamination.

  Recent experience has shown that field screening for elevated radioactivity can be an effective tool in biasing sample locations. Therefore, thirty-six locations were field screened for elevated radioactivity at PRS 3-056(k) to increase the chance of detecting significant releases on the drum storage area. Of the thirty-six locations screened, four sample locations were chosen as described in Subsection 5.6.4 of this RFI, under Random Sampling Strategy. Even though the number of sample locations was reduced from nine to four, the four sample locations chosen provided equal (or greater) probability of detecting contamination. This method of choosing sample locations is effective at detecting releases and quantifying concentrations of releases while minimizing resource expenditures.

- At PRS 3-052(b) two samples were to be collected from each of five locations. However, at one location (03-03292), only one soil sample was collected due to auger refusal at 10 in. Attempts made with a shovel, breaker bar, and post hole digger also met refusal in the rocky soil.

TABLE 5.6.4-1.

SUMMARY OF SAMPLES COLLECTED AT PRSs 3-056(k) and 3-052(b)

PRS #	LOCATION ID	SAMPLE ID	DEPTH (In.)	MEDIA	GROSS ALPHA, BETA & GAMMA	ISOTOPIC URANIUM	VOCs	METALS
					REQUEST NUMBER			
3-056(k)	03-03281	0103-97-0151	0-2	asphalt	N/A[a]	3411R	N/A	N/A
3-056(k)	03-03281	0103-97-0152	6-18	soil	N/A	3411R	N/A	3410R
3-056(k)	03-03281	0103-97-0153	22-34	soil/tuff	N/A	3411R	3408R	3410R
3-056(k)	03-03282	0103-97-0154	0-6	asphalt	3411R	3411R	N/A	N/A
3-056(k)	03-03282	0103-97-0155	6-18	soil	N/A	3411R	N/A	3410R
3-056(k)	03-03282	0103-97-0156	18-26	soil/tuff	N/A	3411R	N/A	3410R
3-056(k)	03-03283	0103-97-0157	0-3	asphalt	N/A	3411R	N/A	N/A
3-056(k)	03-03283	0103-97-0158	4-15	soil/tuff	N/A	3411R	N/A	3410R
3-056(k)	03-03284	0103-97-0160	0-2	asphalt	N/A	3411R	N/A	N/A
3-056(k)	03-03284	0103-97-0161	6-15	soil/tuff	N/A	3411R	N/A	3410R
3-056(k)	03-03284	0103-97-0211	6-15	soil/tuff (dup)	N/A	3411R	N/A	3410R
3-056(k)	03-03289	0103-97-0171	0-12	soil	3411R	3411R	N/A	3410R
3-056(k)	03-03289	0103-97-0172	42-54	soil	N/A	3411R	N/A	3410R
3-056(k)	03-03290	0103-97-0173	0-12	soil	N/A	3411R	N/A	3410R
3-056(k)	03-03290	0103-97-0174	12-18	soil/tuff	N/A	3411R	N/A	3410R
3-052(b)	03-03285	0103-97-0163	0-12	soil	N/A	3411R	N/A	3410R
3-052(b)	03-03285	0103-97-0164	24-30	soil/tuff	N/A	3411R	3408R	3410R
3-052(b)	03-03286	0103-97-0165	0-12	soil	N/A	3411R	N/A	3410R
3-052(b)	03-03286	0103-97-0166	12-24	soil/tuff	N/A	3411R	N/A	3410R
3-052(b)	03-03287	0103-97-0167	0-12	soil	N/A	3411R	N/A	3410R
3-052(b)	03-03287	0103-97-0168	12-24	soil/tuff	N/A	3411R	N/A	3410R
3-052(b)	03-03288	0103-97-0169	0-12	soil	N/A	3411R	N/A	3410R
3-052(b)	03-03288	0103-97-0170	12-24	soil/tuff	N/A	3411R	N/A	3410R
3-052(b)	03-03291	0103-97-0175	0-12	soil	N/A	3411R	N/A	3410R
3-052(b)	03-03291	0103-97-0176	48-60	soil/tuff	N/A	3411R	N/A	3410R
3-052(b)	03-03292	0103-97-0177	0-6	soil	N/A	3411R	N/A	3410R

[a] N/A = Not Analyzed.

Background Comparison Sections

Data for each PRS were evaluated separately for comparison to background. Results of the analyses are presented in Subsections 5.6.5 through 5.6.10 below.

5.6.5 Evaluation of Inorganics for PRS 3-052(b)

Eleven samples collected at PRS 3-052(b) were analyzed for TAL metals. Six of these samples were collected from soil, and the other five samples were collected from a soil and tuff mixture. Each inorganic result was compared to the all soil data background screening value (Longmire et al. 1995, 1142 and 1266).

Five inorganics (cobalt, lead, manganese, nickel, and zinc) were detected above background screening values in at least one sample. Further background comparisons were not performed for these metals. The number of background site samples for these metals are inadequate to support other statistical tests due to an insufficient frequency of detects. The data for each sample that had at least one concentration above the background screening value for these five inorganics are shown in Table 5.6.5-1.

TABLE 5.6.5-1

INORGANIC CHEMICALS WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT PRS 3-052(b)

SAMPLE ID	UTL	0103-97-0160		0103-97-0165		0103-97-0175		0103-97-0176		0103-97-0177[a]	
Analyte											
Cobalt	19.2	4.2		3.9		21.5		13.7		4.2	
Lead	23.3	64		45.0		19.6		15.2		17.9	
Manganese	714	106	J+[b]	124	J+	470	J+	1 000	J+	244	J+
Nickel	15.2	8.6		8.4		8.0		20.0		6.3	
Zinc	50.6	36.0		32		28.0		32.0		152	

Values in BOLD are above the background screening value (see Subsection 3.2.1).
Units are in mg/kg.
[a] Values shown are the greater of either the original sample or its laboratory duplicate.
[b] J+ = Data qualifier (see Subsection 3.1.2).

The qualifiers in Table 5.6.5-1 were assigned during data validation. However, the data are usable for site-specific decisions. As discussed in Section 4.1 (Inorganic Analyses), the J+ qualifiers for manganese were assigned because of high recoveries in the matrix spike sample. To address this problem, post-digestion spikes were performed for chromium and manganese, and these recoveries were within the limits allowed in USEPA SW846 guidelines. The J+ qualifiers indicate that results may be biased high. Because manganese is detected above background screening values, it is further evaluated in the human health screening assessment.

5.6.6 Evaluation of Radionuclides for PRS 3-052(b)

Eleven samples collected at PRS 3-052(b) were analyzed for isotopic uranium. Six of these samples were collected from soil and the other five samples were collected from a soil and tuff mixture. Each isotopic uranium result was compared to the all soil data background screening value (Longmire et al. 1995, 1142 and 1266).

Uranium-234, uranium-235, and uranium-238 were not detected above background screening values in any sample. Therefore, uranium-234, uranium-235, and uranium-238 are not carried forward to the human health screening assessment.

5.6.7 Evaluation of Organic Chemicals for PRS 3-052(b)

One sample collected at PRS 3-052(b) was analyzed for a suite of VOCs. No organics were detected in this sample. Therefore no organics are carried forward to the human health screening assessment.

5.6.8 Evaluation of Inorganics for PRS 3-056(k)

Eleven samples collected at PRS 3-056(k) were analyzed for TAL metals. Five of these samples were collected in soil, and the other six were collected in a soil and tuff mixture. Each inorganic result was compared to the all soil data background screening value (Longmire et al. 1995, 1142 and 1266).

One inorganic, copper, was detected above its background screening value in at least one soil sample. Further background comparisons were not performed for copper. The number of background site metals samples are inadequate to support other statistical tests due to an insufficient frequency of detects. Therefore, copper is carried forward to the human health screening assessment. The data for each sample that had at least one concentration above the background screening value for copper are shown in Table 5.6.8-1.

TABLE 5.6.8-1

INORGANIC CHEMICALS WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT PRS 3-056(k)

SAMPLE ID	ALL SOIL DATA UTL	0103-97-0171	0103-97-0174
Analyte			
Copper	15.6	20.1	28.2

Units are in mg/kg.
Values in BOLD are above the background screening value (see Subsection 3.2.1).

5.6.9 Evaluation of Radionuclides for PRS 3-056(k)

Fifteen samples collected at PRS 3-056(k) were analyzed for isotopic uranium. Four of these samples were collected from asphalt material, five samples were collected from soil, and six samples were collected from a soil and tuff mixture. Two samples, one from asphalt and one from soil, were also analyzed by gamma spectroscopy.

EQLs and minimum detectable activities are often not available for radionuclides by gamma spectroscopy. 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 employed in the same manner as a detection limit. This methodology is similar to Currie's method of determining radionuclide maximum detectable activity (Currie 1968, 0792). This 3-sigma screening value takes into account variability due to counting statistics, but does not account for spectral peak identification problems. Thus, this 3-sigma screening is conservative, and may include radionuclides whose presence is spuriously reported due to spectral interferences or misidentifications. Thirty-four radionuclides in the soil sample and thirty radionuclides in the asphalt sample were eliminated from further consideration based on this criteria.

Potassium-40 is a naturally occurring radionuclide that is also routinely reported by the analyst because it is used as an internal standard to measure such things as equipment performance and laboratory background (or contamination). There is no process knowledge of the use of potassium-40 at TA-3, and reported concentrations are generally within known background ranges for potassium-40 (Longmire et al. 1995, 1142 and 1266). Therefore, potassium-40 will not be considered further.

Samples collected from the soil and soil and tuff mixture were compared to the all soil data background screening values for isotopic uranium. Uranium-234, uranium-235, and uranium-238 were all detected above their respective background screening values.

Uranium-234, uranium-235, and uranium-238 are carried forward to the screening assessment. The data for each sample that had at least one concentration above the background screening value for these three radionuclides are shown in Table 5.6.9-1.

TABLE 5.6.9-1

RADIONUCLIDES IN SOIL WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT PRS 3-056(k)

SAMPLE ID	ALL SOIL DATA UTL	0103-97-0171	0103-97-0173	0103-97-0174
Analyte				
Uranium-234	1.94	1.37	2.14	1.52
Uranium-235	0.084	0.188	0.182	0.203
Uranium-238	1.82	4.44	10.1	7.13

Values in BOLD are above the background screening value (see Subsection 9.2.2).
Units are in pCi/g.

Table 5.6.9-2 presents the detected radionuclides reported by gamma spectroscopy. These detected radionuclides are short-lived daughters of uranium or thorium. Table 5.6.9-2 presents a quantitative evaluation for most of these nuclides by comparing the detected quantities to a background UTL. For all cases where a quantitative comparison to the UTL is possible, the detected quantity is less than the UTL. For the remaining isotope (bismuth-211), the detected activity is consistent with the expected secular equilibrium concentrations for this uranium daughter. If, for some reason, this nuclide was not in secular equilibrium with a parent radionuclide, its short half-life would assure their rapid natural removal from the environment. Thus, none of these radionuclides will be carried forward for further evaluation.

TABLE 5.6.9-2

DETECTED RADIONUCLIDES IN SOIL BY GAMMA SPECTROSCOPY AT PRS 3-056(k)

SAMPLE ID	HALF-LIFE	BACKGROUND UTL[a]	0103-97-0171
Analyte			
Actinium-228	6.1 hours	3.3	0.96
Bismuth-211	2.1 minutes	n/a[b]	0.106
Bismuth-214	19.9 minutes	1.61	0.765
Lead-212	10.6 hours	2.36	1.16
Lead-214	26.8 minutes	1.97	0.858
Thallium-208	3.1 minutes	0.906	0.408

Units are in pCi/g.
[a] Sediment background UTL
[b] n/a = Not available. Minimum detectable activity used as a background screening value.

Samples collected from the asphalt were compared to the minimum detectable activity for each uranium isotope. Uranium-234, uranium-235, and uranium-238 were all detected above their respective minimum detectable activities. Uranium-234, uranium-235, and uranium-238 are carried forward to the screening assessment. The data for each sample that had at least one detected concentration for these three radionuclides are shown in Table 5.6.9-3.

Table 5.6.9-4 presents the detected radionuclides reported by gamma spectroscopy. These detected radionuclides are short-lived daughters of uranium, with the exception of cesium-137 and uranium-235. Because there are no radionuclide background values for asphalt, the rule is to pass forward all detected analytes to the human health screening assessment. Only the detected cesium-137 and uranium-235 will be passed forward to the screening assessment for two reasons. First, all of the remaining isotopes are uranium daughters, and isotopic uranium has already ready been carried forward for further evaluation. Second, if for some reason, these radionuclides were not in secular equilibrium with their uranium parent, their short half-life would assure their rapid natural removal from the environment.

TABLE 5.6.9-3

RADIONUCLIDES IN ASPHALT WITH CONCENTRATIONS EXCEEDING MINIMUM DETECTABLE ACTIVITY AT PRS 3-056(k)

SAMPLE ID	0103-97-0151	0103-97-0154	0103-97-0157	0103-97-0160
Uranium-234	0.801	1.39	0.607	1.07
Uranium-235	0.070	0.144	0.071	0.092
Uranium-238	2.91	4.71	1.59	2.01

Values in **BOLD** are above the minimum detectable activity (see Subsection 5.2.2).
Units are in pCi/g.

TABLE 5.6.9-4

DETECTED RADIONUCLIDES IN ASPHALT BY GAMMA SPECTROSCOPY AT PRS 3-056(k)

SAMPLE ID	HALF-LIFE	0103-97-0154[a]
Analyte		
Actinium-228	6.1 hours	0.988
Bismuth-214	19.9 minutes	0.733
Cesium-137	30.2 years	0.22
Lead-212	10.6 hours	0.915
Lead-214	26.8 minutes	0.734
Protactinium-234m	6.7 hours	31.3
Radium-224	3.6 days	0.033
Thallium-208	3.1 minutes	0.423
Thorium-234	24.1 days	7.92
Uranium-235	700 000 000 years	0.102

Units are in pCi/g.
[a] Values shown are the greater of either the original sample or its laboratory duplicate.
Values in BOLD are above the background screening value (see Subsection 3.2.2).

5.6.10 Evaluation of Organic Chemicals for PRS 3-056(k)

One sample collected at PRS 3-056(k) was analyzed for a suite of VOCs.

Two organics, carbon disulfide and 2-butanone, were detected in this sample. The data for each of these organic chemicals are presented below in Table 5.6.10-1. Carbon disulfide and 2-butanone are carried forward to the human health screening assessment.

TABLE 5.6.10-1

DETECTED ORGANIC CONCENTRATIONS AT PRS 3-056(k)

SAMPLE ID	0103-97-0103	
ANALYTE		
Carbon Disulfide	0.004	J[a]
2-Butanone	0.006	J

Units are mg/kg.
[a] J = Data qualifier (see Subsection 3.1.2).
Values in BOLD are above the background screening value (see Subsection 3.2.1).

The qualifiers in Table 5.6.10-1 were assigned during data validation. However, the data are usable for site-specific decisions. The J qualifiers in sample 0103-97-0153 were assigned to indicate that the results were reported between the method detection limit and the EQL and are estimated values. These organics are still considered detected and are further evaluated in the human health screening assessment.

5.6.11 Risk-Based Screening Assessment for PRS 3-052(b) and 3-056(k)

This subsection discusses the comparison with SALs for COPCs detected at levels greater than background screening levels in the investigation at PRS 3-052(b) (storm drains) and 3-056(k) (the outdoor storage area). A screening assessment was conducted on the RFI data for this PRS following methodology presented in "Risk-Based Corrective Action Process," (Dorries 1996, 1297). Although SAL comparison is intended for surface soils, asphalt data are compared to SALs. It is a conservative screening to assume detected chemicals could be released from the asphalt and incorporated into surface soil.

PRS 3-052(b)

Cobalt, lead, manganese, nickel, and zinc were carried forward from the background evaluations at PRS 3-052(b). These five COPCs are compared to their respective SALs in Table 5.6.11-1.

Greater than SAL. No chemical was detected at concentrations greater than its respective SAL.

Less than SAL. Cobalt, lead, manganese, nickel, and zinc were all detected at concentrations less than their respective SALs

To evaluate multiple chemical effects for this data set, COPCs detected at concentrations less than their SALs were grouped according to their toxicological effects (carcinogenic effects of radionuclides, carcinogenic or noncarcinogenic effects of chemicals). The maximum concentrations for all chemicals were normalized (sample value divided by SAL) and summed as described in the policy document "Risk-Based Corrective Action Process," (Dorries, 1996, 1297). The results of the analysis are shown in Table 5.6.11-1. The result of the multiple chemical evaluation is less than one, indicating that potential adverse human health effects resulting from these exposures are unlikely. Therefore, there are no COPCs retained for this site.

TABLE 5.6.11-1

MULTIPLE CHEMICAL EVALUATION FOR PRS 3-052(b)

BASED ON NONCARCINOGENIC EFFECTS				
CHEMICAL	SAMPLE ID	CONCENTRATION (mg/kg)	SAL (mg/kg)	NORMALIZED VALUE
Cobalt	0103-97-0175	21.5	4600	0.005
Lead	0103-97-0166	64	400	0.16
Manganese	0103-97-0176	1000	3200	0.31
Nickel	0103-97-0176	20.0	1500	0.01
Zinc	0103-97-0177	152	23000	0.007
Normalized Sum				0.5

At the conclusion of this human health screening assessment, there are no COPCs for PRS 3-052(b).

PRS 3-056(k)

The chemicals 2-butanone, carbon disulfide, and copper were carried forward from the background evaluation and the evaluation of organics. The radionuclides uranium-234, uranium-235, uranium-238 were carried forward from the background radionuclide evaluation.

These COPCs are compared to their respective SALs in Table 5.6.11-2.

Greater than SAL. No chemical was detected at concentrations greater than its respective SAL.

Less than SAL. 2-Butanone, carbon disulfide, copper, uranium-234, uranium-235, and uranium-238 were all detected at concentrations less than their respective SALs.

To evaluate multiple chemical effects for this data set, COPCs detected at concentrations less than their SALs were grouped according to their toxicological effects (carcinogenic effects of radionuclides, carcinogenic or noncarcinogenic effects of chemicals). The maximum concentrations for all chemicals were normalized (sample value divided by SAL) and summed as described in the policy document "Risk-Based Corrective Action Process," (Dorries, 1996, 1297). The results of the analysis are shown in Tables 5.6.11-2 and 5.6.11-3. The results of the multiple chemical and radionuclide evaluations are less than one, indicating that potential adverse human health effects resulting from these exposures are unlikely. Therefore, there are no COPCs retained for this site.

TABLE 5.6.11-2

MULTIPLE CHEMICAL EVALUATION FOR PRS 3-056(k)

BASED ON NONCARCINOGENIC EFFECTS				
CHEMICAL	SAMPLE ID	CONCENTRATION (mg/kg)	SAL (mg/kg)	NORMALIZED VALUE
Carbon Disulfide	0103-97-0153	0.004 J[a]	7.6	0.0005
Copper	0103-97-0174	28.2	2800	0.01
2-Butanone	0103-97-0153	0.000 J	7100	0.0000008
Normalized Sum				0.01

[a] J = Data qualifier (see Subsection 3.1.2).

TABLE 5.6.11-3

MULTIPLE RADIONUCLIDE EVALUATION FOR PRS 3-056(k)

RADIONUCLIDE	SAMPLE ID	MAXIMUM ACTIVITY (pCi /g)	SAL pCi/g	NORMALIZED VALUE
Uranium-234	0103-97-0173	2.14	13	0.16
Uranium-235	0103-97-0174	0.203	10	0.02
Uranium-238	0103-97-0173	10.1	67	0.15
Normalized Sum				0.3

5.6.12 Human Health Risk Assessment

No human health risk assessment was conducted for PRS 3-056(k) because no chemicals were carried forward from the screening assessment.

5.6.13 Preliminary 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 ecological risk assessment at PRSs 3-052(b) and 3-056(k) will be deferred until the site can be assessed as part of the ecological exposure unit methodology currently being developed.

5.6.14 Conclusions and Recommendations

Based on the results of the evaluations of inorganic chemicals, radionuclides, and organic chemicals, and the risk-based screening assessment, no analytes are retained as COPCs at PRSs 3-052(b) and 3-056(k). PRSs 3-052(b) and 3-056(k) are recommended for NFA based on NFA Criterion 5. This criterion states that the PRSs have been characterized or remediated in accordance with current applicable state or federal regulations, and the available data indicate that contaminants of concern are either not present or are present in concentrations that would pose an acceptable level of risk under the projected future land use.

5.7 PRS C-3-014, Outdoor Storage Area

PRS C-3-014 consists of an outside equipment storage area located along the west and southern walls of the Press Building, TA-3-35, at the Sigma Complex. Analytical results from the asphalt samples collected at the site indicate that contamination is not present above SALs. Based on these results, PRS C-3-014 is recommended for NFA.

5.7.1 History

PRS C-3-014 is discussed in detail in Subsection 5.18 of the RFI Work Plan for Operable Unit 1114, Addendum 1 (LANL 1995, 1201). PRS C-3-014 consists of an outside equipment storage area located along the west and southern sides of TA-3-35. TA-3-35 was constructed in 1953 and housed operations to fabricate enriched uranium graphite and carbide fuel elements. The northern portion of the building floor is contaminated with uranium-235. In 1991, TA-3-35 was declared inactive due to a lack of funding. However, in 1995 the press was put back into operation. During the operational life of TA-3-35 various pieces of equipment and molds have been stored within the boundary of PRS C-3-014. Potential contamination for PRS C-3-014 includes uranium.

5.7.2 Description

PRS C-3-014 is considered to be the asphalted areas adjacent to the west and southern walls of TA-3-35, the Press Building, at the Sigma Complex. Equipment is no longer stored outside of the building. The PRS has been noticeably disturbed (grading, paving, utilities, etc.) during operation of the site. For further information, refer to Section 2.0 of this report.

ENV-ECOGRU-424

5.7.3 Previous Investigation

No previous investigations have been performed at this site.

5.7.4 Field Investigations

The conceptual model for PRS C-3-014 assumes that inhalation, ingestion, and dermal contact with soil are the primary exposure pathways. The objective of the RFI was to determine the nature and extent of contamination, if any, associated with this PRS.

Field activities were conducted in July 1997 in accordance with the RFI Work Plan for OU 1114, Addendum 1 (LANL 1995, 1291). As discussed in Section 1.3, field activities included a site survey, geodetic survey, field screening, and sample collection. Details of the field activities are presented below.

Random Sampling Strategy. For PRS C-3-014, a random sampling strategy was used to select sampling locations. The sampling grid was established off the southwest corner of building TA-3-35. A total of ten east-west grid lines (paralleling the south wall) and 17 north-south grid lines were established on 10-ft centers across PRS C-3-014. The grid extended 12 ft south and 100 ft west of TA-3-35. Grid nodes were located at every 10 ft, grid intersection near the building (from 0–40 ft) and on 20-ft grid intersections from 40–100 ft. The two distances (10 and 20 ft) chosen to establish grid nodes were based on the assumption that most equipment was stored close to the building. A total of 54 grid nodes were screened for alpha and beta/gamma activity. Screening for beta/gamma radiation was performed using an Eberline™ ESP-1 rate meter with a HP260 pancake probe. Screening for alpha radiation was performed using a Ludlum™ Model 139 survey meter with an air proportional alpha detector. Alpha screening indicated no detectable activity. Beta/gamma screening results were grouped into three categories, low (0–49 cpm), medium (50–80 cpm), and high (greater than 80 cpm). Using a random digits table, two high, one medium, and one low beta/gamma reading were selected. The corresponding grid locations were selected for sampling locations (RAND 1983, 03-1312).

Field Screening. Radiological and organic vapor field screening was performed during sampling activities as described in Section 1.3. All radiological field screening results were at or below the average background radiological levels for the site. Organic vapor monitoring was performed using a PID to monitor samples and the workers' breathing zone. All organic vapor screening results for this site were 0.0 ppm.

Surface and Subsurface sampling. Four random locations (Location IDs 03-03254, 03-03255, 03-03256 and 03-03260) were selected for sampling at PRS C-3-014 (Fig. 5.7.4-1). One duplicate sample was also collected from a random location (Location ID 03-03255). The asphalt was chipped and removed with a breaker bar and then sampled. Sampling information is summarized in Table 5.7.4-1.

Deviations.

- The number of sample locations were reduced for this PRS after a statistical re-evaluation of the SAP was completed to determine if improvements could be made by implementing lessons learned during sampling events occurring after the 1995 SAP was prepared. The original SAP used a binomial sampling strategy described in the Installation Work Plan (IWP), Appendix H, Subsection 4.2 (LANL 1995, 1275). The original plan does not take advantage of field screening approaches to delineate potential releases associated with uranium processing activities in building TA-3-35.

  Recent experience has shown that field screening for elevated radioactivity can be an effective tool in biasing sample locations. Therefore, fifty-four locations were field screened at PRS C-3-014 for elevated radioactivity to increase the chance of detecting significant releases on the storage area. From the fifty-four locations screened, four sample locations were chosen as described in Subsection 5.7.4 of this report, Random Sampling Strategy. Even though number of sample locations was reduced from nine to four, the four locations chosen provided equal (or greater) probability of detecting contamination if it exists. This method of choosing sample locations is effective at detecting releases and quantifying concentrations of releases while minimizing resource expenditures.

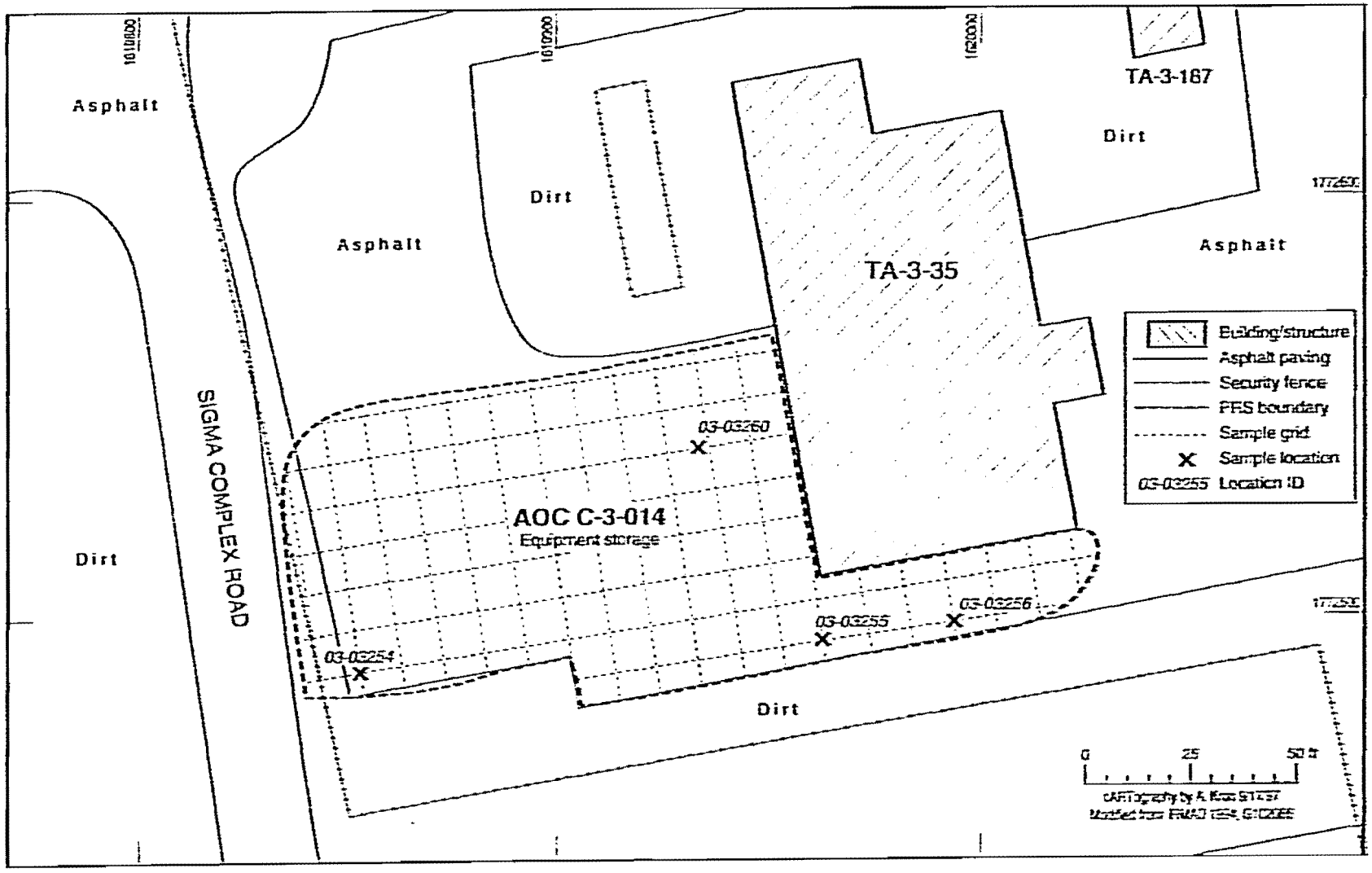


Fig. 5.7.4-1 Locations of samples collected at AOC C-3-014.

TABLE 5.7.4-1
SUMMARY OF SAMPLES COLLECTED AT PRS C-3-014

LOCATION ID	SAMPLE ID	DEPTH (in.)	MEDIA	ISOTOPIC URANIUM
				REQUEST NUMBER
03-03254	0103-97-0104	0-2	asphalt	3370R
03-03255	0103-97-0105	0-2	asphalt	3370R
03-03255	0103-97-0143	0-2	asphalt (dup)	3370R
03-03256	0103-97-0108	0-2	asphalt	3370R
03-03260	0103-97-0110	0-2	asphalt	3370R

5.7.5 Evaluation of Inorganics

No samples collected at PRS C-3-014 were analyzed for TAL metals because TAL metals were not a COPC for this PRS. Therefore, no inorganics are carried forward to the screening assessment.

5.7.6 Evaluation of Radionuclides

Five samples collected at PRS C-3-014 were analyzed for isotopic uranium. These samples were collected in asphalt material. Because background screening values are not available for radionuclides in asphalt, the minimum detectable activity was used as a background screening value.

Minimum detectable activities were not reported for these data, so a value of three times the measurement uncertainty (3 sigma or three standard deviations) was used to calculate a sample-specific minimum detectable activity, which was then employed in the same manner as a detection limit. This methodology is similar to Currie's method of determining radionuclide maximum detectable activity (Currie 1968, 0792).

Uranium-234, uranium-235, and uranium-238 were all detected in at least one asphalt sample. Therefore, uranium-234, uranium-235, and uranium-238 are carried forward to the human health screening assessment. The data for each sample that had at least one concentration above the minimum detectable activity for these uranium isotopes are shown in Table 5.7.6-1.

It is important to note that none of these isotopic uranium values exceed the LANL soil background UTLs. They would not have been carried forward to the human health screening assessment if the samples had been collected from soil.

TABLE 5.7.6-1

RADIONUCLIDES WITH CONCENTRATIONS EXCEEDING MINIMUM DETECTABLE ACTIVITY AT PRS C-3-014

SAMPLE ID	0103-97-0104		0103-97-0105		0103-97-0106	0103-97-0110	0103-97-0143	
ANALYTE								
U-234	0.53		0.58		0.43	0.63	0.49	
U-235	0.02	U[a]	0.01	U	0.04	0.04	0.05	U
U-238	0.61		0.65		0.35	0.66	0.58	

Values in BOLD are above the minimum detectable activity (see Subsection 3.2.2).
Units are in pCi/g.
[a] U = Signifies that the analyte was not positively identified in the sample, and the associated value is the sample-specific EQL/EDL (see Subsection 3.1.2).

5.7.7 Evaluation of Organic Chemicals

No samples collected at PRS C-3-014 were analyzed for organic chemicals because organic contaminants were not a COPC for this PRS. Therefore, no organics are carried forward to the screening assessment.

5.7.8 Risk-Based Screening Assessment for PRS C-3-014

This subsection discusses the comparison with SALs for COPCs detected in the investigation at PRS C-3-014, an outdoor storage area. The radionuclides uranium-234, uranium-235, and uranium-238 were detected in asphalt samples. The data from those samples are carried forward to the screening assessment. Although SAL comparison is intended for surface soils, those asphalt data are compared to SALs. It is a conservative screening to assume the uranium could be released from the asphalt and become incorporated into surface soil.

These three COPCs were compared to their respective SALs in Table 5.7.8-1.

Greater than SAL. No radionuclide was detected at concentrations greater than its respective SAL.

Less than SAL. Uranium-234, uranium-235, and uranium-238 were all detected at activities less than their respective SALs.

To evaluate multiple chemical effects for this data set, the maximum concentrations for all radionuclides were normalized (sample value divided by SAL) and summed as described in the policy document "Risk-Based Corrective Action Process," (Dorries, 1996, 1297). The results of the analysis are shown in Tables 5.7.8-1. The results of the multiple radionuclide evaluation is less than one, indicating that potential adverse human health effects resulting from these exposures are unlikely. Therefore, there are no COPCs associated with this PRS.

TABLE 5.7.8-1

MULTIPLE RADIONUCLIDE EVALUATION FOR PRS C-3-014

RADIONUCLIDE	SAMPLE ID	MAXIMUM ACTIVITY pCi /g	SAL pCi/g	NORMALIZED VALUE
Uranium-234	0103-97-0110	0.63	13	0.05
Uranium-235	0103-97-0110	0.04	10	0.004
Uranium-238	0103-97-0110	0.66	67	0.01
Normalized Sum				0.06

5.7.9 Human Health Risk Assessment

No human health risk assessment was conducted for PRS C-3-014 because no chemicals were carried forward from the screening assessment.

5.7.10 Preliminary Ecological Assessment

In cooperation with the New Mexico Environment Department and EPA Region 6, the LANL ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at PRS C-3-014 will be deferred until the site can be assessed as part of the ecological exposure unit methodology currently being developed.

5.7.11 Conclusions and Recommendations

Based on the results of the evaluations of inorganic chemicals, radionuclides, and organic chemicals, and the risk-based screening assessment, no analytes are retained as COPCs at PRS C-3-014. PRS C-3-014 is recommended for NFA based on NFA Criterion 5. This criterion states that the PRS has been characterized or remediated in accordance with current applicable state or federal regulations, and the available data indicate that contaminants of concern are either not present or are present in concentrations that would pose an acceptable level of risk under the projected future land use.

REFERENCES

Broxton, D. E., and P. G. Eller (Eds), June 1995. "Earth Science Investigations for Environmental Restoration—Los Alamos National Laboratory Technical Area 21," Los Alamos National Laboratory Report LA-12934-MS, Los Alamos, New Mexico. (Broxton and Eller 1995, 1162)

Currie, L. A. (Ed.), 1988. "Detection In Analytical Chemistry: Importance, Theory, and Practice," 191st *Meeting of the American Chemical Society, New York, New York, April 13-18, 1986*, American Chemical Society, Washington, DC. (Currie 1988, 0792)

Dorries, A. M. (Ed.), June 1,1996. "Risk-Based Corrective Action Process," Revision 1, Los Alamos National Laboratory Report LA-UR-96-2811, Los Alamos, New Mexico. (Dorries 1996, 1297)

Environmental Protection Group, December 1990. "Environmental Surveillance at Los Alamos During 1989," Los Alamos National Laboratory Report LA-12000-ENV, Los Alamos, New Mexico. (Environmental Protection Group 1990, 0497)

Environmental Protection Group, March 1992. "Environmental Surveillance at Los Alamos During 1990," Los Alamos National Laboratory Report LA-12271-MS, Los Alamos, New Mexico. (Environmental Protection Group 1992, 0740)

Environmental Restoration Project, February 1996. "RFI Report for 53 Potential Release Sites in TA-3, TA-59, TA-60, TA-61, Field Unit 1," Los Alamos National Laboratory Report LA-UR-96-726, ER ID No. 52930, Los Alamos, New Mexico. (Environmental Restoration Project 1996, 1352)

Environmental Restoration Project Decision Support Council and Earth Science Council, June 30, 1997. "Application of LANL Background Data to ER Project Decision-Making Part II: Radionuclides in Soils, Sediments, and Tuff," Los Alamos National Laboratory, Los Alamos, New Mexico. (Environmental Restoration Project Decision Support Council and Earth Science Council 1997, 1414)

EPA (US Environmental Protection Agency), December 1989. "Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A)," Interim Final, EPA 540/1-89/002, Office of Emergency and Remedial Response, Washington, DC. (EPA 1989, 0305)

EPA (US Environmental Protection Agency), July 27, 1990. "Corrective Action for Solid Waste Management Units (SWMUs) at Hazardous Waste Management Facilities," proposed rule, Title 40, Parts 264, 265, 270, and 271, Federal Register, Vol. 55, pp. 30798-30884. (EPA 1990, 0432)

EPA (US Environmental Protection Agency), March 8, 1990. "National Oil and Hazardous Substances Pollution Contingency Plan," Final Rule, 40 CFR Part 300, Federal Register, Vol. 55, No. 46, p. 8666. (EPA 1990, 0559)

1205 EPA (US Environmental Protection Agency), February 1994. "USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, EPA540/R-94/012, Washington, DC. (EPA 1994, 1205) Verified

EPA (US Environmental Protection Agency), July 1992. "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, Third Edition, Final Update 1, Office of Solid Waste and Emergency Response, Washington, DC. (EPA 1992, 1207)

EPA (US Environmental Protection Agency), September 1, 1995. "Region IX Preliminary Remediation Goals (PRGs) Second Half 1995," ER ID No. 53970, San Francisco, California. (EPA 1995, 1307)

EPA (US Environmental Protection Agency), October 1996. "Drinking Water Regulations and Health Advisories," Office of Water, Washington, DC. (EPA 1996, 1380)

EPA (US Environmental Protection Agency), July 1, 1996. "Disposal of Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions," Code of Federal Regulations, Protection of Environment Title 40 Part 761, Washington, DC. (EPA 1996, 1386)

ESG, May 1988. Environmental Surveillance at Los Alamos During 1987, Los Alamos National Laboratory Report LA-11306-ENV, Los Alamos, New Mexico. (ESG 1988, 0408)

ESG, June 1989. Environmental Surveillance at Los Alamos During 1988, Los Alamos National Laboratory Report LA-11628-ENV, Los Alamos, New Mexico. (ESG 1989, 0308)

LANL (Los Alamos National Laboratory). "Los Alamos National Laboratory Environmental Restoration Program Standard Operating Procedures," Los Alamos National Laboratory report, Los Alamos, New Mexico. (LANL, 0875)

LANL (Los Alamos National Laboratory), July 1993, "RFI Work Plan for Operable Unit 1114," Los Alamos National Laboratory Report LA-UR-93-1000, Los Alamos, New Mexico. (LANL 1993, 1090)

LANL (Los Alamos National Laboratory), November 1995, "Installation Work Plan for Environmental Restoration," Revision 5, Los Alamos National Laboratory Report LA-UR-95-4048, Los Alamos, New Mexico. (LANL 1995, 1275)

LANL (Los Alamos National Laboratory), July 1995, "Statement of Work–Analytical Support," Revision 2, RFP No. 9-XS1-Q4257, ER ID No. 49738, Los Alamos, New Mexico. (LANL 1995, 1278)

LANL (Los Alamos National Laboratory), September 1995, "Request for Permit Modification, Units Proposed for NFA," Los Alamos National Laboratory Report LA-UR-95-3319, ER ID No 51878, Los Alamos, New Mexico. (LANL 1995, 1279)

LANL (Los Alamos National Laboratory), July 1995, "RFI Work Plan for Operable Unit 1114, Addendum 1," Los Alamos National Laboratory Report LA-UR-95-731, Los Alamos, New Mexico. (LANL 1995, 1291)

LANL (Los Alamos National Laboratory), December 1996, "Installation Work Plan for Environmental Restoration Program," Revision 6, Los Alamos National Laboratory Report LA-UR-96-4629, Los Alamos, New Mexico. (LANL 1996, 1379)

Longmire, P., S. Reneau, P. Watt, L. McFadden, J. Gardner, C. Duffy, and R. Ryti, January 1995, "Natural Background Geochemistry, Geomorphology, and Pedogenesis of Selected Soil Profiles and Bandelier Tuff, Los Alamos, New Mexico," (draft) Los Alamos National Laboratory Report LA -12913-MS, Los Alamos, New Mexico. (Longmire et al. 1995, 1142)

Longmire, P. A., D. E. Broxton, and S. L Reneau (Eds.), October 1995, "Natural Background Geochemistry and Statistical Analysis of Selected Soil Profiles, Sediments, and Bandelier Tuff, Los Alamos, New Mexico," Los Alamos National Laboratory Report LA-UR-95-3486, Los Alamos, New Mexico. (Longmire et al. 1995, 1206)

Mitchell, Joe, September 1993, "SWMU #3-007, TA-3-160," Los Alamos National Laboratory Memorandum, Los Alamos, New Mexico. (Mitchell 1993, 17-0947)

Nyhan, J. W., L. W. Hacker, T. E. Calhoun, and D. L. Young, June 1978, "Soil Survey of Los Alamos County, New Mexico," Los Alamos Scientific Laboratory Report LA-6779-MS, Los Alamos, New Mexico. (Nyhan et al. 1978, 0161)

Project Consistency Team, "Project Consistency Team (PCT) Policy Memo Notebook," (Controlled), Environmental Restoration Project, Los Alamos National Laboratory, Los Alamos, New Mexico. (Project Consistency Team, 1210)

Purtymun, W. D., R. J. Peters, T. E. Buhl, M. N. Maes, and F. H. Brown, November 1987, "Background Concentrations of Radionuclides in Soils and River Sediments in Northern New Mexico, 1974-1986," Los Alamos National Laboratory Report LA-11134-MS, Los Alamos, New Mexico. (Purtymun et al. 1987, 0211)

Purtymun, W. D., January 1995, "Geologic and Hydrologic Records of Observation Wells, Test Holes, Test Wells, Supply Wells, Springs, and Surface Water Stations in the Los Alamos Area," Los Alamos National Laboratory Report LA-12883-MS, ER ID No. 45344, Los Alamos, New Mexico. (Purtymun 1995, 1293)

RAND, Copyright 1955 and 1983, "A Million Random Digits with 1000,000 Normal Deviates," New York: The Free Press. (RAND 1983, 17-1312)

Ryti, R., P. Longmire, and E. McDonald, March 20, 1996, "Application of LANL Background Data to ER Project Decision-Making, Part I: Inorganics," Los Alamos National Laboratory Report LA-UR-96-1534, ER ID No. 54585, Los Alamos, New Mexico. (Ryti et al. 1996, 1298)

State of New Mexico, January 23, 1995, "Standards for Interstate and Intrastate Streams," Title 20, Chapter 6, Part 1, Water Quality Control Commission, Santa Fe, New Mexico. (State of New Mexico 1995, 1267)

State of New Mexico, January 1, 1995, "Drinking Water Regulations," Title 20, Chapter 7, Part 1, Drinking Water Bureau, Santa Fe, New Mexico. (State of New Mexico 1995, 1268)

APPENDIX A ANALYTICAL RESULTS

The following tables are the data results from the sampling campaign for PRSs 3-004(c,d), 3-007, 3-014(k,l,o), 3-021, 3-049(a), 3-052(b), 3-056(k), and C-3-014.

Data qualifiers used in the LANL ER Project baseline validation process are as follows.

- "A" signifies that the data required for data review and evaluation are not available.
- "U" signifies that the analyte was not positively identified in the sample, and the associated value is the sample-specific EQL/EDL.
- "J" signifies that 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+" signifies that the analyte was positively identified, and the result is likely to be biased high.
- "J-" signifies that the analyte was positively identified, and the result is likely to be biased low.
- "UJ" signifies that the analyte was not positively identified in the sample, and the associated value is an estimate of the sample-specific EQL/EDL.
- "RPM" signifies that without further review of the raw data, the sample results are unusable due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. Presence or absence cannot be verified. Any results qualified as RPM must be evaluated for relevance to data use.
- "P" signifies that professional judgment should be applied to using the data in decision-making.
- "PM" signifies that 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.
- "R" signifies that the data are rejected as a result of major problems with quality assurance/quality control (QA/QC) parameters.

TABLE A-1

INORGANIC DATA RESULTS FOR PRS 3-004(a)

SAMPLE ID	0103-97-0275	0103-97-0277	0103-97-0278	0103-97-0279	0103-97-0280
ANALYTE NAME					
Aluminum	4800	7080	5330	6730	10800
Antimony	6.6 UJ	6.6 UJ	6.9 UJ	5.7 UJ	7.1 UJ
Arsenic	1.1	1	1.1	1.3	2.1
Barium	58.3	62.2	55.2	70.2	150
Beryllium	0.46	0.59	0.61	0.52	0.84
Cadmium	0.55 U	0.55 U	0.57 U	0.47 U	0.59 U
Calcium	1150	1630	1320	2470	13900
Chromium	4.5	6.8	4.8	5.7	8.4
Cobalt	3.1	4.3	3.2	4.0	5.4
Copper	4.8	5.3	4.0	5.0	6.0
Iron	8400	10400	9910	8750	11100
Lead	5.5	6.2	6.6	7.8	8.6
Magnesium	760	988	1000	797	1730
Manganese	273 J-	316 J-	270 J-	330 J-	208 J-
Mercury	0.05 U	0.06 U	0.06 U	0.05 U	0.06 U
Nickel	5.0	7.1	5.1	6.4	7.2
Potassium	648	830	809	700	995
Selenium	0.20	0.16 U	0.16 U	0.30	0.17
Silver	1.9 U	1.9 U	2 U	1.7 U	2.1 U
Sodium	340	186	315	221	199
Thallium	0.2 U	0.31	0.21 U	0.28	0.33
Vanadium	8.2	12.1	9.3	11.5	16.3
Zinc	28.4	32.7	32.9	29.9	31.2

Units are in mg/kg.
U, J-, UJ = Data qualifiers (see page A-2).

TABLE A-1 (CONTINUED)

INORGANIC DATA RESULTS FOR PRS 3-004(c)

SAMPLE ID	0103-97-0329	0103-97-0330	0103-97-0276D	0103-97-0330D
ANALYTE NAME				
Aluminum	6300	29.1 U	5790	29.1 U
Antimony	6.8 UJ	30.2 U	6.6 U	30.2 U
Arsenic	1.7	1.6 U	1.3	1.6 U
Barium	62.8	2.8 U	60.9	2.8 U
Beryllium	0.52	0.2 U	0.51	0.2
Cadmium	0.57 U	2.5 U	0.55 U	2.5 U
Calcium	1780	39.5	1460	40.3
Chromium	5.3	3.7 U	4.93	3.7 U
Cobalt	3.0	4.6 U	2.76	4.6 U
Copper	4.3	4.2 U	4.14	4.2 U
Iron	9630	18.5	10100	17.5
Lead	11.1	0.9 U	8.37	0.9 U
Magnesium	852	32.7 U	855	32.7 U
Manganese	365 J-	0.9 U	273	0.9 U
Mercury	0.06 U	0.1 U	0.055 U	0.1 U
Nickel	6.9	8.9 U	4.9	0.9 U
Potassium	664	762 U	694	762 U
Selenium	0.16	1.1	0.15 U	0.9
Silver	2 U	6.8 U	1.93 U	6.8 U
Sodium	271	136	385	186
Thallium	0.29	1.1	0.2 U	1.2
Vanadium	11.8	3.6 U	9.6	3.6 U
Zinc	29.5	3.4 U	32.9	3.4 U

U, J-, UJ = Data qualifiers (see page A-2).
Units are in mg/kg.

TABLE A-2

RADIONUCLIDE DATA RESULTS FOR PRS 3-004(c)

SAMPLE ID	0103-97-0270	0103-97-0272	0103-97-0273	0103-97-0274	0103-97-0276	0103-97-0273D
ANALYTE NAME						
Plutonium-239	0.02 U	0.002 U	0.028 U	0.013 U	0.034	0.002 U
Plutonium-238	0.024 U	0.002 U	0.009 U	0.004 U	0.011 U	-0.002 U
Uranium-234	0.6	0.67	0.53	0.56	0.51	NA
Uranium-235	0.064	0.04	0.03	0.04	0.036	NA
Uranium-238	0.62	0.62	0.62	0.64	0.61	NA

U = Data qualifier (see page A-2).
NA = Not available.
Units are in pCi/g.

TABLE A-3

ORGANIC DATA RESULTS FOR PRS 3-004(c)

SAMPLE ID	0103-97-0276	0103-97-0277	0103-97-0278	0103-97-0279	0103-97-0280
NAME					
Acetone	ND	0.006 J	ND	ND	ND
Benzo[b&k]-fluoranthene	0.740 U	1.900 U	0.390 U	1.900 U	0.090 J
Fluoranthene	0.740 U	1.900 U	0.390 U	1.900 U	0.100 J
Methylene chloride	ND	0.004 J	ND	ND	ND
Phenanthrene	0.740 U	1.900 U	0.390 U	1.900 U	0.083 J
Pyrene	0.740 U	1.900 U	0.390 U	1.900 U	0.120 J

U, J = Data qualifiers (see page A-2).
ND = Not detected.
Units are in mg/kg.

TABLE A-4

INORGANIC DATA RESULTS FOR PRS 3-004(d)

SAMPLE ID	0103-97-0261	0103-97-0262	0103-97-0263	0103-97-0264	0103-97-0265
ANALYTE NAME					
Aluminum	2120	1720	1730	1620	930
Antimony	7.7 U	8.2 U	8.1 U	7.6 U	8.2 U
Arsenic	1.7 J-	0.73 J-	1.1 J-	3.2 J-	0.76 J-
Barium	43	28.1	27.7	34.7	17.7
Beryllium	0.24 U	0.25 U	0.25 U	0.01	0.25 U
Cadmium	0.74	0.92	0.7 U	0.65 U	0.71 U
Calcium	7840	3900	2470	5200	909
Chromium	33.1	3.9	1.5	4.4	3.0
Cobalt	1.1	1.1 U	1.1 U	1 U	1.1 U
Copper	9.9	5.0	4.0	9.5	3.1
Iron	11000	8080	6780	8770	5790
Lead	50.0	4.7	4.8	17	1.8
Magnesium	548	555	500	521	301
Manganese	338	269	204	235	175
Mercury	0.05 U	0.06 U	0.06 U	0.05 U	0.06 U
Nickel	9.8	4.7	2.8	5.5	2.0 U
Potassium	435	405	371	317	280
Selenium	0.3 U	0.32 U	0.32 U	0.3 U	0.32 U
Silver	1.3	0.93	0.59	0.83	0.06
Sodium	124	119	108	112	113
Thallium	0.19 U	0.21 U	2 U	0.19	0.21 U
Vanadium	11.1	6.3	4.8	8.9	3.5
Zinc	211 J-	37.4 J-	28.7 J-	61.2 J-	32 J-

U, J- = Data qualifiers (see page A-2).
Units are in mg/kg.

TABLE A-4 (CONTINUED)

INORGANIC DATA RESULTS FOR PRS 3-004(d)

SAMPLE ID	0103-07-0266	0103-07-0267	0103-07-0268	0103-07-0269	0103-07-0261D
ANALYTE NAME					
Aluminum	1620	906	1640	1370	2120
Antimony	7.1 U	7.8 U	8.1 U	7.6 U	7.7 U
Arsenic	0.86 J-	1 J-	0.78 J-	0.78 J-	1.7
Barium	37.3	16.8	27.5	25.0	43.0
Beryllium	0.29	0.24 U	0.26 U	0.23 U	0.24 U
Cadmium	0.61 U	0.67 U	0.7 U	0.65	0.74
Calcium	3400	777	2490	1200	7840
Chromium	3.5	8.0	1.5	0.91 U	33.1
Cobalt	0.96 U	1.1	1.1 U	1 U	1.1
Copper	5.5	3.9	4.2	4.7	8.9
Iron	7310	7440	7090	7020	11000
Lead	6.4	1.5	4.9	4.8	56.6
Magnesium	669	402	477	572	548
Manganese	247	258	227	248	338
Mercury	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Nickel	4.2	5.8	4.0	4.5	9.8
Potassium	430	470	420	396	434
Selenium	0.3 U	0.28 U	0.32 U	0.3 U	0.3 U
Silver	0.87	0.98	0.81	0.89	1.3
Sodium	121	193	117	114	124
Thallium	1.9 U	1.8 U	2.1 U	1.9 U	0.19 U
Vanadium	6.1	4.4	5.5	5.2	11.1
Zinc	37.7 J-	33.1 J-	29.3 J-	33.2 J-	211

U, J- = Data qualifiers (see page A-2).
Units are in mg/kg.

TABLE A-5

ORGANIC DATA RESULTS FOR PRS 3-004(d)

SAMPLE ID	0103-97-0261	0103-97-0262	0103-97-0263	0103-97-0264	0103-97-0265	0103-97-0266
ANALYTE NAME						
Anthracene	0.350 U	0.380 U	0.370 U	0.051 J	0.380 U	0.350 U
Benzo(a)anthracene	0.350 U	0.380 U	0.370 U	0.210 J	0.380 U	0.350 U
Benzo(a)pyrene	0.350 U	0.380 U	0.370 U	0.180 J	0.380 U	0.350 U
Benzo(b)-fluoranthene	0.350 U	0.380 U	0.370 U	0.230 J	0.380 U	0.350 U
Benzo(g,h,i)-perylene	0.350 U	0.380 U	0.370 U	0.095 J	0.380 U	0.350 U
Benzo(k)-fluoranthene	0.350 U	0.380 U	0.370 U	0.100 J	0.380 U	0.350 U
bis(2-Ethylhexyl) phthalate	0.350 U	0.380 U	0.370 U	0.350 J	0.380 U	0.090 U
Carbazole	0.350 U	0.380 U	0.370 U	0.055 J	0.380 U	0.350 U
Chrysene	0.350 U	0.380 U	0.370 U	0.230 J	0.380 U	0.350 U
Di-n-octylphthalate	0.350 U	0.380 U	0.370 U	0.350 U	0.380 U	0.350 U
Dibenzo(a,h)-anthracene	0.350 U	0.380 U	0.370 U	0.350 U	0.380 U	0.350 U
Fluoranthene	0.350 U	0.380 U	0.370 U	0.510	0.380 U	0.350 U
Indeno(1,2,3-cd)- pyrene	0.350 U	0.380 U	0.370 U	0.110 J	0.380 U	0.350 U
Phenanthrene	0.350 U	0.380 U	0.370 U	0.270 J	0.380 U	0.350 U
Pyrene	0.350 U	0.380 U	0.370 U	0.400	0.380 U	0.046 J

U, J = Data qualifiers (see page A-2).
Units are in mg/kg.

TABLE A-5 (CONTINUED)

ORGANIC DATA RESULTS FOR PRS 3-004(d)

SAMPLE ID	0103-97-0267	0103-97-0268	0103-97-0269	0103-97-0263D	0103-97-0266D	0103-97-0267D
ANALYTE NAME						
Anthracene	0.360 U	0.730 U	0.700 U	0.370 U	0.350 U	0.360 U
Benzo(a)anthracene	0.360 U	0.730 U	0.700 U	0.370 U	0.350 U	0.360 U
Benzo(a)pyrene	0.360 U	0.730 U	0.700 U	0.370 U	0.350 U	0.360 UJ
Benzo(b)-fluoranthene	0.360 U	0.730 U	0.700 U	0.370 U	0.350 U	0.360 UJ
Benzo(g,h,i)-perylene	0.360 U	0.730 U	0.700 U	0.370 U	0.350 U	0.360 UJ
Benzo(k)-fluoranthene	0.360 U	0.730 U	0.700 U	0.370 U	0.350 U	0.360 UJ
bis(2-Ethylhexyl) phthalate	0.093 U	0.730 U	0.700 U	0.370 U	0.350 U	0.360 U
Carbazole	0.360 U	0.730 U	0.700 U	0.370 U	0.350 U	0.360 U
Chrysene	0.360 U	0.730 U	0.700 U	0.370 U	0.350 U	0.360 U
Di-n-octylphthalate	0.360 U	0.730 U	0.700 U	0.370 U	0.350 U	0.360 UJ
Dibenzo(a,h)-anthracene	0.360 U	0.730 U	0.700 U	0.370 U	0.350 U	0.360 UJ
Fluoranthene	0.360 U	0.730 U	0.700 U	0.370 U	0.350 U	0.360 U
Indeno(1,2,3-cd)-pyrene	0.360 U	0.730 U	0.700 U	0.370 U	0.350 U	0.360 UJ
Phenanthrene	0.360 U	0.730 U	0.700 U	0.370 U	0.350 U	0.360 U
Pyrene	0.044 J	0.730 U	0.700 U	0.370 U	0.350 U	0.360 U

U, J, UJ = Data qualifiers (see page A-2).
Units are in mg/kg.

TABLE A-6

INORGANIC DATA RESULTS FOR PRS 3-007

SAMPLE ID	0103-97-0221	0103-97-0222	0103-97-0223	0103-97-0224	0103-97-0225
ANALYTE NAME					
Aluminum	2640	5620	11900	11800	4190
Antimony	5.5 UJ	6.2 UJ	6.1 UJ	6.3 UJ	6.4 UJ
Arsenic	0.81 J-	1.9 J-	2.7 J-	3.3 J-	1.2 J-
Barium	24.8	62.6	96.6	128	50.0
Beryllium	0.34	0.56	0.69	0.81	0.50
Cadmium	0.46 U	0.51 U	0.88	0.53 U	0.53 U
Calcium	701	2000	2360	2940	1130
Chromium	2.2	5	10.8	10.9	3.7
Cobalt	2.2	3.4	7.3	7.4	3.1
Copper	3.8	5.3	9.9	9.7	31.5
Iron	4990	6630	12500	13300	6610
Lead	0.9 J-	9.4 J-	12.7 J-	17.8 J-	8.4 J-
Magnesium	442 J+	962	1740	2080	722
Manganese	208	243 J+	375 J+	331 J+	275 J+
Mercury	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U
Nickel	2.4	5.3	7.9	7.7	2.9
Potassium	424	750	1270	1300	549
Selenium	0.14 U	0.14 U	0.15 U	0.15 U	0.15 U
Silver	1.6 U	1.8 U	1.8 U	1.8 U	1.9 U
Sodium	115	90.9	96.1	123	125
Thallium	0.19 U	0.19 U	0.31	0.25	0.23
Vanadium	5.9	10.6	23.4	28.5	11.3
Zinc	33.9	25.5	35.8	31.3	25.6

U, UJ, J-, J+ = Data qualifiers (see page A-2).
Units are in mg/kg.

TABLE A-7

RADIONUCLIDE DATA RESULTS FOR PRS 3-007

SAMPLE ID	0103-97-0221	0103-97-0222	0103-97-0223	0103-97-0224	0103-97-0225	0103-97-223D
ANALYTE NAME						
Bismuth-211	ND	ND	1.36	ND	ND	ND
Bismuth-212	ND	ND	1.25	ND	ND	ND
Bismuth-214	ND	ND	0.07	ND	ND	ND
Cesium-137	ND	ND	0.08	ND	ND	ND
Gross Alpha	NA	NA	24.84	NA	NA	22.35
Gross Beta	NA	NA	37.71	NA	NA	37.77
Lead-212	ND	ND	0.8	ND	ND	ND
Lead-214	ND	ND	0.73	ND	ND	ND
Radium-224	ND	ND	1.52	ND	ND	ND
Thallium-208	ND	ND	0.75	ND	ND	ND
Thorium-228	1.30	1.20	1.18	1.4	1.33	1.4
Thorium-230	1.08	1.07	1.03	1.17	0.99	1.21
Thorium-232	1.30	1.32	1.2	1.27	1.37	1.24

NA = Not available.
ND = Not detected.
Units are in pCi/g.

TABLE A-8

ORGANIC DATA RESULTS FOR PRS 3-007

SAMPLE ID	0103-97-0221	0103-97-0222	0103-97-0223	0103-97-0224	0103-97-0225
ANALYTE NAME					
Acetone	15 U	ND	ND	9 U	4 J
Benzoic Acid	ND	ND	710 J	ND	ND
Methylene Chloride	40 U	ND	ND	23 U	5 U

U, J = Data qualifiers (see page A-2).
ND = Not detected.
Units are in mg/kg.

TABLE A-9

INORGANIC DATA RESULTS FOR PRS 3-014(k)

SAMPLE ID	0103-97-0011	0103-97-0012	0103-97-0013
ANALYTE NAME			
Aluminum	1700	1660	1730 U
Antimony	4.7 U	5.4 U	5
Arsenic	0.6	1.4	2.3
Barium	77.5	17.5	21.5
Beryllium	0.38 U	0.54	0.5
Cadmium	0.47 U	0.54 U	0.5 U
Calcium	3340	773	816
Chromium	10.1	10.3	24
Cobalt	2	1.1	1
Copper	10	4.6	6.9
Iron	6020	10100	11200
Lead	6.2	8.4	10.9
Magnesium	856	833	803
Manganese	60.8	91.3	97.6
Mercury	0.10	0.050 U	0.052 U
Nickel	3.8	5.6	11.9
Potassium	366	578	506
Selenium	0.25 U	0.26 U	0.25 U
Silver	2.7	0.89	0.57
Sodium	280	404	430
Thallium	0.2 U	0.21 U	0.2 U
Vanadium	15.5	4.9	5
Zinc	21.5	154	164

U = Data qualifier (see page A-2).
Units are in mg/kg.

TABLE A-10

RADIONUCLIDE DATA RESULTS FOR PRS 3-014(k)

SAMPLE ID	0103-97-0011	0103-97-0012	0103-97-0013	0103-97-0012D
ANALYTE NAME				
Plutonium-238	-0.016 U	0.005 U	0.004 U	NA
Plutonium-239	0.009 U	0.007 U	0 U	NA
Strontium-90	-0.28 U	-0.46 U	-0.42 U	NA
Tritium	0.02 U	0.06 U	0.04 U	0.15
Uranium-234	0.501	0.36	0.37	NA
Uranium-235	0.0151	0.024	0.018	NA
Uranium-238	0.56	0.34	0.38	NA

U = Data qualifier (see page A-2).
NA = Not available.
Units are in pCi/g.

TABLE A-11

ORGANIC DATA RESULTS FOR PRS 3-014(k)

SAMPLE ID	0103-07-0011	0103-07-0012	0103-07-0013
ANALYTE NAME			
1,4-Dichlorobenzene	0.340 U	0.400 U	0.400 U
Acenaphthene	0.340 U	0.400 U	0.400 U
Anthracene	0.340 U	0.400 U	0.400 U
Aroclor 1254	0.034 U	0.040 U	0.040 U
Benzo(a)anthracene	0.340 U	0.400 U	0.400 U
Benzo(a)pyrene	0.340 U	0.400 U	0.400 U
Benzo(b&k)fluoranthene	0.340 U	0.400 U	0.400 U
Benzo(g,h,i)perylene	0.340 U	0.400 U	0.400 U
Carbazole	0.340 U	0.400 U	0.400 U
Chrysene	0.340 U	0.400 U	0.400 U
Dibenzofuran	0.340 U	0.400 U	0.400 U
Dibenzo(a,h)anthracene	0.340 U	0.400 U	0.400 U
Dibenzo(a,h)anthracene	0.340 U	0.400 U	0.400 U
Fluoranthene	0.340 U	0.400 U	0.400 U
Indeno(1,2,3-c,d)pyrene	0.340 U	0.400 U	0.400 U
Naphthalene	0.340 U	0.400 U	0.400 U
Phenanthrene	0.340 U	0.400 U	0.400 U
Pyrene	0.340 U	0.400 U	0.400 U

U = Data qualifier (see page A-2).
ND = Not detected.
Units are in mg/kg.

TABLE A-12

INORGANIC DATA RESULTS FOR PRS 3-014(l)

SAMPLE ID	0103-97-0014	0103-97-0015	0103-97-0016
ANALYTE NAME			
Aluminum	1720	1790	1360
Antimony	5 U	5.2 U	5 U
Arsenic	0.66	0.89	0.77
Barium	88.9	20.7	18.1
Beryllium	0.4 U	0.42 U	0.61
Cadmium	0.5 U	0.52 U	0.5 U
Calcium	3280	734	610
Chromium	13.1	9.7	11.4
Cobalt	1.9	1 U	1 U
Copper	30	4.7	3.5
Iron	5980	6730	7690
Lead	4.7	4.8	3.8
Magnesium	1320	559	665
Manganese	116	364	354
Mercury	0.15	0.057	0.048 U
Nickel	8.7	8.5	8.2
Potassium	307	421	507
Selenium	0.18 U	0.24 U	0.23 U
Silver	5.7	0.68	0.5 U
Sodium	340	355	376
Thallium	0.14 U	0.19 U	0.18 U
Vanadium	11.2	4.8	4.6
Zinc	44.5	35.1	40.5

U = Data qualifier (see page A-2).
Units are in mg/kg

TABLE A-13

RADIONUCLIDE DATA RESULTS FOR PRS 3-014(l)

SAMPLE ID	0103-97-0014	0103-97-0015	0103-97-0016
NAME			
Plutonium-238	0.002 U	-0.02 U	0.007 U
Plutonium-239	0.027 U	-0.004 U	0.002 U
Strontium-90	0.26 U	-0.38 U	-0.01 U
Tritium	0.03	0.04	0.04
Uranium-234	0.43	0.38	0.36
Uranium-235	0.017	0.023	0.029 U
Uranium-238	0.66	0.041	0.41

U = Data qualifier (see page A-2).
Units are in pCi/g.

TABLE A-14

ORGANIC DATA RESULTS FOR PRS 3-014(l)

SAMPLE ID	0103-97-0014	0103-97-0015	0103-97-0016
NAME			
1,4-Dichlorobenzene	0.340 U	0.370 U	7.400 U
Acenaphthene	0.340 U	0.370 U	7.400 U
Acetone	ND	ND	ND
Anthracene	0.340 U	0.370 U	7.400 U
Aroclor 1254	0.078	0.037 U	0.037 U
Benzo[a]anthracene	0.340 U	0.370 U	7.400 U
Benzo[a]pyrene	0.340 U	0.370 U	7.400 UJ
Benzo[b&k]fluoranthene	0.340 U	0.370 U	7.400 UJ
Benzo[g,h,i]perylene	0.340 U	0.370 U	7.400 UJ
Carbazole	0.340 U	0.370 U	7.400 U
Chrysene	0.340 U	0.370 U	7.400 U
Dibenzofuran	0.340 U	0.370 U	7.400 U
Dibenzo[a,h]anthracene	0.340 U	0.370 U	7.400 U
Dibenzo[a,h]anthracene	0.340 U	0.370 U	7.400 UJ
Fluoranthene	0.340 U	0.370 U	7.400 U
Indeno(1,2,3-c,d)pyrene	0.340 U	0.370 U	7.400 UJ
Methylene chloride	ND	ND	ND
Naphthalene	0.340 U	0.370 U	7.400 U
Phenanthrene	0.340 U	0.370 U	7.400 U
Pyrene	0.340 U	0.370 U	7.400 U
Toluene	ND	ND	0.004 J

U, UJ, J = Data qualifiers (see page A-2).
ND = Not detected.
Units are in mg/kg.

TABLE A-15

INORGANIC DATA RESULTS FOR PRS 3-014(c)

SAMPLE ID	0103-97-0024	0103-97-0025	0103-97-0026	0103-97-0027	0103-97-0028
ANALYTE NAME					
Aluminum	1810 J-	908 J-	867 J-	1580 J-	854 J-
Antimony	4.3 U	3.8 U	4.8 U	5.4 U	4.9 U
Arsenic	0.79	0.512	0.54	0.68	0.66
Barium	50.7	14	15.8	35.1	14.4
Beryllium	0.34 U	0.35	0.38 U	0.43 U	0.39 U
Cadmium	0.63	0.38 U	0.48 U	0.54 U	0.49 U
Calcium	1400	642	394	1660	411
Chromium	40.6 J+	12.8 J+	9.88 J+	14.3 J+	8.66 J+
Cobalt	1.8	0.76 U	0.86	2.2	0.87 U
Copper	46.8	5.04	1.3 U	18.5	1.28
Iron	3290 J-	3170 J-	3560 J-	4600 J-	2.5 J-
Lead	17.1	3.05	2.23	5.96	2.46
Magnesium	640	156	137	892	119 U
Manganese	60.2	237	327	120	284
Mercury	1.43	0.061	0.019 U	0.22	0.019 U
Nickel	4.9	6.7	5.29	5.2	4.3
Potassium	351	179	205	330	172
Selenium	0.18 U	0.22 U	0.22 U	0.23 U	0.23 U
Silver	19.7	1.34	0.479 U	6.48	0.486 U
Sodium	332	263	336	358	329
Thallium	0.15 U	0.17 U	0.18 U	0.19 U	0.18 U
Vanadium	7.62	2.4	2.11	9.5	2
Zinc	53.7	19.1	17.4	29	14.8

U, J-, J+ = Data qualifiers (see page A-2).
Units are in mg/kg.

TABLE A-15 (CONTINUED)

INORGANIC DATA RESULTS FOR PRS 3-014(o)

SAMPLE ID	0103-97-0029	0103-97-0030	0103-97-0031	0103-97-0032
ANALYTE NAME				
Aluminum	706 J-	1530 J-	434 J-	368 J-
Antimony	5.1 U	5 U	4.9 U	4.0 U
Arsenic	0.48	2.32	0.53	0.41
Barium	13.3	85.6	12.4	9.6
Beryllium	0.41 U	0.4 U	0.4 U	0.37 U
Cadmium	0.51 U	2.5	0.49 U	0.46 U
Calcium	449	1480	211	178
Chromium	12 J+	130 J+	25 J+	19.2 J+
Cobalt	1 U	2	0.99 U	0.92 U
Copper	1.05	122	2.94	0.708
Iron	3340 J-	4880 J-	2970 J-	2930 J-
Lead	2.12	46.1	1.48	1.20
Magnesium	108	734	86.7	83.4
Manganese	275	54.9	157	210
Mercury	0.021 U	3.8	0.033	0.018 U
Nickel	0.41	9.8	11.4	10.1
Potassium	178	311	147	140
Selenium	0.25 U	0.34	0.22 U	0.20 U
Silver	0.509 U	71.3	1.13	0.402 U
Sodium	359	295	338	317
Thallium	0.2 U	0.15 U	0.18 U	0.2 U
Vanadium	2.6	17.9	1.5	1.1
Zinc	14.8	131	20.8	16.7

U, J-, J+ = Data qualifiers (see page A-2).
Units are in mg/kg.

TABLE A-16

RADIONUCLIDE DATA RESULTS FOR PRS 3-014(c)

SAMPLE ID	0103-97-0024	0103-97-0025	0103-97-0026	0103-97-0027	0103-97-0028	0103-97-0029	0103-97-0030	0103-97-0031	0103-97-0032
ANALYTE NAME									
Gross Alpha	7.66	7.66	7.66	7.66	7.66	7.66	7.66	7.66	7.66
Gross Beta	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3
Plutonium-238	0.032 U	-0.005 U	0.009 U	0.007 U	-0.012 U	-0.001 U	0.006 U	0.016 U	-0.009 U
Plutonium-239	0.068	0.009 U	0.009 U	0.017	0.007 U	0.0004 U	0.131	0.186	0.003 U
Strontium-90	3	0.56	-0.11	0.1	3.2	-0.18	6.01	-0.25 U	-0.13
Tritium	0.734	-0.04 U	-0.161 U	0.256 U	-0.036 U	-0.124	2.91	0.064 U	-0.055 U
Uranium-234	1.05	0.423	0.504	0.391	0.442	0.398	2.68	0.457	0.426
Uranium-235	0.048	0.049	0.017 U	0.025	0.017	0.035	0.093	0.024	0.025
Uranium-238	1.05	0.429	0.459	0.349	0.418	0.332	1.09	0.377	0.42

U = Data qualifier (see page A-2).
Units are in pCi/g.

TABLE A-17

ORGANIC DATA RESULTS FOR PRS 3-014(o)

SAMPLE ID	0103-97-0024	0103-97-0025	0103-97-0026	0103-97-0027	0103-97-0028
ANALYTE NAME					
Acenaphthylene	0.340 U	0.370 U	0.360 U	0.340 U	0.370 U
Acetone	ND	ND	ND	ND	ND
Anthracene	0.340 U	0.370 U	0.360 U	0.340 U	0.370 U
Benzo(a)-anthracene	0.160 J	0.370 U	0.360 U	0.340 U	0.370 U
Benzo(a)pyrene	0.220 J	0.370 U	0.360 U	0.340 U	0.370 U
Benzo(b)-fluoranthene	0.390	0.370 U	0.360 U	0.340 U	0.370 U
Benzo(g,h,i)-perylene	0.160 J	0.370 U	0.360 U	0.340 U	0.370 U
Benzo(k)-fluoranthene	0.120 J	0.370 U	0.360 U	0.340 U	0.370 U
Benzoic Acid	3.400 U	3.700 U	3.600 U	3.400 U	3.700 U
Bis(2-Ethylhexyl)-phthalate	0.320 U	0.220 U	0.270 U	0.160 U	0.170 U
Butylbenzyl-phthalate	0.340 U	0.370 U	0.360 U	0.340 U	0.370 U
Carbazole	0.340 U	0.370 U	0.360 U	0.340 U	0.370 U
Chrysene	0.250 J	0.370 U	0.360 U	0.340 U	0.370 U
Dibenzo(a,h)-anthracene	0.340 U	0.370 U	0.360 U	0.340 U	0.370 U
Flouranthene	0.200 J	0.370 U	0.360 U	0.340 U	0.370 U
Ideno(1,2,3-cd)-pyrene	0.160 J	0.370 U	0.360 U	0.340 U	0.370 U
MCPA[a]	0.411 U	0.447 U	0.447 U	0.412 U	0.451 U
MCPP[b]	0.411 U	0.447 U	0.447 U	0.993	0.451
Methylene Chloride	ND	ND	0.010 U	ND	ND
PCB-1260	0.093	0.015 U	0.015 U	0.098	0.015 U
Phenanthrene	0.036 J	0.370 U	0.360 U	0.340 U	0.370 U
Pyrene	0.230 J	0.370 U	0.360 U	0.340 U	0.370 U

U, J = Data qualifiers (see page A-2).
ND = Not detected.
Units are in mg/kg.
[a] MCPA: 2-methyl-4-chlorophenoxyacedic acid.
[b] MCPP: 4-(2-methyl-4chlorophenoxy) propanoic acid.

TABLE A-17 (CONTINUED)

ORGANIC DATA RESULTS FOR PRS 3-014(o)

SAMPLE ID	0103-97-0029	0103-97-0030	0103-97-0031	0103-97-0032
ANALYTE NAME				
Acenaphthylene	0.370 U	0.340 U	0.350 U	0.360 U
Acetone	ND	ND	ND	0.002 U
Anthracene	0.370 U	0.055 J	0.350 U	0.360 U
Benzo(a)-anthracene	0.370 U	0.510	0.350 U	0.360 U
Benzo(a)pyrene	0.370 U	0.670	0.350 U	0.360 U
Benzo(b)-fluoranthene	0.370 U	1.300	0.350 U	0.360 U
Benzo(g,h,i)-perylene	0.370 U	0.260 J	0.350 U	0.360 U
Benzo(k)-fluoranthene	0.370 U	0.460	0.350 U	0.360 U
Benzoic Acid	3.700 U	0.150 J	3.500 U	3.600 U
Bis(2-Ethylhexyl)-phthalate	0.370 U	0.840 U	0.350 U	0.420 U
Butylbenzyl-phthalate	0.370 U	0.035 J	0.350 U	0.360 U
Carbazole	0.370 U	0.036 J	0.350 U	0.360 U
Chrysene	0.370 U	0.680	0.350 U	0.360 U
Dibenzo(a,h)-anthracene	0.370 U	0.074 J	0.350 U	0.360 U
Fluoranthene	0.370 U	0.840	0.350 U	0.360 U
Idono(1,2,3-cd)-pyrene	0.370 U	0.260 J	0.350 U	0.360 U
MCPA[a]	0.460 U	0.956 J+	0.429 U	0.435 U
MCPP[b]	0.460 U	0.408 U	0.429 U	0.435 U
Methylene Chloride	0.010 U	ND	ND	0.010 U
PCB-1260	0.015 U	1.220	0.014 U	0.015 U
Phenanthrene	0.370 U	0.260 J	0.350 U	0.360 U
Pyrene	0.370 U	0.710	0.350 U	0.360 U

U, J, J+ = Data qualifiers (see page A-2).
NA = Not available.
Units are in mg/kg.
[a] MCPA: 2-methyl-4-chlorophenoxyacedic acid.
[b] MCPP: 4-(2-methyl-4chlorophenoxy) propanoic acid.

TABLE A-18

INORGANIC DATA RESULTS FOR PRS 3-021

SAMPLE ID	0103-97-0241	0103-97-0242	0103-97-0243	0103-97-0244	0103-97-0245	0103-97-0246	0103-97-0247
ANALYTE NAME							
Aluminum	7000	9250	19900	7950	6110	7750	7330
Antimony	0.75 U	0.83 U	0.95 U	0.83 U	0.66 U	0.78 U	0.76 U
Arsenic	3.5	4.1	6	5.4	2.9	4	4
Barium	69.6	97.9	166	90.1	63.5	119	139
Beryllium	0.95	1	1.7	1	81	0.99	1
Cadmium	0.09 U	0.11 U	0.11 U	0.1 U	0.1 U	0.09 U	0.29
Calcium	1400	1970	4200	1920	1230	2100	1820
Chromium	7.9	28.1	101	9	8.8	11.8	56.6
Cobalt	5.5	5.2	5.7	7.5	2.4	5.8	11.2
Copper	22.9	9.4	12	5.6	2.9	7.5	9.4
Iron	12800	12100	33200	14500	16100	12700	13600
Lead	24.7	84.7	33.7	29.7	8.7	31.4	358
Magnesium	1250	1590	2700	1460	1130	1400	1650
Manganese	145 J-	103 J-	341 J-	504 J-	145 J-	429 J-	624 J-
Mercury	0.02	0.02	0.02 U	0.02	0.02 U	0.05	0.02 U
Nickel	24.5	7.4 U	9.6	6.6	11.4	7.5	13.1
Potassium	912	1660	2510	1330	945	1110	1300
Selenium	0.98	0.78	1	0.66 U	0.68 U	0.66	0.61
Silver	0.27 U	0.29 U	0.34 U	0.29 U	0.3 U	0.27 U	0.27 U
Sodium	114	104	149	107	146	138	116
Thallium	2.1	2	1.3	0.54 U	0.55 U	0.5 U	0.49 U
Vanadium	23.4	21.2	30	28.3	12.1	19	21.6
Zinc	53	39.9	4.6	28	19.5	52.5	193

U, J- = Data qualifiers (see page A-2).
Units are in mg/kg.

TABLE A-18 (CONTINUED)

INORGANIC DATA RESULTS FOR PRS 3-021

SAMPLE ID	0103-97-0248	0103-97-0249	0103-97-0250	0103-97-0251	0103-97-0256
ANALYTE NAME					
Aluminum	4430	4110	4820	3750	4530
Antimony	0.75 U	0.8 U	0.79 U	0.75 U	0.76 U
Arsenic	2.4	2.4	2.5	2.4	2.4
Barium	32	50.8	63.1	36.7	35.1
Beryllium	0.69	0.84	0.86	0.83	0.67
Cadmium	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U
Calcium	747	1150	1260	828	795
Chromium	5.9	6.3	13.5	4.6	5.8
Cobalt	3.6	2.4	3	2.6	3.4
Copper	3.8	2.8	4.5	2.6	3.9
Iron	11900	11600	10900	11200	11200
Lead	103	15.7	41.6	67.1	63.3
Magnesium	781	925	1030	853	762
Manganese	403 J-	312 J-	245 J-	422 J-	357 J-
Mercury	0.02 U	0.02 U	0.03	0.02 U	0.02 U
Nickel	6.2	6.8	12.5	6.8	5.7
Potassium	647	653	760	648	655
Selenium	0.59 U	0.64 U	0.63 U	0.66	0.6 U
Silver	0.26 U	0.28 U	0.28 U	0.26 U	0.27 U
Sodium	148	83.3	85.9	131	141
Thallium	0.48 U	0.52 U	0.51 U	0.48 U	0.49 U
Vanadium	8.8	10.3	11.4	8.1	9.1
Zinc	46.3	49.3	74.9	49.3	48.3

U, J- = Data qualifiers (see page A-2).
Units are in mg/kg.

TABLE A-19

INORGANIC DATA RESULTS FOR PRS 3-049(a)

SAMPLE ID	0103-97-0001	0103-97-0002	0103-97-0003	0103-97-0004	0103-97-0005	0103-97-0006	0103-97-0007
ANALYTE NAME							
Aluminum	1250	5680	3860	2050	8110	980	3480
Antimony	1.1 U	2.3 U	1.2 U	1.2 U	3.3 U	0.95 U	2.3 U
Arsenic	2.4	3.5	2.3	1.2	6.0	0.73 U	2.6
Barium	39.9	80.3	34.2	35.7	171	10.8	41.6
Beryllium	0.12 U	0.27 U	0.25	0.14 U	0.80	0.11 U	0.30
Cadmium	0.12 U	0.27 U	0.15 U	0.14 U	0.39 U	0.11 U	0.27 U
Calcium	1380	5590	1400	1530	4990	273	2240
Chromium	68.2 J-	152 J-	274 J-	204 J-	198 J-	4.2 J-	86.3 J-
Cobalt	4.1	2.8	2.2	2.2	14.7	0.75	3.0
Copper	446	663	68.2	80.7	310	17.0	161
Cyanide	0.49 UJ	0.51 UJ	0.41 UJ	0.48 UJ	0.5 UJ	0.49 UJ	0.47 UJ
Iron	9720	17400	14900	6980	19200	6320	12100
Lead	25.1	53.9	25.2	51.2	92.0	5.2	20.7
Magnesium	445	1830	881	515	1880	170	820
Manganese	254 J-	173 J-	188 J-	249 J-	1110 J-	125 J-	504 J-
Mercury	0.03	0.09	0.03 U	0.03 U	0.08	0.02 U	0.05 U
Nickel	29.9	29.5	12.8	22.3	65.7	1.9	16.2
Potassium	203	720	481	184	800	47.9	340
Selenium	0.84 U	1.8 U	0.99 U	0.92 U	2.6 U	0.75 U	1.8 U
Silver	0.37 U	1.1	0.44 U	0.41 U	1.2 U	0.33 U	0.81 U
Sodium	94.4	220	130	98.3	337	65.5	208
Thallium	1.8	1.5 U	0.81 U	0.75 U	2.1 U	0.61 U	1.5 U
Vanadium	7.7	24.7	17.8	10.2	34.8	2.5	13.6
Zinc	422	421	356	222	564	46.7	270

U, UJ, J- = Data qualifiers (see page A-2).
Units are in mg/kg.

TABLE A-19 (CONTINUED)

INORGANIC DATA RESULTS FOR PRS 3-049(a)

SAMPLE ID	0103-97-0088	0103-97-0091	0103-97-0090	0103-97-0097	0103-97-0098	0103-97-0081D
ANALYTE NAME						
Aluminum	2580	1780	23.6 U	23.6 U	23.6 U	1260
Antimony	1.3 U	0.98 U	3.4 U	3.4 U	3.4 U	0.06 U
Arsenic	0.99 U	1.5	2.8	2.6 U	2.6 U	2.4
Barium	10.0	18.2	28.4	32.0	0.78	39.9
Beryllium	0.16 U	0.36	0.4 U	0.4 U	0.4 U	0.12 U
Cadmium	0.16 U	0.11 U	0.4 U	0.4 U	0.4 U	0.12 U
Calcium	1020	864	11400	12900	2.6 U	1380
Chromium	41.3 J-	17.7 J-	4.6	7.8	0.9 U	66.1
Cobalt	1.8	1.4	0.9 U	0.9 U	0.9 U	4.1
Copper	155	33.9	13.2	6.6	0.9 U	450
Cyanide	0.43 UJ	0.49 UJ	10 U	10 U	10 U	NA
Iron	10200	7800	20.9	93.9	16.6 U	8720
Lead	66.6	11.4	1.6 U	1.6 U	1.6 U	25.1
Magnesium	787	345	3700	4060	10.3 U	446
Manganese	105 J-	103 J-	1.1	5.6	0.58	254
Mercury	0.03 U	0.02 U	0.03 U	0.03 U	0.03 U	0.029
Nickel	21.1	3.7	1 U	2.1	1 U	29.9
Potassium	325	145	1950	1070	83.5 U	203
Selenium	1 U	0.78 U	2.7 U	2.7 U	2.7 U	0.84 U
Silver	0.49	0.34 U	1.2 U	1.2 U	1.2 U	0.37 U
Sodium	110	70.1	11600	12900	266	84.4
Thallium	0.84 U	0.63 U	6.6	6.6	4.9	1.79
Vanadium	6.4	7.6	10.3	6.6	0.9 U	7.73
Zinc	226	80.4	6.9	11.9	1.8	422

U, UJ, J- = Data qualifiers (see page A-2).
NA = Not available.
Units are in mg/kg.

TABLE A-20

RADIONUCLIDE DATA RESULTS FOR PRS 3-049(a)

SAMPLE ID	0103-97-0001	0103-97-0002	0103-97-0003	0103-97-0004	0103-97-0005	0103-97-0006
NAME						
Uranium-234	1.057	1.83	0.71	0.09	2.19	0.63
Uranium-235	0.022 U	0.062 U	0.013 U	0.03 U	0.14	0.028 U
Uranium-238	1.108	2.36	0.69	1.59	3.36	0.66

U = Data qualifier (see page A-2).
Units are in pCi/g.

TABLE A-20 (CONTINUED)

RADIONUCLIDE DATA RESULTS FOR PRS 3-049(a)

SAMPLE ID	0103-97-0067	0103-97-0068	0103-97-0091	0103-97-0096	0103-97-0097	0103-97-0098	0103-97-0061D
ANALYTE NAME							
U-234	0.94	1.14	0.52	0.26	0.11	0.009 U	1.13
U-235	0.046 U	0.08	0.013 U	0 U	0 U	0 U	0.02
U-238	1.32	1.48	0.55	0.08	0.06	0.018 U	1.3

U = Data qualifier (see page A-2).
Units are in pIC/g.

TABLE A-21

ORGANIC DATA RESULTS FOR PRS 3-049(a)

SAMPLE ID	0103-97-0061	0103-97-0062	0103-97-0063	0103-97-0064	0103-97-0065	0103-97-0066
ANALYTE NAME						
2-Butanone	0.013 J	0.042 U	ND	ND	ND	ND
Acetone	0.074 U	0.042 U	ND	ND	ND	ND
Methylene Chloride	0.011 J	0.012	ND	ND	ND	ND

U, J = Data qualifiers (see page A-2).
ND = Not detected.
Units are in mg/kg.

TABLE A-21 (CONTINUED)

ORGANIC DATA RESULTS FOR PRS 3-049(a)

SAMPLE ID	0103-97-0067	0103-97-0068	0103-97-0091	0103-97-0096	0103-97-0097	0103-97-0098
ANALYTE NAME						
2-Butanone	ND	ND	ND	ND	ND	ND
Acetone	ND	ND	ND	ND	ND	ND
Methylene Chloride	ND	ND	ND	ND	ND	ND

U, J = Data qualifiers (see page A-2).
ND = Not detected.
Units are in mg/kg.

TABLE A-22

INORGANIC DATA RESULTS FOR PRS 3-052(a)

SAMPLE ID	0103-97-0170	0103-97-0175	0103-97-0176	0103-97-0177	0103-97-0177D
ANALYTE NAME					
Aluminum	10200	8130	14200	4790	NA
Antimony	7.5 UJ	6.6 UJ	7.1 UJ	6.9 UJ	NA
Arsenic	2.2 J-	2.9 J-	1.5 J-	1.8 J-	NA
Barium	106	108	219	74.2	NA
Beryllium	0.73	0.66	1.4	0.43	NA
Cadmium	0.62 U	0.55 U	0.59 U	0.61	NA
Calcium	2190	2060	3450	4930	NA
Chromium	7.8	7.8	9.6	5.4	NA
Cobalt	3.9	21.5	13.7	4.2	NA
Copper	6.3	6.1	11.3	10.9	NA
Iron	12400	10400	15800	6570	NA
Lead	15.2	19.6	15.2	17.9	NA
Magnesium	1710	1530	2890	1280	NA
Manganese	298 J+	470 J+	1000 J+	244 J+	NA
Mercury	0.06	0.06 U	0.06 U	0.05 U	0.0522 U
Nickel	8.0	8.0	20.0	6.3	NA
Potassium	1140	1190	2030	739	NA
Selenium	0.37 U	0.34 U	0.35 U	0.21	NA
Silver	2.2 U	1.9 U	2.1 U	1.7 U	NA
Sodium	173	133	291	94.1	NA
Thallium	0.3 U	0.27 U	0.29 U	0.25	NA
Vanadium	17.2	24.4	24.5	11.1	NA
Zinc	45.6	28.0	32.0	152	NA

U, UJ, J-, J+ = Data qualifiers (see page A-2).
Units are in mg/kg.

TABLE A-22 (CONTINUED)

INORGANIC DATA RESULTS FOR PRS 3-052(b)

SAMPLE ID	0103-97-0163	0103-97-0164	0103-97-0165	0103-97-0166	0103-97-0167	0103-97-0168	0103-97-0169
ANALYTE NAME							
Aluminum	11300	9380	19800	16500	10700	13200	5390
Antimony	7.7 UJ	7.6 UJ	8.7 UJ	7.2 UJ	7.4 UJ	7.1 UJ	7.3 UJ
Arsenic	2.3 J-	1.7 J-	2.4 J-	2 J-	2.2 J-	3 J-	3.6 J-
Barium	144	190	140	148	103	141	66.2
Beryllium	0.91	0.92	1.1	0.90	0.74	0.90	0.42
Cadmium	0.64 U	0.63 U	0.55 U	0.6 U	0.62 U	0.59 U	0.6 U
Calcium	2380	2040	3980	2690	2850	2900	1090
Chromium	11.8	8.9	16.3	10.5	8.2	9.1	3.7
Cobalt	5.0	3.8	8.2	4.2	3.5	3.9	2.0
Copper	9.0	8.1	9.0	8.6	9.6	7.6	3.5
Iron	13200	9090	16300	14700	12700	13900	7130
Lead	17.4	15.9	17.6	64	16.4	45	18
Magnesium	2030	1820	2600	2340	1070	2130	740
Manganese	455 J+	216	330 J+	100 J+	203 J+	124 J+	228 J+
Mercury	0.07 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U	0.06 U
Nickel	11.6	10.0	14.5	8.6	8.7	8.4	2.5
Potassium	1550	1300	1620	1070	1080	1390	631
Selenium	0.46 U	0.4 U	0.39 U	0.4 U	0.38 U	0.38 U	0.38 U
Silver	2.2 U	2.2 U	1.9 U	2.1 U	2.2 U	2.1 U	2.1 U
Sodium	152	176	208	228	109	204	131
Thallium	0.37 U	0.33 U	0.32 U	0.32 U	0.31 U	0.31 U	0.31 U
Vanadium	25.0	15.0	22.2	23.1	18.6	21.9	10.1
Zinc	40.2	20.6	31.7	36.9	49.8	32	23.6

U, UJ, J-, J+ = Data qualifiers (see page A-2).
NA = Not available.
Units are in mg/kg.

TABLE A-23

RADIONUCLIDE DATA RESULTS FOR PRS 3-052(b)

SAMPLE ID	0103-97-0163	0103-97-0164	0103-97-0165	0103-97-0166	0103-97-0167	0103-97-0168
ANALYTE NAME						
Gross Alpha	3.75	11.9	NA	NA	NA	NA
Gross Beta	20.4	30.3	NA	NA	NA	NA
Uranium-234	0.983	0.735	0.778	0.62	0.606	0.596
Uranium-235	0.039	0.024	0.059	0.044	0.043	0.021
Uranium-238	0.837	0.708	0.875	0.606	0.799	0.615

NA = Not available.
Units are in pCi/g.

TABLE A-23 (CONTINUED)

RADIONUCLIDE DATA RESULTS FOR PRS 3-052(b)

SAMPLE ID	0103-97-0169	0103-97-0170	0103-97-0175	0103-97-0176	0103-97-0177
ANALYTE NAME					
Gross Alpha	NA	NA	NA	NA	2.23
Gross Beta	NA	NA	NA	NA	37.9
Uranium-234	0.582	0.642	0.69	0.478	0.598
Uranium-235	0.052	0.021	0.054	0.025	0.026
Uranium-238	0.613	0.937	0.682	0.668	0.867

NA = Not available.
Units are in pCi/g

TABLE 2-24

ORGANIC DATA RESULTS FOR PRS 3-052(b)

SAMPLE ID	0103-97-0169	0103-97-0170	0103-97-0175	0103-97-0176	0103-97-0177
ANALYTE NAME					
Gross Alpha	NA	NA	NA	NA	2.23
Gross Beta	NA	NA	NA	NA	37.9
Uranium-234	0.582	0.642	0.69	0.478	0.598
Uranium-235	0.052	0.021	0.054	0.025	0.026
Uranium-238	0.613	0.937	0.682	0.668	0.867

U = Data qualifier (see page A-2).
ND = Not detected.
Units are in mg/kg.

TABLE 2-24 (CONTINUED)

ORGANIC DATA RESULTS FOR PRS 3-052(b)

SAMPLE ID	0103-97-0169	0103-97-0170	0103-97-0175	0103-97-0176	0103-97-0177
NAME					
Acetone	ND	ND	ND	ND	ND
Carbon Disulfide	ND	ND	ND	ND	ND
Methylene Chloride	ND	ND	ND	ND	ND
2-Butanone	ND	ND	ND	ND	ND

ND = Not detected.
Units are in mg/kg.

TABLE A-25

INORGANIC DATA RESULTS FOR PRS 3-056(k)

SAMPLE ID	0103-97-0151	0103-97-0152	0103-97-0153	0103-97-0154	0103-97-0155	0103-97-0156	0103-97-0158
ANALYTE NAME							
Aluminum	NA	7250	12300	NA	21700	15500	11000
Antimony	NA	7.6 UJ	7.2 UJ	NA	6.4 UJ	7.5 UJ	7.4 UJ
Arsenic	NA	2.4 J-	1.6 J-	NA	0.99 J-	2.7 J-	1.8 J-
Barium	NA	75.6	113	NA	174	136	103
Beryllium	NA	0.55	0.92	NA	1.2	1.2	0.81
Cadmium	NA	0.63 U	0.6 U	NA	0.53 U	0.62 U	0.61 U
Calcium	NA	1830	2910	NA	3970	2840	2380
Chromium	NA	4.5	6.5	NA	14.9	10.6	7.4
Cobalt	NA	1.9	5.0	NA	6.5	5.6	4.5
Copper	NA	6.6	6.9	NA	10.7	7.7	6.2
Iron	NA	9020	12400	NA	20000	19300	13000
Lead	NA	15.8 J-	15.9 J-	NA	7 J-	18 J-	15 J-
Magnesium	NA	1210	2140	NA	3040	2270	1790
Manganese	NA	140 J+	222 J+	NA	433 J+	501 J+	268 J+
Mercury	NA	0.06 U	0.06 U	NA	0.05 U	0.06 U	0.06 U
Nickel	NA	4.2	9.2	NA	8.2	7.5	5.9
Potassium	NA	753	1530	NA	1810	1510	1310
Selenium	NA	0.4 U	0.37 U	NA	0.31 U	0.38 U	0.39 U
Silver	NA	2.2 U	2.1 U	NA	1.9 U	2.2 U	2.2 U
Sodium	NA	121	190	NA	141	171	170
Thallium	NA	0.33 U	0.3 U	NA	0.25 U	0.31 U	0.32 U
Vanadium	NA	10.9	17.4	NA	33.9	36.2	16.9
Zinc	NA	23.1	26.3	NA	37.7	32.4	35.2

U, UJ, J-, J= Data qualifiers (see page A-2).
NA = Not available.
Units are in mg/kg.

TABLE A-25 (CONTINUED)

INORGANIC DATA RESULTS FOR PRS 3-056(k)

SAMPLE ID	0103-97-0161	0103-97-0171	0103-97-0172	0103-97-0173	0103-97-0174	0103-97-0211	0103-97-0152D
ANALYTE NAME							
Aluminum	5460	10600	10500	9990	11200	5790	8590
Antimony	7 UJ	6.6 UJ	7.4 UJ	6.3 UJ	6.9 UJ	6.7 UJ	7.6 U
Arsenic	1.8 J-	2.2 UJ	2.7 J-	1.7 J-	1.5 J-	1.6 J-	2.1
Barium	75.6	120	86.5	88.2	94.2	61	182
Beryllium	0.46	0.82	0.71	0.73	0.77	0.46	0.75
Cadmium	0.58 U	0.55 U	0.61 U	0.52 U	0.57 U	0.56 U	0.63 U
Calcium	575	2650	2110	2210	2420	636	3660
Chromium	3.5	10.2	8.5	8.4	9	4.9	5.4
Cobalt	3.4	8.1	5.6	5.7	4.2	4.3	2.4
Copper	4.0	20.1	5.4	10.1	28.2	4.4	6.3
Iron	7910	12600	12400	11800	12200	9040	9130
Lead	13.3 J-	24.9 J-	15.3 J-	17.5 J-	20.5 J-	13.1 J-	8.9
Magnesium	827	1630	1690	1690	1800	751	1570
Manganese	476 J+	461 J+	238 J+	275 J+	224 J+	399 J+	158
Mercury	0.06 U	0.05 U	0.06 U	0.08	0.06 U	0.06	0.06 U
Nickel	3.1	9.4	7	7.8	6.9	4.6	7.1
Potassium	664	1320	1130	1350	1430	857	1000
Selenium	0.35 U	0.34 U	0.39 U	0.35 U	0.36 U	0.16 U	0.4 U
Silver	2 U	1.9 U	2.1 U	1.8 U	2 U	2 U	2.2 U
Sodium	112	167	128	164	157	125	144
Thallium	0.28 U	0.28 U	0.31 U	0.28 U	0.29 U	0.32	0.32 U
Vanadium	9.6	22.4	19	15.3	17.1	11.1	13.1
Zinc	26.6	40.8	26.9	37.3	39.6	34.4	22.3

U, UJ, J-, J+ Data qualifiers (see page A-2).
Units are in mg/kg.

TABLE A-26

RADIONUCLIDE DATA RESULTS FOR PRS 3-056(k)

SAMPLE ID	0103-97-0151	0103-97-0152	0103-97-0153	0103-97-0154	0103-97-0155	0103-97-0156	0103-97-0157	0103-97-0158
ANALYTE NAME								
Actinium-228	ND	ND	ND	0.988	ND	ND	ND	ND
Bismuth-211	ND	ND	ND	ND	ND	ND	ND	ND
Bismuth-214	ND	ND	ND	0.733	ND	ND	ND	ND
Cesium-137	ND	ND	ND	0.22	ND	ND	ND	ND
Gross Apha	10.7	8.42	22.3	2.13	NA	NA	NA	9.44
Gross Beta	28.4	25.2	34.1	31	NA	NA	NA	43.9
Lead-212	ND	ND	ND	0.915	ND	ND	ND	ND
Lead-214	ND	ND	ND	0.734	ND	ND	ND	ND
Protactinium-234	ND	ND	ND	31.3	ND	ND	ND	ND
Radium-224	ND	ND	ND	0.033	ND	ND	ND	ND
Thallium-208	ND	ND	ND	0.423	ND	ND	ND	ND
Thorium-234	ND	ND	ND	7.92	ND	ND	ND	ND
Uranium-234	0.601	0.532	0.579	1.39	0.527	0.642	0.607	0.472
Uranium-235	0.076	0.022	0.042	0.144	0.055	0.027	0.071	0.026
Uranium-238	2.91	0.407	0.676	4.71	0.72	0.666	1.59	0.498

NA = Not available.
ND = Not detected.
Units are in pCi/g.

TABLE A-26 (CONTINUED)

RADIONUCLIDE DATA RESULTS FOR PRS 3-056(k)

SAMPLE ID	0103-97-0160	0103-97-0161	0103-97-0171	0103-97-0172	0103-97-0173	0103-97-0174	0103-97-0211
ANALYTE NAME							
Actinium-228	ND	ND	0.96	ND	ND	ND	ND
Bismuth-211	ND	ND	0.106	ND	ND	ND	ND
Bismuth-214	ND	ND	0.765	ND	ND	ND	ND
Cesium-137	ND	ND	ND	ND	ND	ND	ND
Gross Apha	NA	NA	16.5	NA	NA	NA	NA
Gross Beta	NA	NA	32.3	NA	NA	NA	NA
Lead-212	ND	ND	1.16	ND	ND	ND	ND
Lead-214	ND	ND	0.958	ND	ND	ND	ND
Protactinium-234	ND	ND	ND	ND	ND	ND	ND
Radium-224	ND	ND	ND	ND	ND	ND	ND
Thallium-208	ND	ND	0.408	ND	ND	ND	ND
Thorium-234	ND	ND	ND	ND	ND	ND	ND
Uranium-234	1.07	0.528	1.37	0.529	2.14	1.52	0.535
Uranium-235	0.092	0.037	0.158	0.035	0.182	0.203	0.011
Uranium-238	2.01	0.017	4.44	0.737	10.1	7.13	0.625

NA = Not available.
ND = Not detected.
Units are in piC/g.

TABLE A-27

ORGANIC DATA RESULTS FOR PRS 3-056(k)

SAMPLE ID	0103-97-0151	0103-97-0152	0103-97-0153	0103-97-0154	0103-97-0155	0103-97-0156	0103-97-0157	0103-97-0158
ANALYTE NAME								
2-Butanone	ND	ND	6 J	ND	ND	ND	ND	ND
Acetone	ND	ND	49 U	ND	ND	ND	ND	ND
Carbon Disulfide	ND	ND	4 J	ND	ND	ND	ND	ND
Methylene Chloride	ND	ND	62 U	ND	ND	ND	ND	ND

U, J = Data qualifiers (see page A-2).
ND = Not detected.
Units are in mg/kg.

TABLE A-27 (CONTINUED)

ORGANIC DATA RESULTS FOR PRS 3-056(k)

SAMPLE ID	0103-97-0160	0103-97-0161	0103-97-0171	0103-97-0172	0103-97-3173	0103-97-0174	0103-97-0211
ANALYTE NAME							
2-Butanone	ND	ND	ND	ND	ND	ND	ND
Acetone	ND	ND	ND	ND	ND	ND	ND
Carbon Disulfide	ND	ND	ND	ND	ND	ND	ND
Methylene Chloride	ND	ND	ND	ND	ND	ND	ND

ND = Not detected.

TABLE A-28

RADIONUCLIDE DATA RESULTS FOR PRS C-3-014

SAMPLE ID	0103-97-0104	0103-97-0105	0103-97-0106	0103-97-0110	0103-97-0143
ANALYTE NAME					
Uranium-234	0.53	0.56	0.43	0.63	0.49
Uranium-235	0.02 U	0.01 U	0.04	0.04	0.005 U
Uranium-238	0.61	0.55	0.35	0.66	0.58

U = Data qualifier (see page A-2).
Units are in pCi/g.

APPENDIX B DATA VALIDATION

TABLE B-1

SUMMARY TABLE OF QUALITY CONTROL RESULTS FOR PRS3-004(c,d)

REQUEST NUMBER	SAMPLE ID	MATRIX	ANALYTE SUITE	QUALITY CONTROL (QC) COMMENTS
3412R	0103-97-0262	Soil/Ifill	VOC	All VOC data are valid and usable without added qualifiers.
3414R	0103-97-0277	Tuff	VOC	Acetone (4 ug/kg) and methylene chloride (14 ug/kg) found in method blank. All detects <10x blank value are qualified U.
3412R	0103-97-0261	Soil/Ifill	SVOC	Bis(2-ethylhexyl)phthalate found in method blank (56 ug/kg). All detects less than 560 ug/kg consider not detected.
3412R	0103-97-0262	Soil/Ifill	SVOC	Bis(2-ethylhexyl)phthalate found in method blank (56 ug/kg). All detects less than 560 ug/kg consider not detected.
3412R	0103-97-0263	Soil/Ifill	SVOC	Bis(2-ethylhexyl)phthalate found in method blank (56 ug/kg). All detects less than 560 ug/kg consider not detected.
3412R	0103-97-0264	Soil/Ifill	SVOC	Bis(2-ethylhexyl)phthalate found in method blank (56 ug/kg). All detects less than 560 ug/kg consider not detected.
3412R	0103-97-0265	Soil/Ifill	SVOC	Bis(2-ethylhexyl)phthalate found in method blank (56 ug/kg). All detects less than 560 ug/kg consider not detected.
3412R	0103-97-0266	Soil/Ifill	SVOC	Bis(2-ethylhexyl)phthalate found in method blank (56 ug/kg). All detects less than 560 ug/kg consider not detected.
3412R	0103-97-0267	Tuff	SVOC	There was a low recovery for the 6th IS. All associated analytes are qualified UJ. Bis(2-ethylhexyl)phthalate found in method blank (56 ug/kg). All detects less than 560 ug/kg consider not detected.
3412R	0103-97-0268	Tuff	SVOC	Bis(2-ethylhexyl)phthalate found in method blank (56 ug/kg). All detects less than 560 ug/kg consider not detected.
3412R	0103-97-0269	Soil/tuff	SVOC	Bis(2-ethylhexyl)phthalate found in method blank (56 ug/kg). All detects less than 560 ug/kg consider not detected.
3414R	0103-97-0275	Tuff	SVOC	All SVOC data are valid and usable without added qualifiers.
3414R	0103-97-0277	Tuff	SVOC	All SVOC data are valid and usable without added qualifiers.
3414R	0103-97-0278	Tuff	SVOC	All SVOC data are valid and usable without added qualifiers.
3414R	0103-97-0279	Tuff	SVOC	All SVOC data are valid and usable without added qualifiers.
3414R	0103-97-0280	Tuff	SVOC	All SVOC data are valid and usable without added qualifiers.
3414R	0103-97-0329	Tuff (dup)	SVOC	All SVOC data are valid and usable without added qualifiers.
3414R	0103-97-0336	Water (rinse)	SVOC	All SVOC data are qualified UJ for exceeding holding times by 5 days.
3413R	0103-97-0261	Soil/Ifill	METALS	As and Zn qualified UJ or J- for low recovery in the matrix spike sample.
3413R	0103-97-0262	Soil/Ifill	METALS	As and Zn qualified UJ or J- for low recovery in the matrix spike sample.

TABLE B-1 (CONTINUED)

SUMMARY TABLE OF QUALITY CONTROL RESULTS FOR PRS3-004(c,d)

REQUEST NUMBER	SAMPLE ID	MATRIX	ANALYTE SUITE	QUALITY CONTROL (QC) COMMENTS
3413R	0103-97-0263	Soil/tuff	METALS	As and Zn qualified UJ or J- for low recovery in the matrix spike sample.
3413R	0103-97-0264	Soil/tuff	METALS	As and Zn qualified UJ or J- for low recovery in the matrix spike sample.
3413R	0103-97-0265	Soil/tuff	METALS	As and Zn qualified UJ or J- for low recovery in the matrix spike sample.
3413R	0103-97-0266	Soil/tuff	METALS	As and Zn qualified UJ or J- for low recovery in the matrix spike sample.
3413R	0103-97-0267	Tuff	METALS	As and Zn qualified UJ or J- for low recovery in the matrix spike sample.
3413R	0103-97-0268	Tuff	METALS	As and Zn qualified UJ or J- for low recovery in the matrix spike sample.
3413R	0103-97-0269	Soil/tuff	METALS	As and Zn qualified UJ or J- for low recovery in the matrix spike sample.
3415R	0103-97-0275	Tuff	METALS	As and Zn qualified UJ or J- for low recovery in the matrix spike sample.
3415R	0103-97-0277	Tuff	METALS	As and Zn qualified UJ or J- for low recovery in the matrix spike sample.
3415R	0103-97-0278	Tuff	METALS	As and Zn qualified UJ or J- for low recovery in the matrix spike sample.
3415R	0103-97-0279	Tuff	METALS	As and Zn qualified UJ or J- for low recovery in the matrix spike sample.
3415R	0103-97-0280	Tuff	METALS	As and Zn qualified UJ or J- for low recovery in the matrix spike sample.
3415R	0103-97-0329	Tuff (dup)	METALS	As and Zn qualified UJ or J- for low recovery in the matrix spike sample.
3415R	0103-97-0336	Water (rinse)	METALS	All metals data are valid and usable without added qualifiers.
3416R	0103-97-0270	Asphalt	RADIO-NUCLIDES	All radiochemical data are valid and usable without added qualifiers.
3416R	0103-97-0272	Asphalt	RADIO-NUCLIDES	All radiochemical data are valid and usable without added qualifiers.
3416R	0103-97-0273	Asphalt	RADIO-NUCLIDES	All radiochemical data are valid and usable without added qualifiers.
3416R	0103-97-0274	Asphalt	RADIO-NUCLIDES	All radiochemical data are valid and usable without added qualifiers.
3416R	0103-97-0276	Asphalt	RADIO-NUCLIDES	All radiochemical data are valid and usable without added qualifiers.

RADIONUCLIDES = Isotopic Uranium and Isotopic Plutonium
METALS = Target analyte list for metals
VOC = Volatile Organic Compounds
SVOC = Semi-volatile Organic Compounds

TABLE B-2

SUMMARY TABLE OF QUALITY CONTROL RESULTS FOR PRS 3-007

REQUEST NUMBER	SAMPLE ID	MATRIX	ANALYTE SUITE	QUALITY CONTROL (QC) COMMENTS
3408R	0103-97-0221	Soil	VOC	Acetone (2 ug/kg) and methylene chloride (4 ug/kg) found in method blank. All detects <10x blank value are qualified U.
3408R	0103-97-0224	Soil	VOC	Acetone (2 ug/kg) and methylene chloride (4 ug/kg) found in method blank. All detects <10x blank value are qualified U.
3408R	0103-97-0225	Soil	VOC	Acetone (2 ug/kg) and methylene chloride (4 ug/kg) found in method blank. All detects <10x blank value are qualified U.
3408R	0103-97-0221	Soil	SVOC	All SVOC data are valid and usable without added qualifiers
3408R	0103-97-0222	Soil	SVOC	All SVOC data are valid and usable without added qualifiers
3408R	0103-97-0223	Soil	SVOC	All SVOC data are valid and usable without added qualifiers
3408R	0103-97-0224	Soil	SVOC	All SVOC data are valid and usable without added qualifiers
3408R	0103-97-0225	Soil	SVOC	All SVOC data are valid and usable without added qualifiers
3409R	0103-97-0221	Soil	HE	All HE data are valid and usable without added qualifiers
3409R	0103-97-0222	Soil	HE	All HE data are valid and usable without added qualifiers
3409R	0103-97-0223	Soil	HE	All HE data are valid and usable without added qualifiers
3409R	0103-97-0224	Soil	HE	All HE data are valid and usable without added qualifiers
3409R	0103-97-0225	Soil	HE	All HE data are valid and usable without added qualifiers
3410R	0103-97-0221	Soil	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (103%) in the matrix spike sample.
3410R	0103-97-0222	Soil	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (103%) in the matrix spike sample.
3410R	0103-97-0223	Soil	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (103%) in the matrix spike sample.
3410R	0103-97-0224	Soil	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (103%) in the matrix spike sample.
3410R	0103-97-0225	Soil	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (103%) in the matrix spike sample.
3411R	0103-97-0221	Soil	ISO Th	All radiochemical data are valid and usable without added qualifiers.
3411R	0103-97-0222	Soil	ISO Th	All radiochemical data are valid and usable without added qualifiers.
3411R	0103-97-0223	Soil	ISO Th	All radiochemical data are valid and usable without added qualifiers.
3411R	0103-97-0224	Soil	ISO Th	All radiochemical data are valid and usable without added qualifiers.
3411R	0103-97-0225	Soil	ISO Th	All radiochemical data are valid and usable without added qualifiers.
3426R	0103-97-0223	Soil	RADIO-LOGICAL	All radiochemical data are valid and usable without added qualifiers.

ISO Th = Isotopic Thorium
METALS = Target analyte list for metals
VOC = Volatile Organic Compounds
SVOC = Semi-volatile Organic Compounds
HE = High Explosives
RADIOLOGICAL = Gross Alpha and Beta and Gamma Spec.

TABLE B-3

SUMMARY TABLE OF QUALITY CONTROL RESULTS FOR PRSs 3-014(k,l,o)

REQUEST NUMBER	SAMPLE ID	MATRIX	ANALYTE SUITE	QUALITY CONTROL (QC) COMMENTS
3375R	0103-97-0013	Tuff	VOC	Acetone (4 ug/kg) and methylene chloride (14 ug/kg) found in method blank. All detects <10x blank value are qualified U.
3375R	0103-97-0016	Tuff	VOC	4th IS low and one high surrogate recovery (BFB). Analytes associated with the surrogate or IS are qualified J+ or UJ. Acetone (4 ug/kg) and methylene chloride (14 ug/kg) found in method blank. All detects <10x blank value are qualified U.
3375R	0103-97-0011	Soil	SVOC	All SVOC data are valid and usable without added qualifiers.
3375R	0103-97-0012	Tuff	SVOC	All SVOC data are valid and usable without added qualifiers.
3375R	0103-97-0013	Tuff	SVOC	All SVOC data are valid and usable without added qualifiers.
3375R	0103-97-0014	Soil	SVOC	All SVOC data are valid and usable without added qualifiers.
3375R	0103-97-0015	Tuff	SVOC	All SVOC data are valid and usable without added qualifiers.
3375R	0103-97-0016	Tuff	SVOC	There was a low recovery for the 6th IS. All associated analytes are qualified UJ.
3375R	0103-97-0011	Soil	PCB/PEST/HERB	All PCB, pesticide, and herbicide data are valid and usable without added qualifiers.
3375R	0103-97-0012	Tuff	PCP/PEST/HERB	All PCB, pesticide, and herbicidedata are valid and usable without added qualifiers.
3375R	0103-97-0013	Tuff	PCB/PEST/HERB	All PCB, pesticide, and herbicide data are valid and usable without added qualifiers.
3375R	0103-97-0014	Soil	PCB/PEST/HERB	All PCB, pesticide, and herbicide data are valid and usable without added qualifiers.
3375R	0103-97-0015	Tuff	PCB/PEST/HERB	All PCB, pesticide, and herbicide data are valid and usable without added qualifiers.
3375R	0103-97-0016	Tuff	PCB/PEST/HERB	All PCB, pesticide, and herbicide data are valid and usable without added qualifiers.
3376R	0103-97-0011	Soil	METALS	All metals data are valid and usable without added qualifiers.
3376R	0103-97-0012	Tuff	METALS	All metals data are valid and usable without added qualifiers.
3376R	0103-97-0013	Tuff	METALS	All metals data are valid and usable without added qualifiers.
3376R	0103-97-0014	Soil	METALS	All metals data are valid and usable without added qualifiers.
3376R	0103-97-0015	Tuff	METALS	All metals data are valid and usable without added qualifiers.
3376R	0103-97-0016	Tuff	METALS	All metals data are valid and usable without added qualifiers.
3377R	0103-97-0011	Soil	RADIO-NUCLIDES	All radiochemical data are valid and usable without added qualifiers.
3377R	0103-97-0012	Tuff	RADIO-NUCLIDES	All radiochemical data are valid and usable without added qualifiers.
3377R	0103-97-0013	Tuff	RADIO-NUCLIDES	All radiochemical data are valid and usable without added qualifiers.
3377R	0103-97-0014	Soil	RADIO-NUCLIDES	All radiochemical data are valid and usable without added qualifiers.
3377R	0103-97-0015	Tuff	RADIO-NUCLIDES	All radiochemical data are valid and usable without added qualifiers.

TABLE B-3 (CONTINUED)

SUMMARY TABLE OF QUALITY CONTROL RESULTS FOR PRSs 3-014(k,l,o)

REQUEST NUMBER	SAMPLE ID	MATRIX	ANALYTE SUITE	QUALITY CONTROL (QC) COMMENTS
3377R	0103-97-0016	Tuff	RADIO-NUCLIDES	All radiochemical data are valid and usable without added qualifiers.
3444R	0103-97-0026	Tuff	VOC	Acetone (8 ug/kg) and methylene chloride (3 ug/kg) found in method blank. All detects <10x blank value are qualified U.
3444R	0103-97-0029	Tuff	VOC	Acetone (8 ug/kg) and methylene chloride (3 ug/kg) found in method blank. All detects <10x blank value are qualified U.
3444R	0103-97-0032	Tuff	VOC	Acetone (8 ug/kg) and methylene chloride (3 ug/kg) found in method blank. All detects <10x blank value are qualified U.
3444R	0103-97-0024	Soil	SVOC	Bis(2-ethylhexyl)phthalate (230 ug/kg) and di-n-butylphthalate (230 ug/kg) found in method blank. All detects <10x blank value are qualified U.
3444R	0103-97-0025	Tuff	SVOC	Bis(2-ethylhexyl)phthalate (230 ug/kg) and di-n-butylphthalate (230 ug/kg) found in method blank. All detects <10x blank value are qualified U.
3444R	0103-97-0026	Tuff	SVOC	Bis(2-ethylhexyl)phthalate (230 ug/kg) and di-n-butylphthalate (230 ug/kg) found in method blank. All detects <10x blank value are qualified U.
3444R	0103-97-0027	Soil	SVOC	Bis(2-ethylhexyl)phthalate (230 ug/kg) and di-n-butylphthalate (230 ug/kg) found in method blank. All detects <10x blank value are qualified U.
3444R	0103-97-0028	Tuff	SVOC	Bis(2-ethylhexyl)phthalate (230 ug/kg) and di-n-butylphthalate (230 ug/kg) found in method blank. All detects <10x blank value are qualified U.
3444R	0103-97-0029	Tuff	SVOC	Bis(2-ethylhexyl)phthalate (230 ug/kg) and di-n-butylphthalate (230 ug/kg) found in method blank. All detects <10x blank value are qualified U.
3444R	0103-97-0030	Soil	SVOC	Bis(2-ethylhexyl)phthalate (230 ug/kg) and di-n-butylphthalate (230 ug/kg) found in method blank. All detects <10x blank value are qualified U.
3444R	0103-97-0031	Tuff	SVOC	Bis(2-ethylhexyl)phthalate (230 ug/kg) and di-n-butylphthalate (230 ug/kg) found in method blank. All detects <10x blank value are qualified U.
3444R	0103-97-0032	Tuff	SVOC	Bis(2-ethylhexyl)phthalate (230 ug/kg) and di-n-butylphthalate (230 ug/kg) found in method blank. All detects <10x blank value are qualified U.
3444R	0103-97-0024	Soil	PCB/PEST/HERB	All PCB, pesticide, and herbicide data are valid and usable without added qualifiers.
3444R	0103-97-0025	Tuff	PCB/PEST/HERB	All PCB, pesticide, and herbicide data are valid and usable without added qualifiers.
3444R	0103-97-0026	Tuff	PCB/PEST/HERB	All PCB, pesticide, and herbicide data are valid and usable without added qualifiers.

TABLE B-3 (CONTINUED)

SUMMARY TABLE OF QUALITY CONTROL RESULTS FOR PRSs 3-014(k,l,o)

REQUEST NUMBER	SAMPLE ID	MATRIX	ANALYTE SUITE	QUALITY CONTROL (QC) COMMENTS
3444R	0103-97-0027	Soil	PCB/PEST/HERB	All PCB, pesticide, and herbicide data are valid and usable without added qualifiers.
3444R	0103-97-0028	Tuff	PCB/PEST/HERB	All PCB, pesticide, and herbicide data are valid and usable without added qualifiers.
3444R	0103-97-0029	Tuff	PCB/PEST/HERB	All PCB, pesticide, and herbicide data are valid and usable without added qualifiers.
3444R	0103-97-0030	Soil	PCB/PEST/HERB	All PCB and pesticide data are valid and usable without added qualifiers. The surrogate, dichlorophenlyacetic acid, had a high recovery (148%). All detects qualified J+ for possible high bias.
3444R	0103-97-0031	Tuff	PCB/PEST/HERB	All PCB, pesticide, and herbicide data are valid and usable without added qualifiers.
3444R	0103-97-0032	Tuff	PCB/PEST/HERB	All PCB, pesticide, and herbicide data are valid and usable without added qualifiers.
3445R	0103-97-0024	Soil	METALS	Al (66%) and Fe (72%) qualified J- for low recovery in the lab control sample. Cr detects qualified J+ for a high recovery (139%) in the matrix spike sample.
3445R	0103-97-0025	Tuff	METALS	Al (66%) and Fe (72%) qualified J- for low recovery in the lab control sample. Cr detects qualified J+ for a high recovery (139%) in the matrix spike sample.
3445R	0103-97-0026	Tuff	METALS	Al (66%) and Fe (72%) qualified J- for low recovery in the lab control sample. Cr detects qualified J+ for a high recovery (139%) in the matrix spike sample.
3445R	0103-97-0027	Soil	METALS	Al (66%) and Fe (72%) qualified J- for low recovery in the lab control sample. Cr detects qualified J+ for a high recovery (139%) in the matrix spike sample.
3445R	0103-97-0028	Tuff	METALS	Al (66%) and Fe (72%) qualified J- for low recovery in the lab control sample. Cr detects qualified J+ for a high recovery (139%) in the matrix spike sample.
3445R	0103-97-0029	Tuff	METALS	Al (66%) and Fe (72%) qualified J- for low recovery in the lab control sample. Cr detects qualified J+ for a high recovery (139%) in the matrix spike sample.
3445R	0103-97-0030	Soil	METALS	Al (66%) and Fe (72%) qualified J- for low recovery in the lab control sample. Cr detects qualified J+ for a high recovery (139%) in the matrix spike sample.
3445R	0103-97-0031	Tuff	METALS	Al (66%) and Fe (72%) qualified J- for low recovery in the lab control sample. Cr detects qualified J+ for a high recovery (139%) in the matrix spike sample.
3445R	0103-97-0032	Tuff	METALS	Al (66%) and Fe (72%) qualified J- for low recovery in the lab control sample. Cr detects qualified J+ for a high recovery (139%) in the matrix spike sample.

TABLE B-3 (CONTINUED)

SUMMARY TABLE OF QUALITY CONTROL RESULTS FOR PRSs 3-014(k,l,o)

REQUEST NUMBER	SAMPLE ID	MATRIX	ANALYTE SUITE	QUALITY CONTROL (QC) COMMENTS
3446R	0103-97-0024	Soil	RADIO-NUCLIDES	All radiochemical data are valid and usable without added qualifiers.
3446R	0103-97-0025	Tuff	RADIO-NUCLIDES	All radiochemical data are valid and usable without added qualifiers.
3446R	0103-97-0026	Tuff	RADIO-NUCLIDES	All radiochemical data are valid and usable without added qualifiers.
3446R	0103-97-0027	Soil	RADIO-NUCLIDES	All radiochemical data are valid and usable without added qualifiers.
3446R	0103-97-0028	Tuff	RADIO-NUCLIDES	All radiochemical data are valid and usable without added qualifiers.
3446R	0103-97-0029	Tuff	RADIO-NUCLIDES	All radiochemical data are valid and usable without added qualifiers.
3446R	0103-97-0030	Soil	RADIO-NUCLIDES	All radiochemical data are valid and usable without added qualifiers.
3446R	0103-97-0031	Tuff	RADIO-NUCLIDES	All radiochemical data are valid and usable without added qualifiers.
3446R	0103-97-0032	Tuff	RADIO-NUCLIDES	All radiochemical data are valid and usable without added qualifiers.

RADIONUCLIDES = Isotopic Uranium, Isotopic Plutonium, Strontium-90, and Tritium
METALS = Target analyte list for metals
VOC = Volatile Organic Compounds
SVOC = Semi-volatile Organic Compounds
PCB = Polychlorinated Biphenyls
PEST = Pesticides
HERB = Phenoxy Acid Herbicides

TABLE B-4

SUMMARY TABLE OF QUALITY CONTROL RESULTS FOR PRS 3-021

REQUEST NUMBER	SAMPLE ID	MATRIX	ANALYTE SUITE	QUALITY CONTROL (QC) COMMENTS
3427R	0103-97-0244	Soil/tuff	VOC	All data are qualified UJ for 1 low internal standard and 1 low surrogate recovery (BFB = 74%).
3428R	0103-97-0241	Soil/tuff	SVOC	All SVOC data are valid and usable without added qualifiers.
3428R	0103-97-0242	Soil/tuff	SVOC	All SVOC data are valid and usable without added qualifiers.
3428R	0103-97-0243	Soil/tuff	SVOC	All SVOC data are valid and usable without added qualifiers.
3428R	0103-97-0244	Soil/tuff	SVOC	All SVOC data are valid and usable without added qualifiers.
3428R	0103-97-0245	Soil/tuff	SVOC	All SVOC data are valid and usable without added qualifiers.
3428R	0103-97-0246	Soil/tuff	SVOC	All SVOC data are valid and usable without added qualifiers.
3428R	0103-97-0247	Soil/tuff	SVOC	All SVOC data are valid and usable without added qualifiers.
3428R	0103-97-0248	Soil/tuff	SVOC	All SVOC data are valid and usable without added qualifiers.
3428R	0103-97-0249	Soil/tuff	SVOC	All SVOC data are valid and usable without added qualifiers.
3428R	0103-97-0250	Soil/tuff	SVOC	All SVOC data are valid and usable without added qualifiers.
3428R	0103-97-0251	Soil/tuff	SVOC	All SVOC data are valid and usable without added qualifiers.
3428R	0103-97-0256	Soil/tuff (dup)	SVOC	All SVOC data are valid and usable without added qualifiers.
3429R	0103-97-0241	Soil/tuff	METALS	Mn qualified UJ or J- for low recovery in the matrix spike sample.
3429R	0103-97-0242	Soil/tuff	METALS	Mn qualified UJ or J- for low recovery in the matrix spike sample.
3429R	0103-97-0243	Soil/tuff	METALS	Mn qualified UJ or J- for low recovery in the matrix spike sample.
3429R	0103-97-0244	Soil/tuff	METALS	Mn qualified UJ or J- for low recovery in the matrix spike sample.
3429R	0103-97-0245	Soil/tuff	METALS	Mn qualified UJ or J- for low recovery in the matrix spike sample.
3429R	0103-97-0246	Soil/tuff	METALS	Mn qualified UJ or J- for low recovery in the matrix spike sample.
3429R	0103-97-0247	Soil/tuff	METALS	Mn qualified UJ or J- for low recovery in the matrix spike sample.
3429R	0103-97-0248	Soil/tuff	METALS	Mn qualified UJ or J- for low recovery in the matrix spike sample.
3429R	0103-97-0249	Soil/tuff	METALS	Mn qualified UJ or J- for low recovery in the matrix spike sample.
3429R	0103-97-0250	Soil/tuff	METALS	Mn qualified UJ or J- for low recovery in the matrix spike sample.
3429R	0103-97-0251	Soil/tuff	METALS	Mn qualified UJ or J- for low recovery in the matrix spike sample.
3429R	0103-97-0256	Soil/tuff	METALS	Mn qualified UJ or J- for low recovery in the matrix spike sample.

METALS = Target analyte list for metals
VOC = Volatile Organic Compounds
SVOC = Semi-volatile Organic Compounds

TABLE B-5

SUMMARY TABLE OF QUALITY CONTROL RESULTS FOR PRS 3-049(a)

REQUEST NUMBER	SAMPLE ID	MATRIX	ANALYTE SUITE	QUALITY CONTROL (QC) COMMENTS
3302R	0103-97-0001	Soil/sed	VOC	Acetone in method blank (5 ug/kg). All detects <50 ug/kg considered not detected.
3302R	0103-97-0002	Soil/sed	VOC	Acetone in method blank (5 ug/kg). All detects <50 ug/kg considered not detected.
3303R	0103-97-0001	Soil/sed	METALS / Cr/CN	Cr, Mn, CN qualified J- or UJ for low recoveries in the matrix spike sample.
3303R	0103-97-0002	Soil/sed	METALS / Cr/CN	Cr, Mn, CN qualified J- or UJ for low recoveries in the matrix spike sample.
3303R	0103-97-0003	Soil/sed	METALS / Cr/CN	Cr, Mn, CN qualified J- or UJ for low recoveries in the matrix spike sample.
3303R	0103-97-0004	Soil/sed	METALS / Cr/CN	Cr, Mn, CN qualified J- or UJ for low recoveries in the matrix spike sample.
3303R	0103-97-0005	Soil/sed	METALS / Cr/CN	Cr, Mn, CN qualified J- or UJ for low recoveries in the matrix spike sample.
3303R	0103-97-0006	Soil/sed	METALS / Cr/CN	Cr, Mn, CN qualified J- or UJ for low recoveries in the matrix spike sample.
3303R	0103-97-0007	Soil/sed	METALS / Cr/CN	Cr, Mn, CN qualified J- or UJ for low recoveries in the matrix spike sample.
3303R	0103-97-0008	Soil/sed	METALS / Cr/CN	Cr, Mn, CN qualified J- or UJ for low recoveries in the matrix spike sample.
3303R	0103-97-0091	Soil/sed (dup)	METALS / Cr/CN	Cr, Mn, CN qualified J- or UJ for low recoveries in the matrix spike sample.
3303R	0103-97-0096	Water	METALS / CN	All metals data are valid and usable without added qualifiers.
3303R	0103-97-0097	Water	METALS / CN	All metals data are valid and usable without added qualifiers.
3303R	0103-97-0098	Water	METALS / CN	All metals data are valid and usable without added qualifiers.
3304R	0103-97-0001	Soil/sed	ISO U	All radiochemical data are valid and usable without added qualifiers.
3304R	0103-97-0002	Soil/sed	ISO U	All radiochemical data are valid and usable without added qualifiers.
3304R	0103-97-0003	Soil/sed	ISO U	All radiochemical data are valid and usable without added qualifiers.
3304R	0103-97-0004	Soil/sed	ISO U	All radiochemical data are valid and usable without added qualifiers.
3304R	0103-97-0005	Soil/sed	ISO U	All radiochemical data are valid and usable without added qualifiers.
3304R	0103-97-0006	Soil/sed	ISO U	All radiochemical data are valid and usable without added qualifiers.
3304R	0103-97-0007	Soil/sed	ISO U	All radiochemical data are valid and usable without added qualifiers.
3304R	0103-97-0008	Soil/sed	ISO U	All radiochemical data are valid and usable without added qualifiers.
3304R	0103-97-0091	Soil/sed (dup)	ISO U	All radiochemical data are valid and usable without added qualifiers.
3304R	0103-97-0096	Water	ISO U	All radiochemical data are valid and usable without added qualifiers.
3304R	0103-97-0097	Water	ISO U	All radiochemical data are valid and usable without added qualifiers.
3304R	0103-97-0098	Water (rinse)	ISO U	All radiochemical data are valid and usable without added qualifiers.

ISO U = Isotopic Uranium
METALS = Target analyte list for metals
Cr = Hexavalent chromium
CN = Cyanide
VOC = Volatile organic compounds

TABLE B-6

SUMMARY TABLE OF QUALITY CONTROL RESULTS FOR
PRSs 3-052(b) and 3-056(k)

REQUEST NUMBER	SAMPLE ID	MATRIX	ANALYTE SUITE	QUALITY CONTROL (QC) COMMENTS
3408R	0103-97-0053	Soil/tuff	VOC	Acetone (2 ug/kg) and methylene chloride (4 ug/kg) found in method blank. All detects <10x blank value are qualified U.
3408R	0103-97-0054	Soil/tuff	VOC	Acetone (2 ug/kg) and methylene chloride (4 ug/kg) found in method blank. All detects <10x blank value are qualified U.
3410R	0103-97-0152	Soil	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0153	Soil/tuff	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0155	Soil	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0156	Soil/tuff	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0158	Soil/tuff	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0161	Soil/tuff	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0163	Soil	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0164	Soil/tuff	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0165	Soil	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0166	Soil/tuff	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0167	Soil	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0168	Soil/tuff	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0169	Soil	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0170	Soil/tuff	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.

TABLE B-6 (CONTINUED)

SUMMARY TABLE OF QUALITY CONTROL RESULTS FOR
PRSs 3-052(b) and 3-056(k)

REQUEST NUMBER	SAMPLE ID	MATRIX	ANALYTE SUITE	QUALITY CONTROL (QC) COMMENTS
3408R	0103-97-0053	Soil/tuff	VOC	Acetone (2 ug/kg) and methylene chloride (4 ug/kg) found in method blank. All detects <10x blank value are qualified U.
3408R	0103-97-0064	Soil/tuff	VOC	Acetone (2 ug/kg) and methylene chloride (4 ug/kg) found in method blank. All detects <10x blank value are qualified U.
3410R	0103-97-0152	Soil	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0153	Soil/tuff	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0155	Soil	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0156	Soil/tuff	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0158	Soil/tuff	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0161	Soil/tuff	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0163	Soil	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0164	Soil/tuff	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0165	Soil	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0166	Soil/tuff	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0167	Soil	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0168	Soil/tuff	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0169	Soil	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.
3410R	0103-97-0170	Soil/tuff	METALS	Sb (38%) and As (71%) qualified UJ or J- for low recovery in the matrix spike sample. Mn detects qualified J+ for high recovery (163%) in the matrix spike sample.

TABLE B-6 (CONTINUED)

SUMMARY TABLE OF QUALITY CONTROL RESULTS FOR
PRSs 3-052(b) and 3-056(k)

REQUEST NUMBER	SAMPLE ID	MATRIX	ANALYTE SUITE	QUALITY CONTROL (QC) COMMENTS
3411R	0103-97-0163	Soil	ISO U	All radiochemical data are valid and usable without added qualifiers.
3411R	0103-97-0164	Soil/tuff	ISO U	All radiochemical data are valid and usable without added qualifiers.
3411R	0103-97-0165	Soil	ISO U	All radiochemical data are valid and usable without added qualifiers.
3411R	0103-97-0166	Soil/tuff	ISO U	All radiochemical data are valid and usable without added qualifiers.
3411R	0103-97-0167	Soil	ISO U	All radiochemical data are valid and usable without added qualifiers.
3411R	0103-97-0168	Soil/tuff	ISO U	All radiochemical data are valid and usable without added qualifiers.
3411R	0103-97-0169	Soil	ISO U	All radiochemical data are valid and usable without added qualifiers.
3411R	0103-97-0170	Soil/tuff	ISO U	All radiochemical data are valid and usable without added qualifiers.
3411R	0103-97-0171	Soil	ISO U	All radiochemical data are valid and usable without added qualifiers.
3411R	0103-97-0171	Soil	RADIOLOGICAL	All radiochemical data are valid and usable without added qualifiers.
3411R	0103-97-0172	Soil	ISO U	All radiochemical data are valid and usable without added qualifiers.
3411R	0103-97-0173	Soil	ISO U	All radiochemical data are valid and usable without added qualifiers.
3411R	0103-97-0174	Soil/tuff	ISO U	All radiochemical data are valid and usable without added qualifiers.
3411R	0103-97-0175	Soil	ISO U	All radiochemical data are valid and usable without added qualifiers.
3411R	0103-97-0176	Soil/tuff	ISO U	All radiochemical data are valid and usable without added qualifiers.
3411R	0103-97-0177	Soil	ISO U	All radiochemical data are valid and usable without added qualifiers.
3411R	0103-97-0211	Soil/tuff (dup)	ISO U	All radiochemical data are valid and usable without added qualifiers.

RADIOLOGICAL = Gross alpha and beta and gamma spec.
METALS = Target analyte list for metals
VOC = Volatile Organic Compounds
ISO U = Isotopic Uranium

TABLE B-7

SUMMARY TABLE OF QUALITY CONTROL RESULTS FOR PRS C-3-014

REQUEST NUMBER	SAMPLE ID	MATRIX	ANALYTE SUITE	QUALITY CONTROL (QC) COMMENTS
3370R	0103-97-0104	Asphalt	ISO U	All radiochemical data are valid and usable without added qualifiers.
3370R	0103-97-0105	Asphalt	ISO U	All radiochemical data are valid and usable without added qualifiers.
3370R	0103-97-0106	Asphalt	ISO U	All radiochemical data are valid and usable without added qualifiers.
3370R	0103-97-0110	Asphalt	ISO U	All radiochemical data are valid and usable without added qualifiers.
3370R	0103-97-0143	Asphalt (dup)	ISO U	All radiochemical data are valid and usable without added qualifiers.

ISO U = Isotopic Uranium

THIS PAGE LEFT INTENTIONALLY BLANK

APPENDIX C PAH RISK ASSESSMENT FOR PRSs 3-004(c,d)

Screening-Level Risk Estimates of Non-PRS-Related Organic Chemicals in Soil

In risk assessment, the concentration of a chemical in soil is related to the associated hazard quotient (for noncarcinogenic health effects) or theoretical excess cancer risk in a linear manner [i.e., doubling the soil concentration would double the hazard quotient or risk (referred to here collectively as "risk level")]. Therefore, this relationship between a known soil concentration and associated risk level (expressed as a ratio) can be used to estimate the risk associated with the measured concentration of the same chemical in soil at the site as shown below.

For a given chemical:

$$\frac{\text{Risk Level Associated with Known Soil Concentration}}{\text{Known Soil Concentration}} = \frac{\text{Site Risk Level}}{\text{Site Soil Concentration}}$$

For this evaluation, the U.S. EPA Region 9 preliminary remediation goals (PRGs) were used as the "known soil concentrations," because they represent readily available soil concentrations associated with specified risk levels. This equation is rearranged and solved for the risk posed by each individual chemical at the site as follows:

$$\text{Site Risk Level} = \frac{\text{PRG Risk Level} \times \text{Site Soil Concentration}}{\text{PRG}}$$

where:

Site Risk Level	=	Calculated risk value
PRG Risk Level	=	1×10^{-6} for carcinogens or a hazard index of 1 for noncarcinogens
Site Soil Concentration	=	Concentration of polycyclic aromatic hydrocarbons (PAH) in soil at the site (mg/kg) *[Use most appropriate value (e.g., 95% upper control limit of the mean or arithmetic mean)]*
PRG	=	Risk-based concentration in soil for residential *(or commercial/industrial, whichever is appropriate for that particular PRS)* exposure assumptions (mg/kg)

The total carcinogenic risk or total hazard index (for noncarcinogenic chemicals) PAHs at PRS 3-004(c) for sample 0103-97-0280 and at PRS 3-004(d) for sample 0103-97-264, was estimated by summing the individual risk or hazard index for each detected chemical as shown in Table C-1 and Table C-2, respectively. It should be noted that this relationship is not valid for chemicals with PRGs based on saturation concentrations (denoted "sat" by U.S. EPA Region 9) or a theoretical maximum concentration (denoted "max" by U.S. EPA Region 9), because these PRGs are not truly health-based values. In these cases, alternative PRGs calculated by U.S. EPA Region 9 were used. These alternative PRGs are intended to represent "health-based" values, and are provided in the electronic version of the U.S. EPA Region 9 PRG table and in the following table; a more thorough discussion of the development of these alternative PRGs is presented in the Screening Assessment Methodology. In the event that a PRG had not been calculated due to a lack of toxicity information, a surrogate PRG based on the toxicity information for a structurally similar compound was used.

TABLE C-1

RISK DUE TO PAHS AT PRS 3-004(c) SAMPLE 0103-97-0280

CHEMICAL	CONCENTRATION (mg/kg)	ALTERNATIVE PRG RESIDENTIAL SOIL (mg/kg)	CONCENTRATION/PRG
Based on Carcinogenic Effects			
Benzo(b&k)fluoranthene	0.090 J[a]	0.61	0.1
Summed Cancer Risk (Risk is x 10^{-0})			0.1 x 10^{-0}
Based on Noncarcinogenic Effects			
Fluoranthene	0.100 J	2600	0.00004
Phenanthrene[b]	0.003 J	10000	0.000005
Pyrene	0.0120 J	1000	0.000008
Summed Hazard Quotients (Hazard Index)			0.00005

[a] J = Signifies that the analyte was positively identified, and the associated numerical value is estimated to be more uncertain than would normally be expected for that analysis.

[b] Toxicity criteria are not available for phenanthrene; therefore, the toxicity criteria for anthracene were used as surrogates based on similarity in chemical structure.

TABLE C-2

RISK DUE TO PAHS AT PRS 3-004(d) SAMPLE 0103-97-0264

CHEMICAL	CONCENTRATION (mg/kg)	ALTERNATIVE PRG RESIDENTIAL SOIL (mg/kg)	CONCENTRATION/PRG
Based on Carcinogenic Effects			
Benzo(a)anthracene	0.210 J[a]	0.61	0.3
Benzo(a)pyrene	0.180 J	0.061	3
Benzo(b)fluoranthene	0.230 J	0.61	0.4
Benzo(k)fluoranthene	0.100 J	6.1	0.02
Chrysene	0.230 J	61	0.004
Indeno(1,2,3)pyrene	0.110 J	0.61	0.2
Summed Cancer Risk (Risk is x 10^{-6})			4 x 10^{-6}
Based on Noncarcinogenic Effects			
Anthracene	0.051 J	18000	0.000002
Benzo(g,h,i)perylene[b]	0.095 J	1900	0.00005
Fluoranthene	0.510 J	2600	0.0002
Phenanthrene[c]	0.270 J	18000	0.00002
Pyrene	0.400 J	1900	0.00005
Summed Hazard Quotients(Hazard Index)			0.0003

[a] J = Signifies that the analyte was positively identified, and the associated numerical value is estimated to be more uncertain than would normally be expected for that analysis.

[b] Toxicity criteria are not available for benzo(g,h,i)perylene; therefore, the toxicity criteria for pyrene were used as surrogates based on similarity in chemical structure.

[c] Toxicity criteria are not available for phenanthrene; therefore, the toxicity criteria for anthracene were used as surrogates based on similarity in chemical structure.

PRS 3-014(o) Human Health Risk Assessment Calculations

Preliminary risk estimates can be calculated using EPA Region 9 PRGs. The carcinogenic PRG for each chemical is based on a lifetime excess cancer risk of 1 x 10^{-6} assuming lifetime residential exposure. This value can then be used to estimate risk assuming the PRG exposure model is consistent with the site exposure model. Region 9 PRGs are based on the following soil exposure pathways:

- Incidental ingestion of soil;
- dermal contact with soil;
- inhalation of resuspended soil particulates; and
- inhalation of volatilized chemicals of potential concern (COPCs).

These pathways are considered consistent with the site exposure model since transport to groundwater is not a viable pathway for the sludge beds and since plant uptake factors are not

significant for this PRS's COPCs such that a produce ingestion pathway would contribute significantly to risk.

A ratio of the soil concentration to the PRG for each chemical represents an estimate of the lifetime cancer risk when multiplied by 10^{-6}. When these risks are summed, it represents the total risk estimate for the site as shown in Table C-3. The lifetime excess cancer risk estimate is 28×10^{-6} or approximately 3×10^{-5}. Because maximum concentrations are used in this calculation and lifetime residential exposure is assumed, this estimate is a reasonable maximum exposure (RME) risk estimate.

A similar risk estimate can be calculated for radionuclides using the screening action levels (SALs). Radionuclide SALs are based on a lifetime residential exposure of 10 mrem/yr. The SAL can be used to estimate site dose if the SAL exposure model is consistent with the site exposure model. The SAL exposure model is based on the following exposure pathways:

- incidental soil ingestion;
- resuspended soil particulate inhalation;
- ingestion of garden produce grown in contaminated soil; and
- external radiation.

This exposure model is consistent with the site exposure model since transport to groundwater is not a viable pathway for the sludge beds. Because strontium-90 is readily taken up by plants, ingestion of garden produce is a significant pathway.

A ratio of the soil concentration to the SAL for each radionuclide represents an estimate of the annual radiologic dose when multiplied by 10 mrem/yr. When these doses are summed, it represents the total dose estimate for the site as shown in Table C-4. The annual residential dose estimate is 20 mrem/yr. Because maximum concentrations are used in this calculation and residential exposure is assumed, this estimate is an RME dose estimate.

TABLE C-3

CHEMICAL RME RESIDENTIAL RISK ESTIMATE FOR PRS 3-014(c)

BASED ON CARCINOGENIC EFFECTS				
CHEMICAL	SAMPLE ID	CONCENTRATION (mg/kg)	PRG (mg/kg)	CONCENTRATION/ PRG
Aroclor	0103-97-0030	1.22	0.1	12
Benzo(a)anthracene	0103-97-0030	0.51	0.61	0.8
Benzo(a)pyrene	0103-97-0030	0.07	0.061	11
Benzo(b)fluoranthene	0103-97-0030	1.3	0.61	2
Chromium	0103-97-0030	130	210	0.6
Dibenzo(a,h)anthracene	0103-97-0030	0.074 J[a]	0.061	1
Indeno(1,2,3)pyrene	0103-97-0030	0.25 J	0.61	0.4
Summed Cancer Risk (Risk is x 10^{-6})				28 x 10^{-6}

[a] J = Signifies that the analyte was positively identified, and the associated numerical value is estimated to be more uncertain than would normally be expected for that analysis.

TABLE C-4

RADIONUCLIDE RME DOSE ESTIMATE FOR PRS 3-014(c)

RADIONUCLIDE	SAMPLE ID	MAXIMUM ACTIVITY (pCi/g)	SAL (pCi/g)	RATIO X 10 mrem/yr
Strontium-90	0103-97-0030	8.01	4.4	18
Uranium-234	0103-97-0030	2.68	13	2
ESTIMATED DOSE				20

A risk estimate can also be made for industrial land use by using the Region 9 industrial PRGs. These exposure pathways are similar to those for residential pathways, but industrial use pathways are adjusted for reduced exposure frequency and intake parameters. The industrial risk estimate using maximum soil concentrations is 5 x 10^{-6} as shown in Table C-5.

TABLE C-5

INDUSTRIAL RISK ESTIMATE FOR COPCS AT PRS 3-014(c)

CHEMICAL	SAMPLE ID	CONCENTRATION (mg/kg)	INDUSTRIAL PRG (mg/kg)	CONCENTRATION/PRG
Aroclor-1260	0103-97-0030	1.22	1.0	1.2
Benzo(a)anthracene	0103-97-0030	0.51	2.6	0.2
Benzo(a)pyrene	0103-97-0030	0.07	0.26	2.6
Benzo(b)fluoranthene	0103-97-0030	1.3	2.6	0.5
Chromium	0103-97-0030	130	450	0.3
Dibenzo(a,h)anthracene	0103-97-0030	0.074	0.26	0.3
Indeno(1,2,3)pyrene	0103-97-0030	0.25 J	2.6	0.1
Summed Cancer Risk (Risk is x 10^{-6})				5

* J = Signifies that the analyte was positively identified, and the associated numerical value is estimated to be more uncertain than would normally be expected for that analysis.

Statistical Evaluations of PRS 3-021 Inorganic Data

The objective of this section is to present detailed statistical and graphical analysis that compares PRS 3-021 data to Los Alamos National Laboratory (LANL) background data. The purpose of these analyses is to determine whether the PRS data show evidence of a release through a systematic increase in concentration over that observed in the background data. Inorganic analysis of samples for PRS 3-021 samples were collected from two media and were analyzed for 23 analytes. The media sampled included soil and Unit 4 of the Tshirege member of the Bandelier tuff (Qbt4). Nine inorganic chemicals were measured at concentrations less than the geologically appropriate LANL background upper threshold limit (UTL) (antimony, beryllium, cadmium, cobalt, magnesium, manganese, potassium, silver, and sodium), and thus, did not require further statistical evaluation. Three of the other inorganics, mercury, selenium and thallium, resulted in measured site concentrations greater than their background UTL, but the frequency of detects in background is too low to support further statistical testing.

This section will discuss results of statistical and graphical analyses for the remaining eleven inorganics (aluminum, arsenic, barium, calcium, chromium, copper, iron, lead, nickel, vanadium, and zinc).

Methods

Three types of analyses were used to evaluate the PRS concentrations of inorganics versus background data. The first set of comparisons will be a graphical comparison of concentrations for both PRS and background data by media. Second, the results of formal statistical tests that compare PRS data to background data will be presented. Lastly, a graphical presentation

showing the relationship of inorganics to concentration of aluminum will be presented. Each of these methods is discussed in more detail below.

Comparisons of Inorganic Data by Media

This comparison uses graphical displays call "box plots." The box plots show the actual values (as different symbols for each media) for each inorganic chemical. The ends of the box represent the "inter-quartile" range of the data distribution. The inter-quartile range is specified by the 25th percentile and 75th percentile of the data distribution. The line within the box plot is 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. If the majority of the data is represented by a single concentration value (usually the detection limit), the box is reduced to a single line.

Statistical Testing

Because the data for these inorganics do not appear to satisfy normality assumptions, nonparametric tests were preferred for further background comparisons. The Slippage test, the Gehan modification to the Wilcoxon Rank Sum test and the Quantile test were used for these evaluations. The purpose of these tests is to detect whether the PRS data show evidence of a release through a systematic increase in concentration over that observed in the background data. The Slippage test is an alternative to the Hot Measurement or UTL comparison. It is based on the maximum observed background value and the number of site concentration values ("n") that exceed the maximum of the background data. The result of the Slippage test is a probability that "n" site samples exceed the maximum background concentration by chance alone. The Gehan test pools site and background data into one aggregate set and determines whether the average rank of site data is greater than that of the background data. The Gehan test is best suited for assessing cases where most of the PRS concentration data exhibit elevated values, whereas the Quantile test is better suited for assessing releases that impact only a fraction of the PRS data. The Quantile test evaluates data from the upper quantile (80th percentile) of the pooled PRS and background data, and tests if the number of PRS samples is high relative to a random expectation. Readers interested in more information on these tests are referred to Ryti et al. (1996, 1298).

The metric used to determine if a statistically significant difference between PRS data and site data is the calculated significance levels (p-values) for the tests. A low p-value (near zero) indicates that PRS data are elevated above background, whereas a p-value of 1 indicates no difference between PRS and background data. If a p-value is less than some small probability

(0.05), then there is some reason to suspect that site distribution may be elevated above the background distribution; otherwise, no difference is indicated.

Interelement correlations

One way to evaluate the applicability of LANL-wide background data is to evaluate the data through interelement correlations. Typically, there are significant correlations between major elements (aluminum, iron, and potassium) and trace elements (arsenic, beryllium, copper, nickel, vanadium, and zinc). The correlations are presented and the geochemical basis is detailed in *Natural Background Geochemistry and Statistical Analysis of Selected Soil Profiles, Sediments, and Bandelier Tuff, Los Alamos, New Mexico* (Longmire et al. 1995, 1266). For most inorganic chemicals, these strong correlations result in a consistent ratio of trace to major elements. A significantly elevated ratio of a given trace to a major element can be used to document a release of that trace element. Bivariate plots of trace elements to major elements are one way to visually display the ratios for background and PRS data. We present bivariate plots of all inorganic chemicals versus aluminum as a graphical assessment of the similarity between the PRS data and the LANL-wide soils background data. These plots show three groups of data, including: the LANL soil background data, PRS 3-021 data collected from soil, and PRS 3-021 data collected from Qbt4. The PRS 3-021 data are depicted as open squares or cross marks, and the LANL soil data are depicted as closed squares.

Results

The overall conclusions from reviewing the box plots presented in Figures C-1 to C-11 suggest that PRS chemical concentrations are more similar to soil than to Qbt4 background. In addition, the bivariate plots presented in Figures C-12 to C-21, show that PRS data for most chemicals exhibit interelement correlations (or chemical ratios) similar to that observed for background soils. The most likely explanation is that Qbt4 sampled at PRS 3-021 has been chemically weathered so that the chemical concentrations resemble soil. In fact, some of the field notes confirm that weathered Qbt4 was sampled. In addition, high moisture (around 30%) was recorded by the analytical laboratory for sample 0103-97-0223, which suggests that the tuff matrix is more permeable, and thus weathered. Thus, it is concluded that all PRS data should be compared to soil as the more geologically appropriate background data.

The results of the statistical analyses are presented for each inorganic chemical, which includes discussion of statistical tests that compare all PRS data with soil background data.

Aluminum: Table C-6 presents the results for formal statistical tests that compared the PRS 3-021 aluminum results to the LANL-wide soil background data. The p-values suggest that the

PRS aluminum data do not differ from background soil. A similar conclusion is reached by evaluating the results presented in Figure C-1. Figure C-1 does show that the Qbt4 samples collected from PRS 3-021 have an interquartile range similar to soil but are elevated compared to background Qbt4. The conclusion is that the PRS 3-021 Qbt4 samples have been chemically weathered, which has increased the extractability of all inorganics. Thus, aluminum will not be carried forward for further evaluation in the human health screening assessment.

Arsenic: Table C-6 presents the results for formal statistical tests that compared the PRS 3-021 arsenic results to the LANL-wide soil background data. The p-values suggest that the PRS arsenic data do not differ from background soil. A similar conclusion is reached by evaluating the results presented in Figure C-2. Figure C-2 does show that the Qbt4 samples collected from PRS 3-021 have an interquartile range similar to soil but are elevated compared to background Qbt4. The bivariate plot of arsenic versus aluminum (Figure C-12) shows that the PRS arsenic results have the same abundance of arsenic relative to aluminum as do LANL-wide soils. Thus, arsenic will not be carried forward for further evaluation in the human health screening assessment.

Barium: Table C-6 presents the results for formal statistical tests that compared the PRS 3-021 barium results to the LANL-wide soil background data. The p-values suggest that the PRS barium data do not differ from background soil. A similar conclusion is reached by evaluating the results presented in Figure C-3. Figure C-3 does show that the Qbt4 samples collected from PRS 3-021 have an interquartile range similar to soil but are elevated compared to background Qbt4. The bivariate plot of barium versus aluminum (Figure C-13) shows that the PRS barium results have the same abundance of barium relative to aluminum as do LANL-wide soils. Thus, barium will not be carried forward for further evaluation in the human health screening assessment.

Calcium: Table C-6 presents the results for formal statistical tests that compared the PRS 3-021 calcium results to the LANL-wide soil background data. The p-values suggest that the PRS calcium data do not differ from background soil. A similar conclusion is reached by evaluating the results presented in Figure C-4. Figure C-4 does show that the Qbt4 samples collected from PRS 3-021 have an interquartile range similar to soil but are elevated compared to background Qbt4. The bivariate plot of calcium versus aluminum (Figure C-14) shows that the PRS calcium results have the same abundance of calcium relative to aluminum as do LANL-wide soils. Thus, calcium will not be carried forward for further evaluation in the human health screening assessment.

Chromium: Table C-6 presents the results for formal statistical tests that compared the PRS 3-021 chromium results to the LANL-wide soil background data. The p-values suggest that the PRS chromium data are elevated above background soil. A similar conclusion is reached by evaluating the results presented in Figure C-5. Figure C-5 also shows that PRS 3-021 Qbt4 interquartile range is elevated compared to background Qbt4. The bivariate plot of chromium versus aluminum (Figure C-15) shows the presence of three elevated PRS chromium results, two of which exceed the maximum concentration measured in LANL-wide soil. Because of the differences detected by the statistical tests and the observation of two values greater than the background maximum, chromium will be carried forward for further evaluation in the human health screening assessment.

Copper: Table C-6 presents the results for formal statistical tests that compared the PRS 3-021 copper results to the LANL-wide soil background data. The p-values suggest that the PRS copper data may be elevated above background soil, but the results of these tests are not definitive. An evaluation of Figure C-6 shows one PRS soil copper result that exceeds the soil background maximum. Figure C-6 also shows that most Qbt4 samples collected from PRS 3-021 are similar to soil but are elevated compared to background Qbt4. The bivariate plot of copper versus aluminum (Figure C-16) shows the presence of one elevated PRS copper result, which also exceed the maximum concentration measured in LANL-wide soil. Because the magnitude of this one elevated copper value is large (nearly equal to range in background), copper will be carried forward for further evaluation in the human health screening assessment.

Iron: Table C-6 presents the results for formal statistical tests that compared the PRS 3-021 iron results to the LANL-wide soil background data. The p-values suggest that the PRS iron data may be elevated above background soil, but the results of these tests are not definitive. An evaluation of Figure C-7 shows one elevated PRS Qbt4 iron result that is close to the soil background maximum. Figure C-7 also shows that most Qbt4 samples collected from PRS 3-021 are similar to soil but are elevated compared to background Qbt4. The bivariate plot of iron versus aluminum (Figure C-17) shows the presence of one elevated PRS iron result. Because the magnitude of this one elevated iron value is large (nearly equal to range in background), iron will be carried forward for further evaluation in the human health screening assessment.

Lead: Table C-6 presents the results for formal statistical tests that compared the PRS 3-021 lead results to the LANL-wide soil background data. The p-values suggest that the PRS lead data are elevated above background soil. An evaluation of Figure C-8 shows several elevated PRS soil and Qbt4 lead results, where eight PRS values are greater than the soil background maximum. The bivariate plot of lead versus aluminum (Figure C-18) also shows the presence

of multiple elevated PRS lead results. Clearly, lead warrants additional assessment, and will be carried forward for further evaluation in the human health screening assessment.

Nickel: Table C-6 presents the results for formal statistical tests that compared the PRS 3-021 nickel results to the LANL-wide soil background data. The p-values suggest that the PRS nickel data are elevated above background soil. An evaluation of Figure C-9 shows one elevated PRS soil nickel result that is close to the soil background maximum. Figure C-9 also shows that most Qbt4 samples collected from PRS 3-021 are similar to soil but are elevated compared to both background Qbt4 and soil. The bivariate plot of nickel versus aluminum (Figure C-19) shows the presence of four elevated PRS nickel results (one from soil and three from Qbt4). Because the magnitude of the elevated value is large (nearly equal to range in background), nickel will be carried forward for further evaluation in the human health screening assessment.

Vanadium: Table C-6 presents the results for formal statistical tests that compared the PRS 3-021 vanadium results to the LANL-wide soil background data. The p-values suggest that the PRS vanadium data do not differ from background soil. A similar conclusion is reached by evaluating the results presented in Figure C-10. Figure C-10 also shows that the Qbt4 samples collected from PRS 3-021 have an interquartile range similar to soil, but are elevated compared to background Qbt4. The bivariate plot of vanadium versus aluminum (Figure C-20) shows that the vanadium results at PRS 3-021 have the same abundance of vanadium relative to aluminum as do LANL-wide soils. Thus, vanadium will not be carried forward for further evaluation in the human health screening assessment.

Zinc: Table C-6 presents the results for formal statistical tests that compared the PRS 3-021 zinc results to the LANL-wide soil background data. The p-values suggest that the PRS zinc data are elevated above background soil. An evaluation of Figure C-11 shows some elevated Qbt4 zinc results at PRS 3-021, where one PRS value is greater than the soil background maximum. The bivariate plot of zinc versus aluminum (Figure C-21) also shows that the presence of multiple elevated PRS zinc results. Clearly, zinc warrants additional assessment, and will be carried forward for further evaluation in the human health screening assessment.

Conclusions

These additional analyses led to carrying forward six inorganic chemicals: chromium, copper, iron, lead, nickel, and zinc. These chemicals are in addition to mercury, selenium, and thallium, which were carried forward based on the background UTL comparison alone. Thus, the complete list of inorganic chemicals carried forward to the human health screening assessment includes the following: chromium, copper, iron, lead, mercury, nickel, selenium, thallium, and zinc.

Table C-6

Summary of P-Values for Statistical Tests

That Compared PRS Data to LANL-wide Soil Background Data

Chemical	Gehan	Slippage	Quantile
Aluminum	0.972	>0.999	0.936
Arsenic	0.782	>0.999	0.720
Barium	0.999	>0.999	>0.999
Calcium	0.998	>0.999	0.937
Chromium	0.177	0.004	0.066
Copper	0.679	0.065	0.107
Iron	0.089	>0.999	0.440
Lead	<0.001	<0.001	<0.001
Nickel	0.040	>0.999	0.065
Vanadium	0.945	>0.999	0.732
Zinc	0.002	0.065	<0.001

BOLD values are p-values less than 0.05.

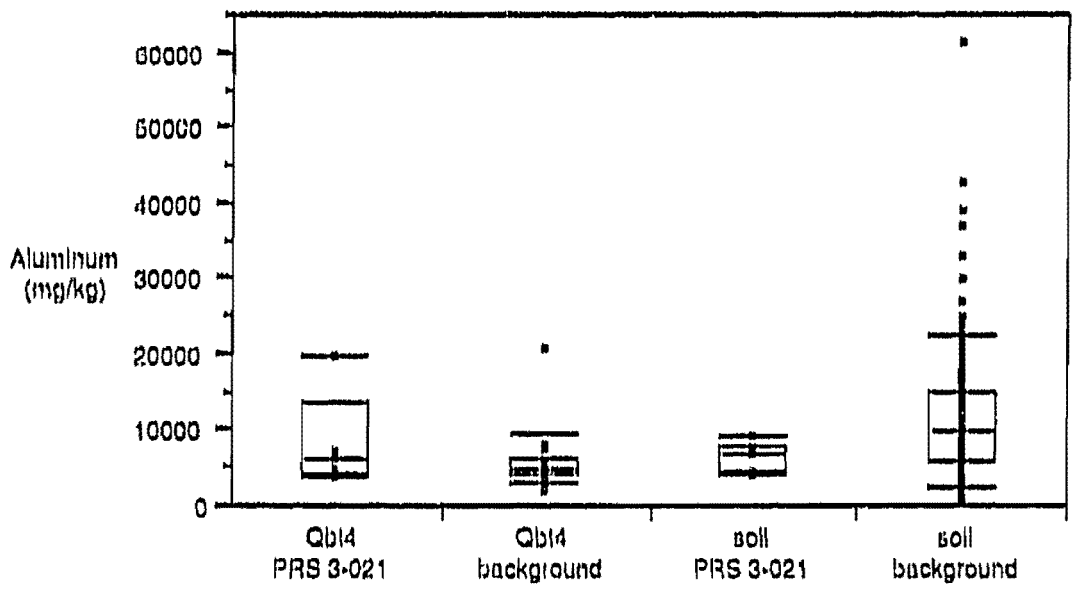


Figure C-1. Box plot comparison of PRS 3-021 data and LANL background aluminum data by media.

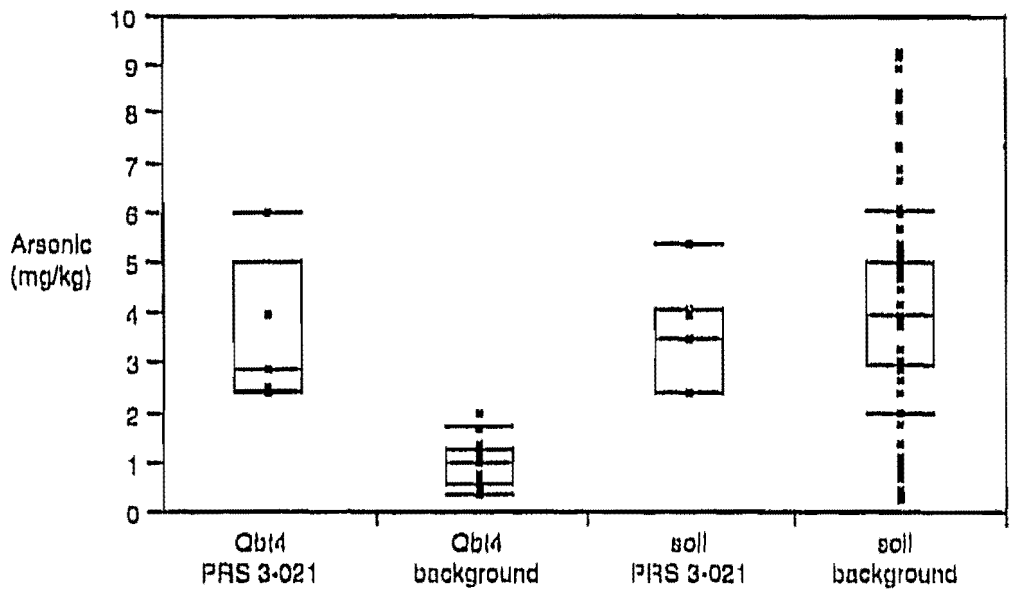


Figure C-2. Box plot comparison of PRS 3-021 data and LANL background arsenic data by media.

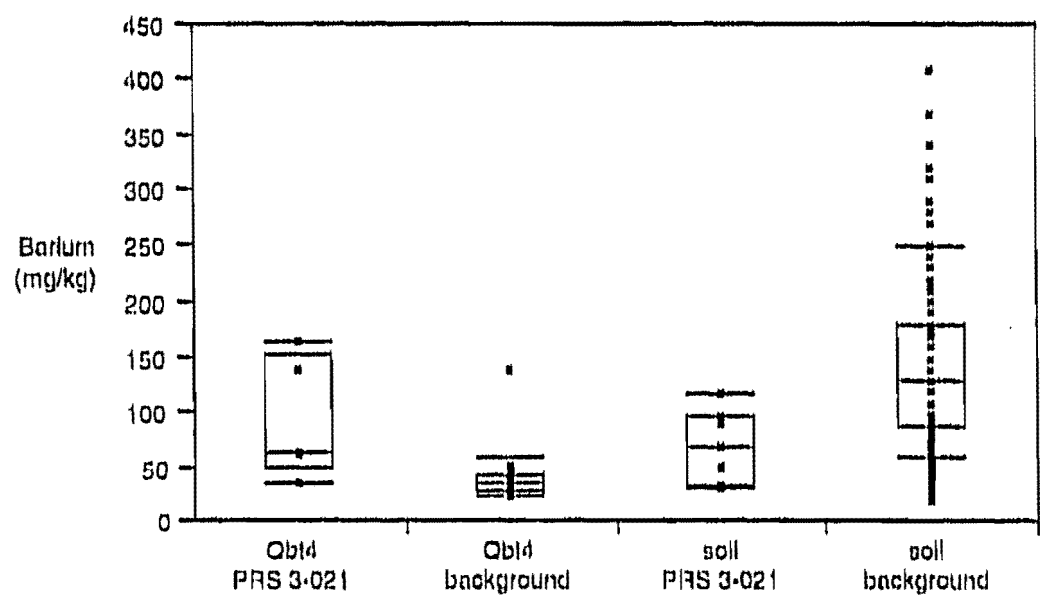


Figure C-3. Box plot comparison of PRS 3-021 data and LANL background barium data by media.

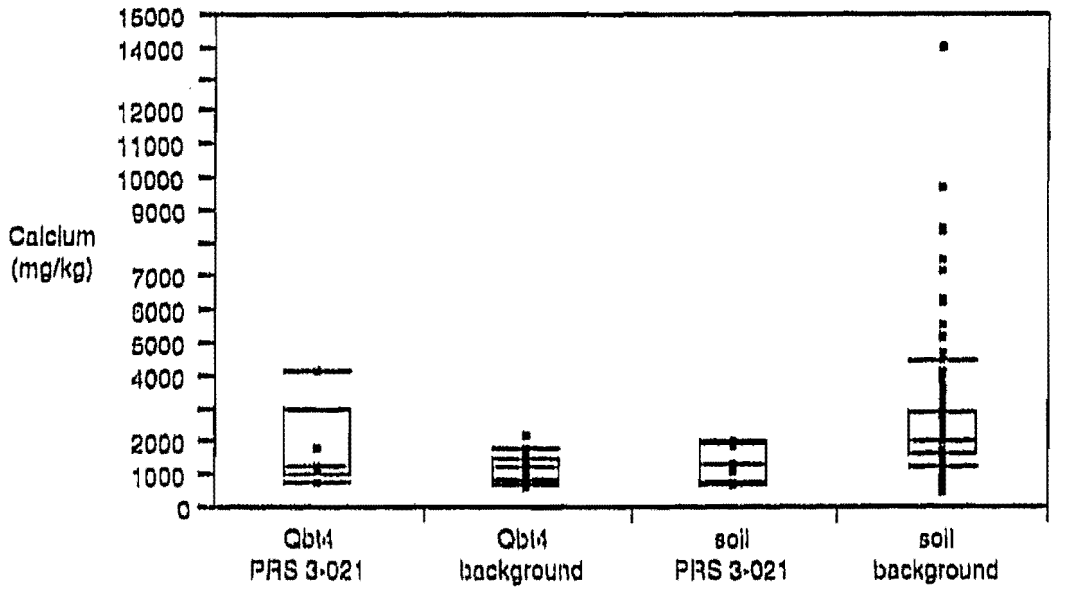


Figure C-4. Box plot comparison of PRS 3-021 data and LANL background calcium data by media.

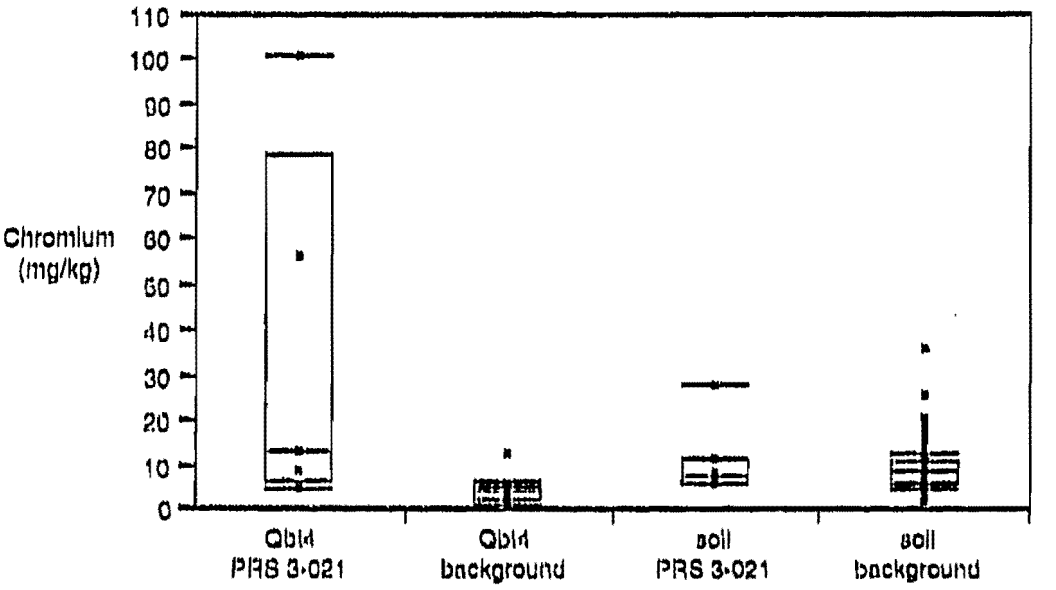


Figure C-5. Box plot comparison of PRS 3-021 data and LANL background chromium data by media.

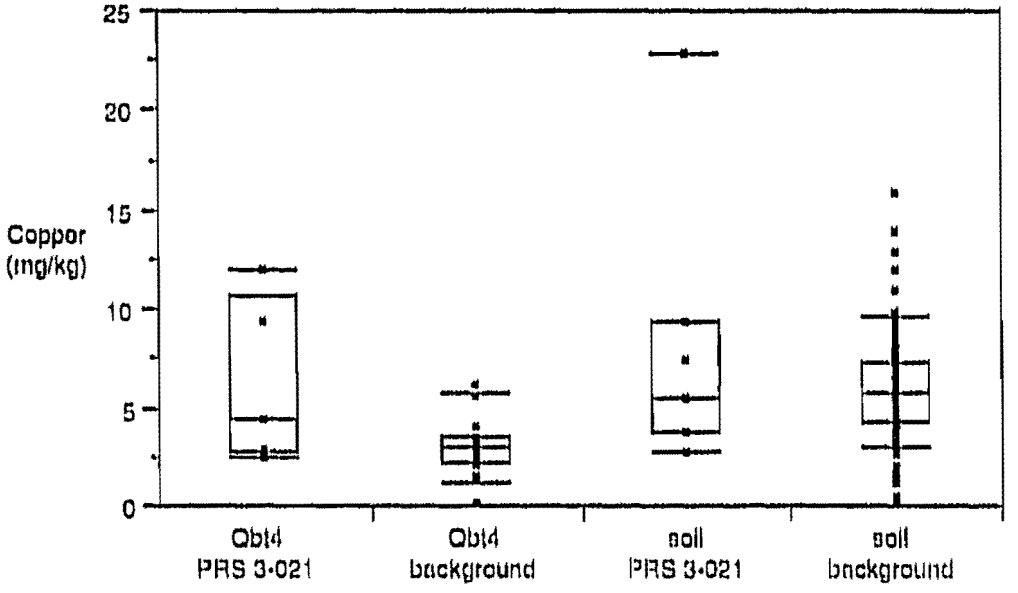


Figure C-6. Box plot comparison of PRS 3-021 data and LANL background copper data by media.

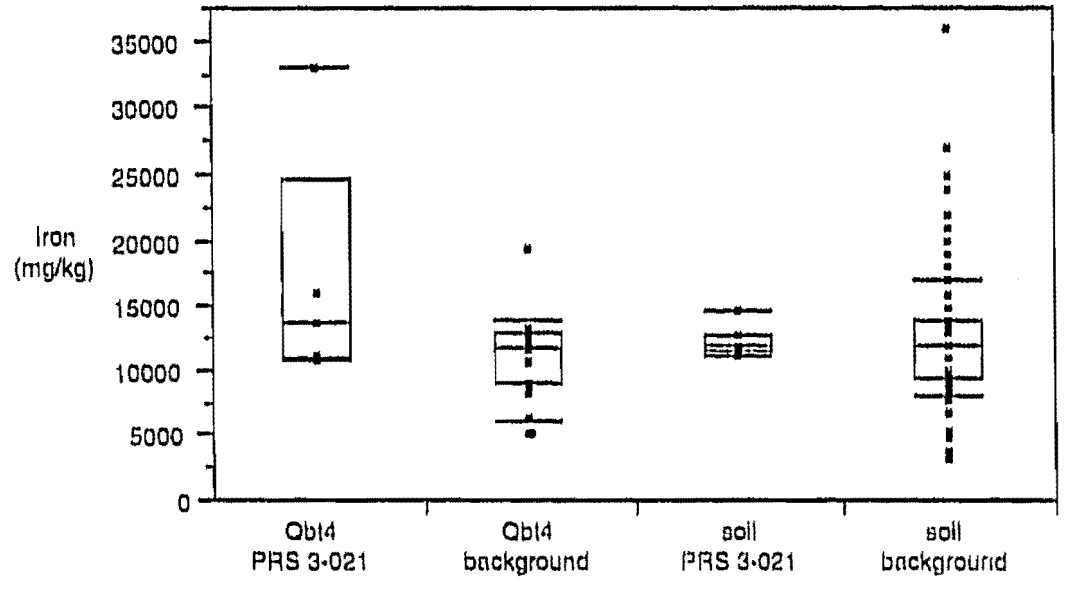


Figure C-7. Box plot comparison of PRS 3-021 data and LANL background iron data by media.

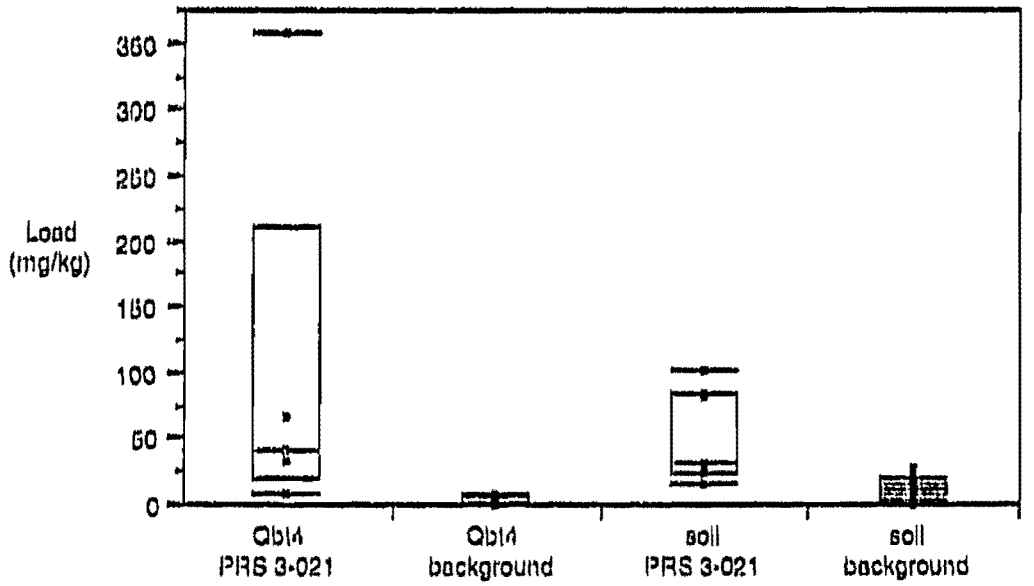


Figure C-8. Box plot comparison of PRS 3-021 data and LANL background lead data by media.

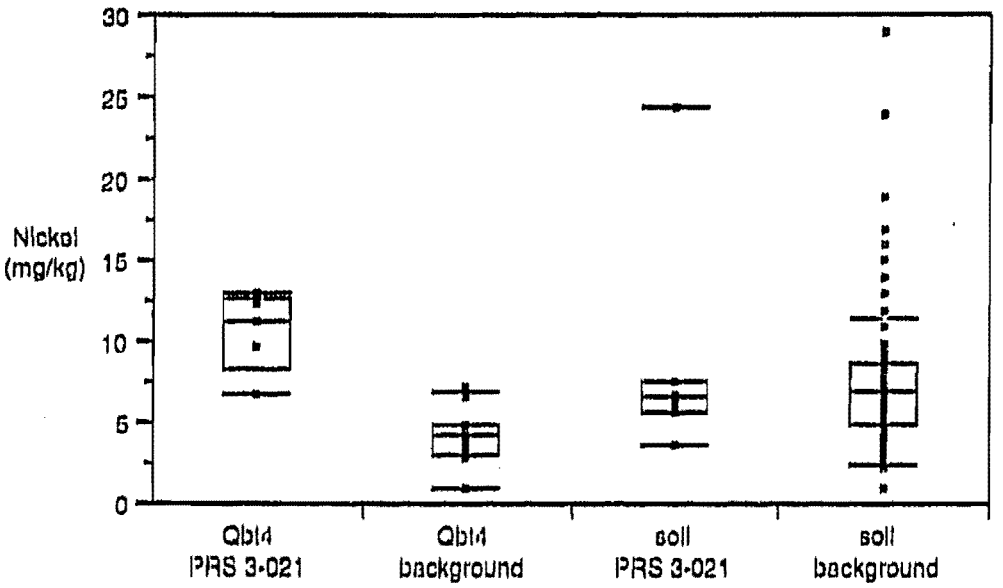


Figure C-9. Box plot comparison of PRS 3-021 data and LANL background nickel data by media.

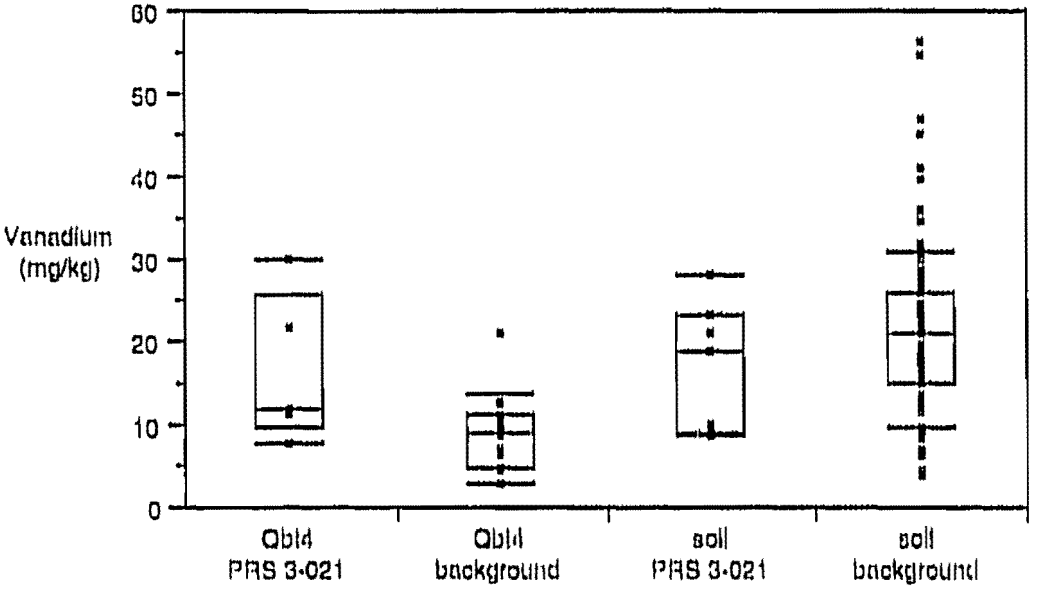


Figure C-10. Box plot comparison of PRS 3-021 data and LANL background vanadium data by media.

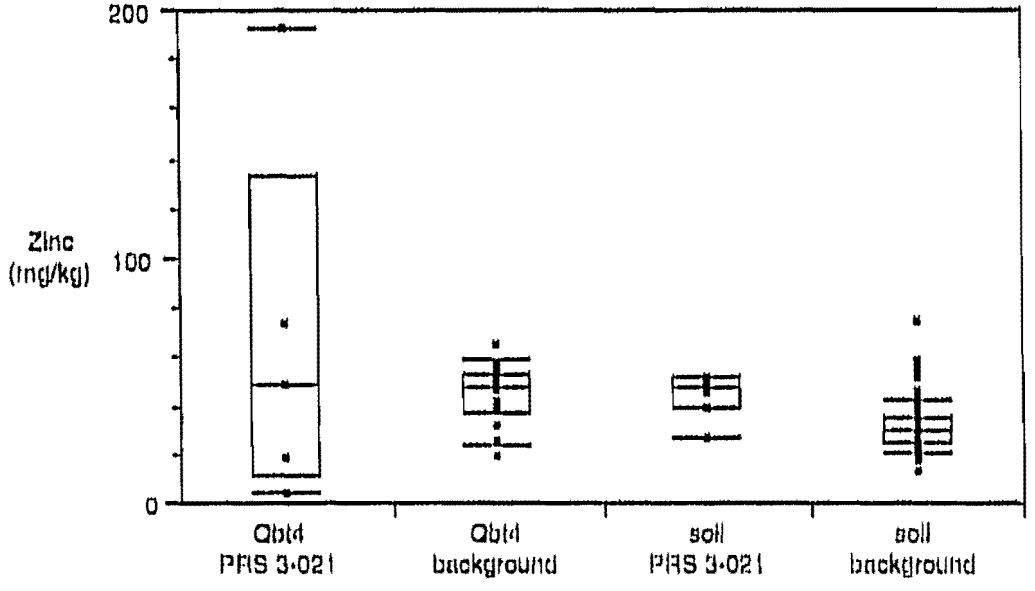


Figure C-11. Box plot comparison of PRS 3-021 data and LANL background zinc data by media.

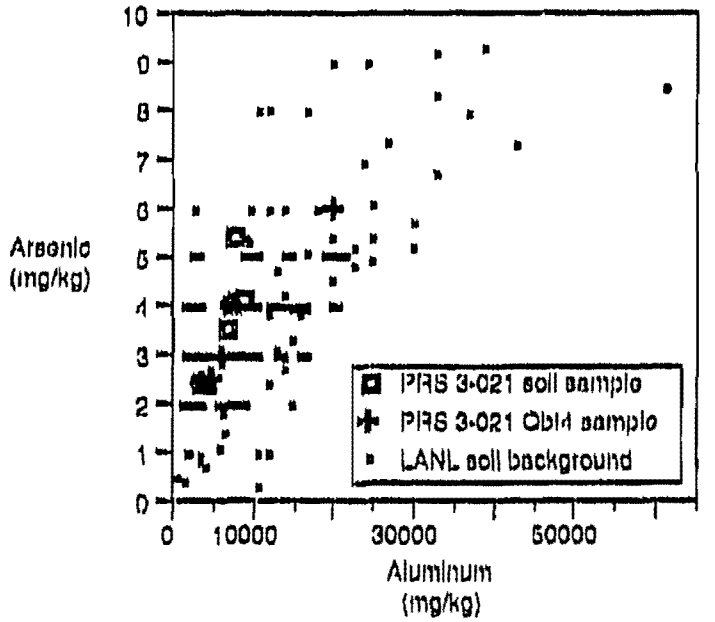


Figure C-12. Bivariate plot of arsenic versus aluminum for PRS 3-021 data and LANL background data by media.

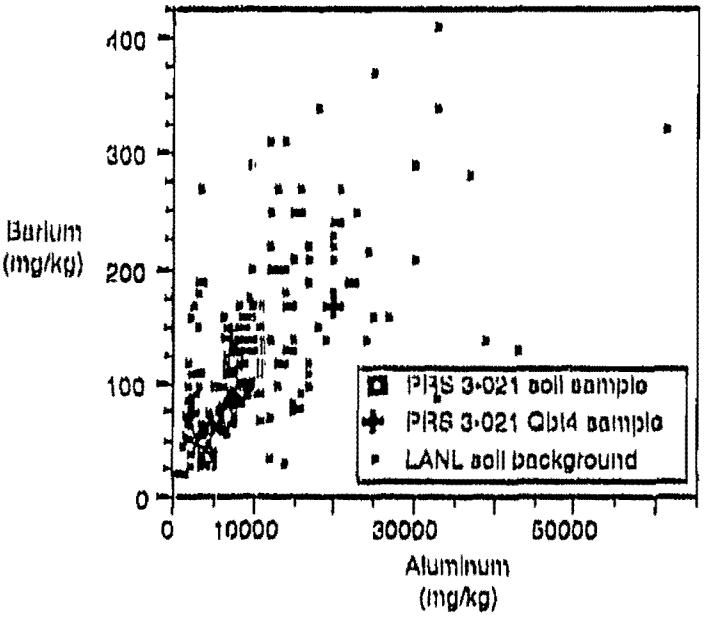


Figure C-13. Bivariate plot of barium versus aluminum for PRS 3-021 data and LANL background data by media.

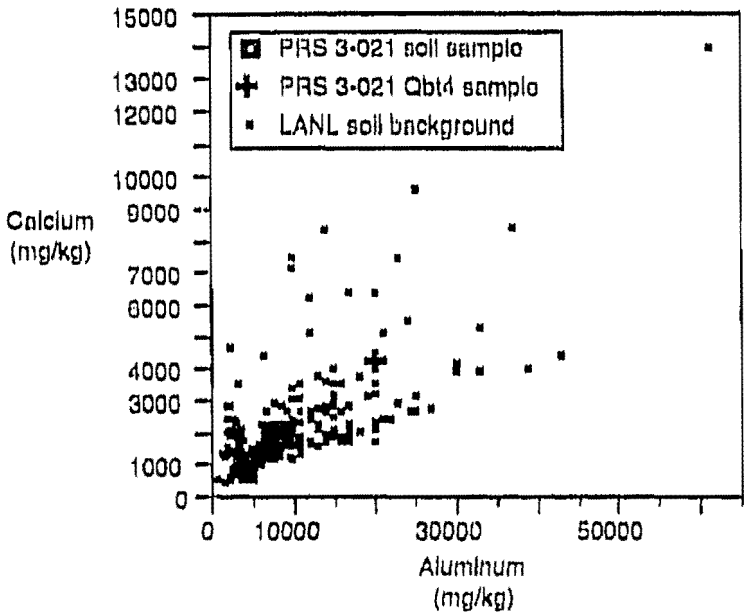


Figure C-14. Bivariate plot of calcium versus aluminum for PRS 3-021 data and LANL background data by media.

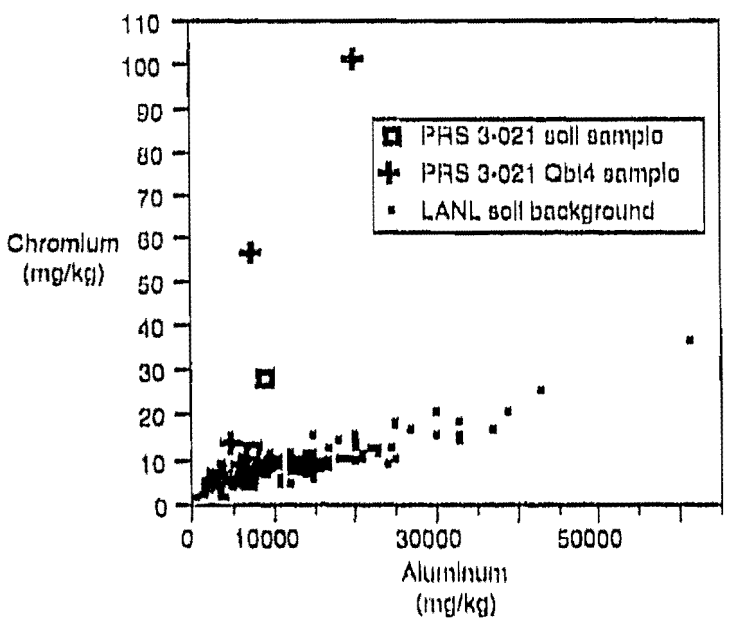


Figure C-15. Bivariate plot of chromium versus aluminum for PRS 3-021 data and LANL background data by media.

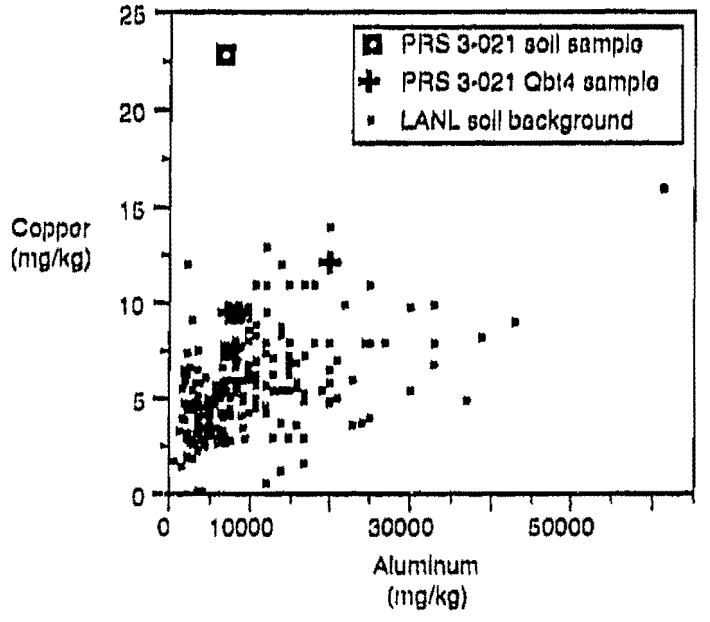


Figure C-16. Bivariate plot of copper versus aluminum for PRS 3-021 data and LANL background data by media.

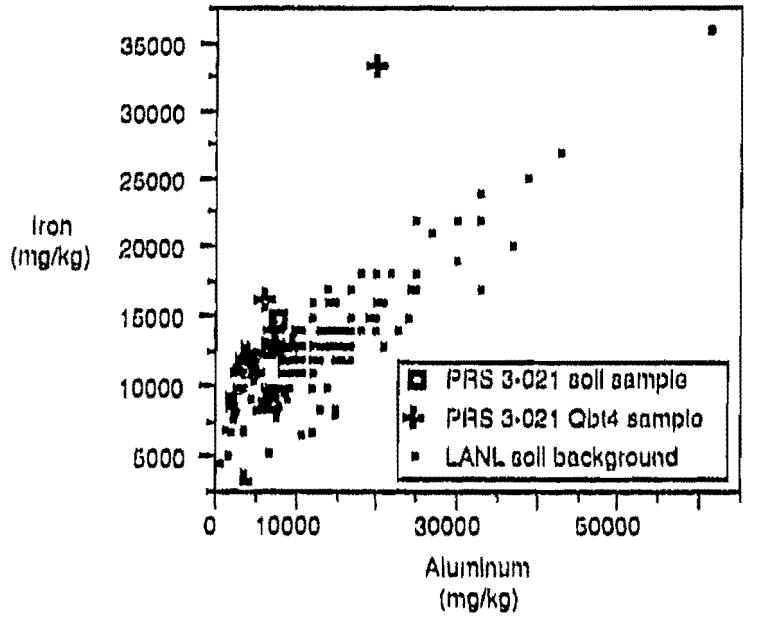


Figure C-17. Bivariate plot of iron versus aluminum for PRS 3-021 data and LANL background data by media.

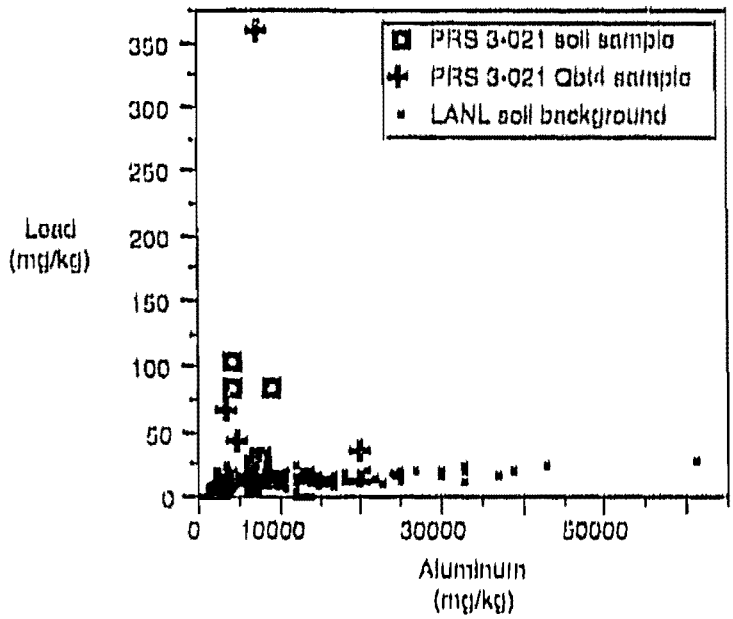


Figure C-18. Bivariate plot of lead versus aluminum for PRS 3-021 data and LANL background data by media.

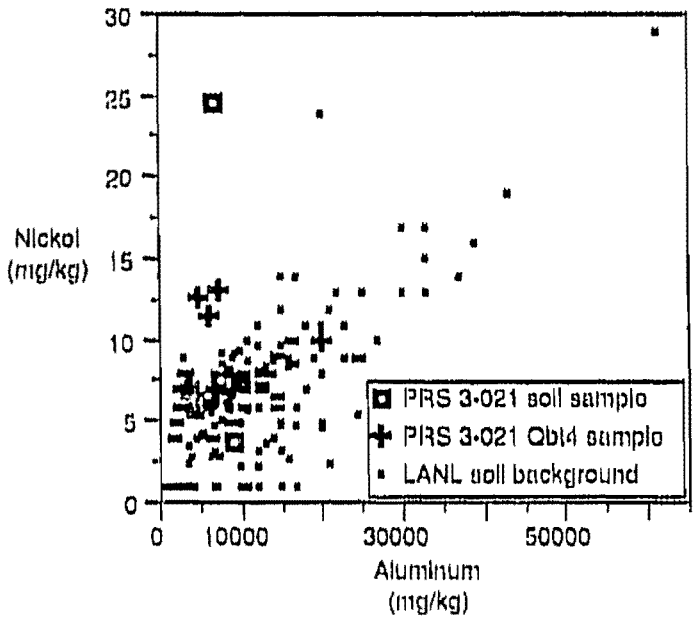


Figure C-19. Bivariate plot of nickel versus aluminum for PRS 3-021 data and LANL background data by media.

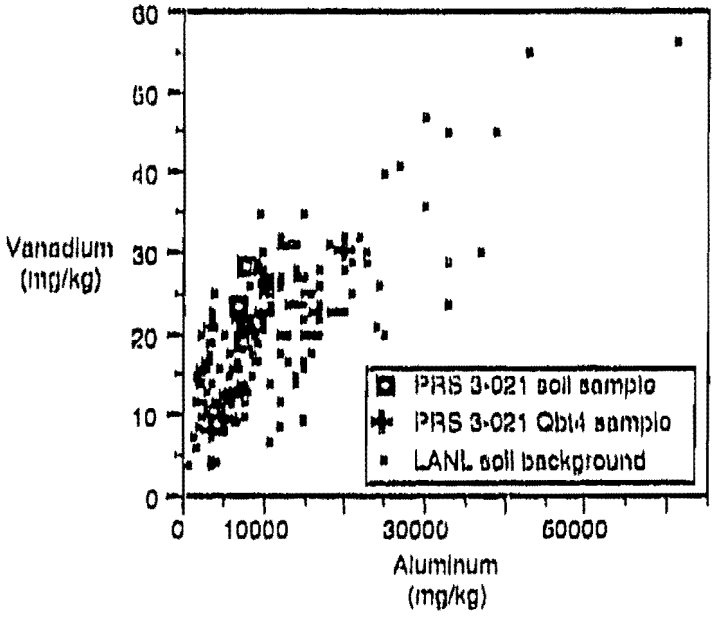


Figure C-20. Bivariate plot of vanadium versus aluminum for PRS 3-021 data and LANL background data by media.

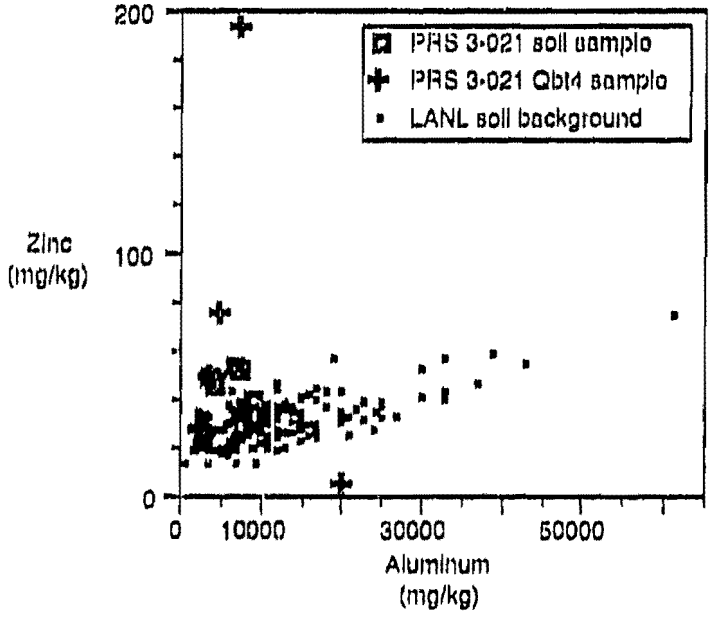


Figure C-21. Bivariate plot of zinc versus aluminum for PRS 3-021 data and LANL background data by media.

REFERENCES

Longmire, P. A., D. E. Broxton, and S. L Reneau (Eds.), October 1995. "Natural Background Geochemistry and Statistical Analysis of Selected Soil Profiles, Sediments, and Bandelier Tuff, Los Alamos, New Mexico," Los Alamos National Laboratory Report LA-UR-95-3486, Los Alamos, New Mexico. (Longmire et al. 1995, 1266)

Ryti, R., P. Longmire, and E. McDonald, March 29, 1996. "Application of LANL Background Data to ER Project Decision-Making, Part I: Inorganics," Los Alamos National Laboratory Report LA-UR-96-1534, ER ID No. 54585, Los Alamos, New Mexico. (Ryti et al. 1996, 1298)

THIS PAGE LEFT INTENTIONALLY BLANK

RFI Report for Phase I Investigation

TA-1 Aggregates N and P

Field Unit 1

Environmental Restoration Project

August 1997

A Department of Energy
Environmental Cleanup Program

Los Alamos
NATIONAL LABORATORY

LA-UR-97-3320

EXECUTIVE SUMMARY

This report presents the results of the Phase I site investigations and an Interim Action conducted under the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) for former Technical Area (TA) 1, Aggregates N and P, at Los Alamos National Laboratory (LANL). Both of these aggregates are in the Los Alamos townsite and are within county or privately owned real estate. Included in this report are background information, analysis approach, data assessment, and site-specific results, conclusions, and recommendations for all potential release sites (PRSs) associated with TA-1, Aggregates N and P. Although radionuclides are regulated by the Department of Energy (DOE) and not under RCRA, it is more efficient and cost-effective to investigate all types of potential contamination during a single site characterization. Therefore, it is a LANL/DOE policy to address radiochemical concerns in this report.

Aggregate N, also known as the Western Sanitary Waste Line (WSWL), consists of two former sanitary waste lines: PRSs 1-001(s) and 1-001(u). PRS 1-001(s) was a gravity main that served ten TA-1 buildings while PRS 1-001(u) was a forced main that served only one TA-1 building and discharged into PRS 1-001(s).

Thirteen locations along the WSWL were initially considered physically accessible for field investigation. Intrusive field activities were conducted at six of these thirteen locations (Locations 1A, 2, 8, 10, 11, and 13) following a precharacterization phase which included geophysical exploration at all sites and trenching or boring at locations 1A, 2, 8 and 13. The objectives of the first (precharacterization) investigation were to locate the WSWL and assess the nature of potential wastes that could be generated during Phase I investigations. The objectives of the Phase I investigation were to characterize any contamination within the WSWL and surrounding soils, to assess pipe integrity, and to remove and dispose of sections of the WSWL. At locations 10 and 11 an Interim Action (IA) was conducted before the construction of a motel on the site. The IA also included remediation at location 1A on a vacant lot that could be developed at any time. Chemicals of potential concern (COPCs) for Aggregate N included plutonium-239/240, thorium-232, cesium-137, uranium-235, uranium-238, beryllium, uranium, tritium, and metals.

Aggregate P, also referred to as Trinity Drive, consists of PRSs 1-006(s) and 1-007(l). PRS 1-006(s) is a former storm drain and outfall for Building P, and PRS 1-007(l) is an area of suspected soil contamination located beneath a section of Trinity Drive. The Operable Unit (OU) 1078 Work Plan proposed PRS 1-006(s) for No Further Action (NFA), and the US Environmental Protection Agency (EPA), Region 6, concurred in the Work Plan Notice of Deficiency document. The objective of the Phase I RFI at Aggregate P was to determine the

presence or absence of radiological and/or hazardous contaminants in the subsurface fill material used for Trinity Drive. COPCs for Aggregate P included uranium, plutonium, and metals.

All PRSs included in the investigation were assessed for human health risks and are proposed for NFA on the bases of those assessments. Ecological risk assessment is deferred until an approved process is implementable. It was not possible to remove all sections of the contaminated waste line, but the risk assessment included future potential exposures and the calculated risks were below DOE guidelines for radiological exposures.

PRS 1-001(u), a cast-iron forced main that connected to PRS 1-001(a), had been found contamination free on the basis of nuclear radiation measurements in 1976, and this investigation was not able to locate the line. Portions of the former line would have been above the present surface in the Timber Ridge residential area and apparently the line was removed during residential real estate development.

PRS 1-001(a) contained radiological and inorganic contamination which was removed and disposed as low level radiological waste because the inorganic TCLP results were below regulatory disposal limits. Portions of the line that were left in place include isolated portions beneath residential and commercial buildings, and the distal end that is currently carrying municipal sanitary liquid waste to a publicly owned treatment works (Bayo Plant).

PRS 1-007(l) is a layer of fill that is below the asphalt surfaced eastbound lanes of Trinity Drive. Some contamination was found in the fill material, but the concentrations are below SALs.

TABLE ES-1

SUMMARY OF PROPOSED ACTIONS PROPOSED ACTION

		PROPOSED ACTION			
PRS NUMBER	HSWA[a]	NFA CRITERION	FURTHER ACTION[b]	RATIONALE	SECTION NUMBER
1-001(a)	X	4		Contamination is contained in vitrified clay pipe beneath residential or commercial structures. Potential future human exposures are acceptable.	5.1.11
1-001(u)	X	4		After the line was judged to be free of radioactive contamination at the end of Building J-2, Development of residential units apparently resulted in the removal of the line.	5.1.11
1-007(l)	X	4		Contamination contained in layer of fill beneath Trinity Drive. Concentrations were below SAL.	5.2.11

[a] An X in this column indicates that the site is listed on the Hazardous and Solid Waste Amendments (HSWA) Module (Module VIII) of the Laboratory's RCRA operating permit.
[b] VCA, EC, further investigation, or CMS.

CONTENTS

EXECUTIVE SUMMARY I

1.0 INTRODUCTION 1

1.1 General Site History 1

1.2 RFI Overview 4

1.2.1 Aggregate N 4

1.2.2 Aggregate P 5

1.3 Field Activities 9

1.3.1 Aggregate N 9

1.3.2 Aggregate P 9

2.0 ENVIRONMENTAL SETTING 10

2.1 Climate 10

2.2 Geology 10

2.2.1 Geologic Setting 10

2.2.2 Soils 10

2.3 Hydrology 11

2.3.1 Surface Water 11

2.3.2 Ground Water 11

2.4 Biological Surveys 11

2.5 Cultural Surveys 12

3.0 APPROACH TO SAMPLE ANALYSES AND DATA ASSESSMENT 12

3.1 Sample Analyses 14

3.1.1 Analytical Methods 14

3.1.2 Data Validation 15

3.2 Process for the Identification of COPCs 17

3.2.1 Inorganic Chemicals 17

3.2.2 Radionuclides 18

3.2.3 Organic Chemicals 19

3.2.4 Risk-Based Screening Assessment 19

3.3 Human Health Assessment 20

3.3.1 Risk Due to Naturally Occurring Inorganic Chemicals in Soils (Background) 20

3.3.2 Risk Assessment 22

3.4 Ecological Assessment 23

4.0 RESULTS OF QUALITY ASSURANCE/QUALITY CONTROL ACTIVITIES 23

4.1 Aggregate N 23

4.1.1 Inorganic Analysis 23

4.1.2 Organic Analysis 26

4.1.2.1 PCBs/Pesticides 26

4.1.2.2 SVOCs 27

4.1.2.3 VOCs 28

4.1.3 Radiochemical Analysis 29

4.2 Aggregate P 31

4.2.1 Inorganic Analysis 31

4.2.2 Organic Analysis 31

4.2.3 Radiochemical Analysis 31

5.0 SPECIFIC RESULTS, CONCLUSIONS, AND RECOMMENDATIONS 32

5.1 Aggregate N 32

5.1.1 History 32

5.1.2 Description 35

5.1.3 Previous Investigations 35

5.1.4 Field Investigation at Aggregate N 36

5.1.4.1 Location 1A 37

5.1.4.2 Locations 10 and 11 45

5.1.4.3 Location 13 49

5.1.4.4 Locations 2 and 8 58

5.1.5 Evaluation of Inorganics 60

5.1.5.1 Location 1A 60

5.1.5.2 Locations 10 and 11 60

5.1.5.3 Location 13 64

5.1.5.4 Inside the Pipe 66

5.1.6 Evaluation of Radionuclides 70

5.1.6.1 Location 1A 70

5.1.6.2 Locations 10 and 11 70

5.1.6.3 Location 13 73

5.1.6.4 Inside the Pipe, Location 13 73

5.1.7 Evaluation of Organics 77

5.1.7.1 Location 1A 77

5.1.7.2 Locations 10 and 11 77

5.1.7.3 Location 13 77
5.1.7.4 Inside the Pipe 79
5.1.8 Risk-Based Screening Assessment 79
5.1.8.1 Location 1A 79
5.1.8.2 Locations 10 and 11 89
5.1.8.3 Location 13 91
5.1.8.4 Inside the Pipe 94
5.1.9 Human Health Risk Assessment 101
5.1.9.1 Location 1A 103
5.1.9.2 Location 13 112
5.1.9.3 Inside the Pipe 119
5.1.10 Preliminary Ecological Assessment 131
5.1.11 Conclusions and Recommendations 131
5.2 Aggregate P, Trinity Drive 132
5.2.1 History 132
5.2.2 Description 132
5.2.3 Previous Investigations 133
5.2.4 Field Investigation at Aggregate P 133
5.2.5 Evaluation of Inorganics 136
5.2.6 Evaluation of Radionuclides 138
5.2.7 Evaluation of Organic Chemicals 140
5.2.8 Risk-Based Screening Assessment 140
5.2.9 Human Health Risk Assessment 141

5.2.10 Preliminary Ecological Assessment 142

5.2.11 Conclusions and Recommendations 142

6.0 References 143

APPENDIX A ANALYTICAL DATA A-1

APPENDIX B DATA QUALITY EVALUATION TABLES B-1

APPENDIX C RISK ASSESSMENT CALCULATIONS C-1

LIST OF TABLES

Table ES-1	Summary of Proposed Actions Proposed Action	II
Table 3.3.1-1	Risk Due to Background Concentrations of Inorganic Chemicals in Soil Assuming a Residential Scenario[a]	22
Table 5.1.4.1-1	Summary of Samples Collected in February/March 1994 at Aggregate N, Location 1A	39
Table 5.1.4.1-2	Summary of Samples Collected in July 1994 at Aggregate N, Location 1A	42
Table 5.1.4.1-3	Summary of Samples Collected in June 1996 at Aggregate N, Location 1A	45
Table 5.1.4.2-1	Summary of Samples Collected in June 1996 at Aggregate N, Locations 10 and 11	48
Table 5.1.4.3-1	Summary of Samples Collected in February/March 1994 at Aggregate N, Location 13	51
Table 5.1.4.3-2	Summary of Samples Collected November/December 1994 at Aggregate N, Location 13	55
Table 5.1.5.1-1	Inorganics with Concentrations Exceeding Background Screening Values at Aggregate N, Location 1A[a]	61
Table 5.1.5.2-1	Statistical Tests for Background Comparisons at Aggregate N, Locations 10 and 11	63
Table 5.1.5.2-2	Inorganics with Concentrations Exceeding Background Screening Values at Aggregate N, Locations 10 and 11[a]	63
Table 5.1.5.3-1	Statistical Tests for Background Comparisons at Aggregate N, Location 13	65
Table 5.1.5.3-2	Inorganics with Concentrations Exceeding Background Screening Values at Aggregate N, Location 13[a]	65
Table 5.1.5.4-1	Statistical Tests for Background Comparisons at Aggregate N, Inside The Pipe	67
Table 5.1.5.4-2	Inorganics with Concentrations Exceeding Background Screening Values at Aggregate N, Inside the Pipe	68
Table 5.1.6.1-1	Radionuclides with Concentrations Exceeding Background Screening Values at Aggregate N, Location 1A[a]	70

Table 5.1.6.2-1 Radionuclides with Concentrations Exceeding Background Screening Values at Aggregate N, Locations 10 and 11* 72

Table 5.1.6.3-1 Radionuclides with Concentrations Exceeding Background Screening Values at Aggregate N, Location 13* 74

Table 5.1.6.4-1 Radionuclides with Concentrations Exceeding Background Screening Values at Aggregate N, Inside The Pipe 75

Table 5.1.7.1-1 Organics with Detected Concentrations at Aggregate N, Location 1A 78

Table 5.1.7.3-1 Organics with Detected Concentrations at Aggregate N, Location 13* 78

Table 5.1.7.4-1 Organics with Detected Concentrations at Aggregate N, Inside the Pipe 80

Table 5.1.8.1-1 Aggregate N, Location 1A Carcinogens with Concentrations in Soil that Exceed SALs 83

Table 5.1.8.1-2 Aggregate N, Location 1A Radionuclides with Concentrations in Soil that Exceed SALs 83

Table 5.1.8.1-3 Multiple Chemical Evaluation for Soil Samples at Aggregate N, Location 1A 87

Table 5.1.8.2-1 Multiple Chemical Evaluation for Soil Samples at Aggregate N, Locations 10 and 11* 90

Table 5.1.8.3-1 Aggregate N, Location 13 Noncarcinogens with Concentrations in Soil that Exceed SALs 91

Table 5.1.8.3-2 Aggregate N, Location 13 Radionuclides with Concentrations in Soil that Exceed SALs 91

Table 5.1.8.3-3 Multiple Chemical Evaluation for Soil Samples at Aggregate N, Location 13 93

Table 5.1.8.4-1 Aggregate N, Inside the Pipe Noncarcinogens with Concentrations in Soil that Exceed SALs 96

Table 5.1.8.4-2 Aggregate N, Inside the Pipe Carcinogens with Concentrations in Soil that Exceed SALs 97

Table 5.1.8.4-3 Aggregate N, Inside the Pipe Radionuclides with Concentrations in Soil that Exceed SALs 98

Table 5.1.8.4-4	Multiple Chemical Evaluation for Soil Samples at Aggregate N, Inside the Pipe	100
Table 5.1.9.1-1	Source Term Concentrations, Location 1A	107
Table 5.1.9.1-2	Selected Resrad Code Input Parameters, Location 1A	108
Table 5.1.9.1-3	Dose Estimates for Radioactive COPCs, Location 1A	110
Table 5.1.9.2-1	Source Term Concentrations, Location 13	115
Table 5.1.9.2-2	Selected Resrad Code Input Parameters, Location 13	116
Table 5.1.9.2-3	Dose Estimates for Radioactive COPCs, Location 13	118
Table 5.1.9.3-1	Chemicals of Potential Concern, Inside the Pipe	121
Table 5.1.9.3-2	Source Term Concentrations, Inside the Pipe	123
Table 5.1.9.3-3	Total Normalized Value for Noncarcinogenic Chemicals of Potential Concern, Inside the Pipe	125
Table 5.1.9.3-4	Estimates of Circle Diameters such that Total Normalized Value is Equal to One	127
Table 5.2.4-1	Summary of Samples Collected in September 1993 at Aggregate P	134
Table 5.2.4-2	Summary of Samples Collected in July 1996 at Aggregate P	134
Table 5.2.5-1	Inorganics with Concentrations Exceeding Background Screening Values at Aggregate P	138
Table 5.2.6-1	Radionuclides with Concentrations Exceeding Background Screening Values at Aggregate P	140
Table 5.2.8-1	Multiple Chemical Evaluation for Soil Samples from Aggregate P	141
Table B-1	1995 Summary Table of Quality Control Results for Aggregate N	B-1
Table B-2	1996 Summary Table of Quality Control Results for Aggregate N	140
Table B-3	Multiple Chemical Evaluation for Soil Samples from Aggregate P	140

LIST OF FIGURES

Fig. 1.1-1. Location map of TA-1 within Los Alamos National Laboratory, Los Alamos, New Mexico 2

Fig. 1.1-2. Location and detail of TA-1 with respect to Laboratory TAs and surrounding townsite 3

Fig. 1.2.1-1. Location of WSWL at Aggregate N, TA-1. Numbers refer to access areas 6

Fig. 1.2.1-2. Current status of Western Sanitary Waste Line at Aggregate N, TA-1. Numbers refer to access areas 8

Fig. 1.2.2-1. Location of Aggregate P, TA-1 9

Fig. 2.2.1-1. Generalized stratigraphy at TA-1 13

Fig. 5.1.1-1. Location of Western Sanitary Waste Line (highlights former Laboratory buildings) 35

Fig. 5.1.4.1-1. Location of boreholes at Location 1A, Aggregate N 39

Fig. 5.1.4.1-2. Location 1A sampling locations (by reference number) 42

Fig. 5.1.4.1-3. Location of samples collected in June 1996 at Aggregate N, Location 1A 45

Fig. 5.1.4.2-1. Location of samples collected in June 1996 at Aggregate N, Location 10 and 11 48

Fig. 5.1.4.3-1. Locations of boreholes at Aggregate N, Location 13 51

Fig. 5.1.4.3-2. Location 13 samples collected cross-trenches 54

Fig. 5.1.4.3-3. Sampling locations and intervals at Location 13, Aggregate N 55

Fig. 5.1.5.2-1. Chemicals with concentrations above background screening values at Locations 10 and 11 83

Fig. 5.1.8.1-1. Chemicals with concentrations above screening action levels at Location 1A 85

Fig. 5.1.8.1-2. Chemicals with concentrations above screening action levels at Location 1A 86

Fig. 5.1.8.1-3. Chemicals with concentrations above screening action levels at Location 1A 89

Fig. 5.1.8.3-1. Chemicals with concentrations above screening action levels at Location 13 92

Fig. 5.1.8.4-1. Chemicals with concentrations above screening action levels inside the pipe 96

Fig. 5.1.0.1-1 106

Fig. 5.1.1-1. Preliminary Ecological Assessment 114

5.1.1.1-1 Conclusions and recommendations. 121

Fig. 5.2.4-1 Location of samples collected at Aggregate P. 135

Fig. 5.2.5-1. Chemicals above background screening values at Aggregate P. 137

1.0 INTRODUCTION

This report presents the results of the Phase I site investigations conducted under the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) for former Technical Area (TA) 1, Aggregates N and P, at Los Alamos National Laboratory (LANL). This report contains background information, analysis approach, data assessment, and site-specific results, conclusions, and recommendations for all potential release sites (PRSs) associated with TA-1, Aggregates N and P. Although radionuclides are regulated by the Department of Energy (DOE) and not under RCRA, it is more efficient and cost-effective to investigate all types of potential contamination during a single site characterization. Therefore, it is a LANL/DOE policy to address radiochemical concerns in this report.

1.1 General Site History

TA-1 covers approximately 80 acres; 50 acres span the mesa top and 30 acres cover canyon walls and hillsides (Figs. 1.1-1, and 1.1-2). TA-1 is located on East Mesa in an area that includes a portion of the present-day townsite of Los Alamos. TA-1 extends east to west from 18th Street to the edge of Timber Ridge Road, and north to south from Central Avenue to the north rim of Los Alamos Canyon. In all, 66 PRSs have been identified in TA-1; 33 PRSs have been proposed for no further action (NFA) based on-site records, past activities, and previous decontamination efforts (LANL 1992, 0782). Five RFI reports and one voluntary corrective action (VCA) report made recommendations for NFA for an additional 32 PRSs. Aggregates N and P are two of 16 aggregates into which the PRSs at TA-1 have been divided. The Aggregate N PRSs addressed in this report are PRSs 1-001(s) and 1-001(u). The Aggregate P PRSs addressed in this report are PRS 1-006(s) and PRS 1-007(l).

Activities at TA-1 began in 1943 and reached a peak between 1945 and 1955. LANL's initial bench-scale physical and chemical experiments involving plutonium, uranium, and other radionuclides were almost exclusively conducted at TA-1. Basic chemical operations that occurred at TA-1 included chemical laboratory wet-chemistry experimentation and wet- and dry-chemistry processing. TA-1 also housed several mechanical operations such as casting, machining, powder metallurgy, and metallurgical and solid materials procedures for shaping metals. These activities generated a variety of hazardous and radioactive wastes. LANL attempted to keep radioactively contaminated wastes separated from sanitary liquid wastes by dedicating a separate disposal line for the collection of industrial liquid wastes. This industrial waste line led from TA-1 to Acid Canyon, a small tributary of Pueblo Canyon. The industrial discharge was untreated until 1951 when the TA-45 treatment plant was built (Fenenbaugh et al. 1982, 0668). Some outlying TA-1 buildings used separate sanitary waste (septic) tanks (International Technology Corporation 1991, 09-0003).

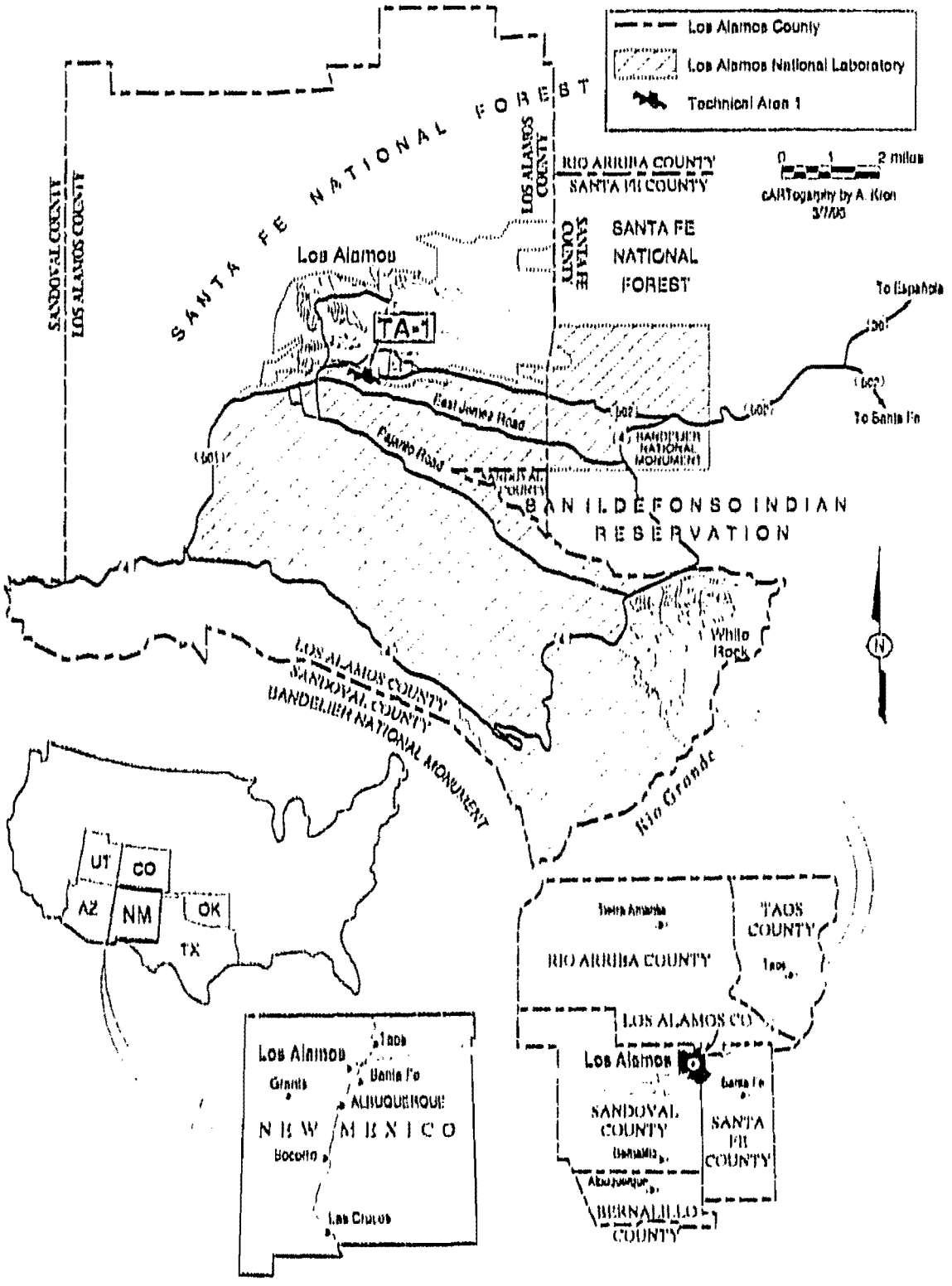


Fig. 1.1-1. Location map of TA-1 within Los Alamos National Laboratory, Los Alamos, New Mexico.

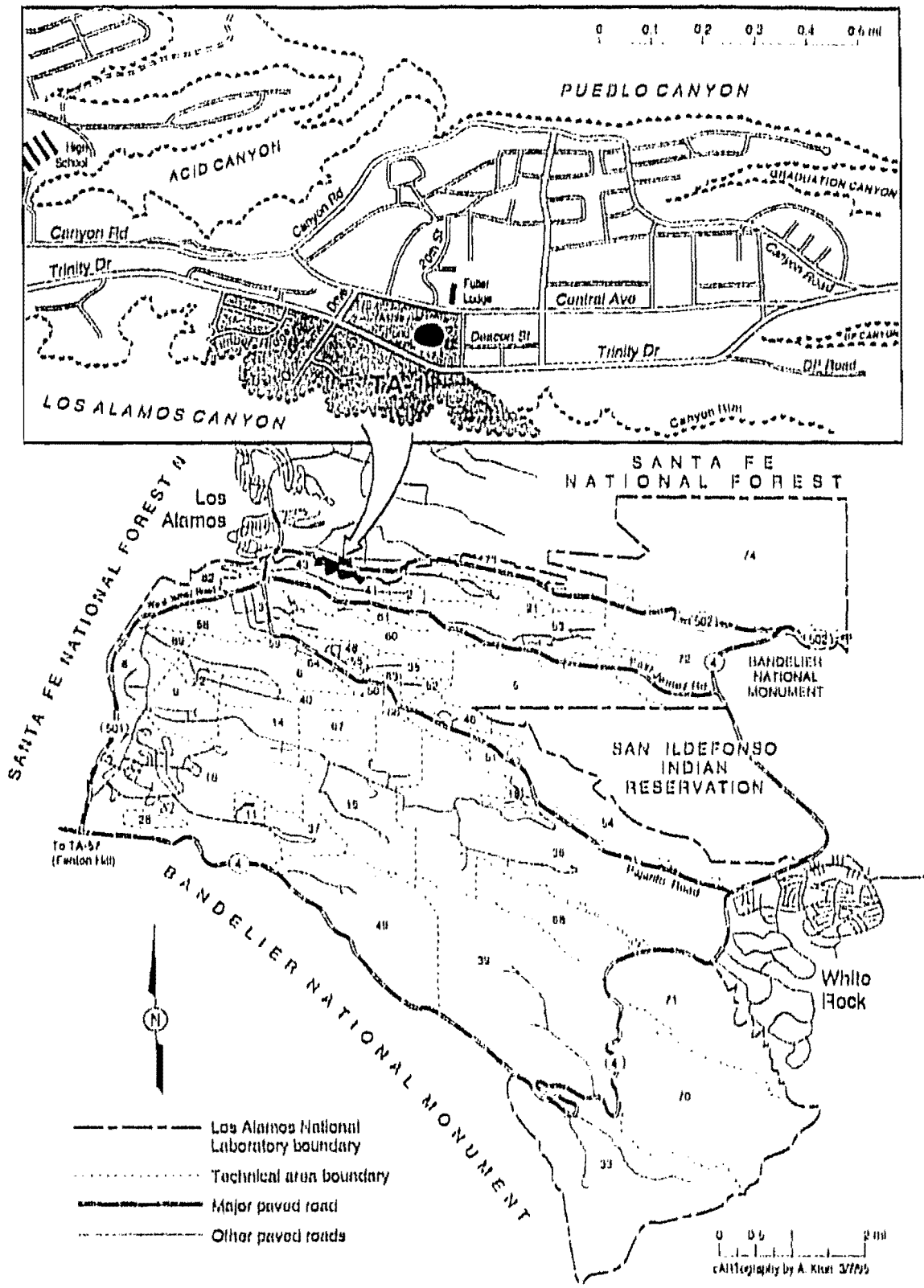


Fig. 1.1-2. Location and detail of TA-1 with respect to Laboratory TAs and surrounding townsite.

1.2 RFI Overview

In general, the objectives of the RFIs for the PRSs associated with TA-1 were to determine the presence or absence of potential contamination. These investigations were designed within the context of a generic conceptual site model for mesa top and hillside PRSs presented in Subsection 4.3 of the RFI Work Plan for Operable Unit (OU) 1078 (LANL 1992, 0782). The specific objectives of the RFIs for TA-1 Aggregates N and P are discussed separately in following sections. With regard to the conceptual site model for these aggregates, the generic model presented in the Work Plan was intended to encompass the wide variety of PRSs within TA-1 and contains components that are not applicable to Aggregates N and P. As discussed in subsequent sections of this report, residual contamination associated with these aggregates would be present in subsurface soil or tuff, if at all. Therefore, the primary receptors to this residual contamination would be construction or maintenance workers as a result of intrusion into subsurface soil or tuff in these areas. The primary exposure routes associated with this type of construction or maintenance activity would be inhalation, ingestion, dermal contact, and/or external irradiation. Specific conceptual site models were developed as necessary in the risk assessment section of this report.

1.2.1 Aggregate N

Aggregate N, also known as the Western Sanitary Waste Line (WSWL), consists of two former sanitary waste lines: PRSs 1-001(s) and 1-001(u). PRS 1-001(s) was a gravity main that served ten TA-1 buildings while PRS 1-001(u) was a forced main that served only one TA-1 building. Thirteen locations along the WSWL were initially considered physically accessible for field investigation. These locations were identified because they have at least 20 ft of continuous access in directions both parallel and perpendicular to the WSWL and do not contain restraints such as buildings, structures, retaining walls, concrete drives/walks, or identified buried utilities. Field activities were conducted at six of these thirteen locations along the WSWL initially considered accessible for investigation (Fig. 1.2.1-1). The field investigations at these six locations (Locations 1A, 2, 8, 10, 11, and 13) were conducted in two phases. The objectives of the first investigation were to locate the WSWL and assess any residual contamination associated with the soils surrounding the WSWL. Field activities associated with the location and assessment phase consisted of geophysical surveys, trenching activities, and drilling and sampling activities. At six locations (4, 5, 6, 7, 12, and 13) the field activities were solely geophysical surveys. During the geophysical surveys, buried utilities (including electric, gas, water, telephone, gasoline underground storage tanks, and traffic sensors) were identified at most locations. The objectives of the second investigation phase were to characterize any

contamination within the WSWL and surrounding soils, to assess pipe integrity, and to remove and dispose of sections of the WSWL. Field activities associated with the characterization phase consisted of collecting samples from materials within (inside) the WSWL to provide RFI characterization data for other inaccessible sections of the WSWL, removing and disposing sections of the WSWL, and collecting samples from materials underlying (outside) the WSWL to provide RFI characterization data for removed sections of the WSWL. Removal and sampling activities at Locations 10, 11, and 1A (partial) were reported in an Interim Action report (LANL 1996, 09-0533). Past WSWL excavation and building construction activities coupled with these RFI activities have removed the majority of the WSWL (Fig. 1.2.1-2). Suspected chemicals for Aggregate N included plutonium-239/240, thorium-232, cesium-137, uranium-235, uranium-238, beryllium, uranium, tritium, and metals (LANL 1992, 0782).

1.2.2 Aggregate P

Aggregate P, also referred to as Trinity Drive, consists of PRSs 1-006(s) and 1-007(l). PRS 1-006(s) is a former storm drain and outfall for Building P, and PRS 1-007(l) is an area of suspected soil contamination located beneath a section of Trinity Drive (Fig. 1.2.2-1). The objective of the Phase 1 RFI at Aggregate P was to determine the presence or absence of radiological and/or hazardous contaminants in the subsurface fill material used for Trinity Drive. Suspected chemicals for Aggregate P included uranium, plutonium, and metals (LANL 1992, 0782).

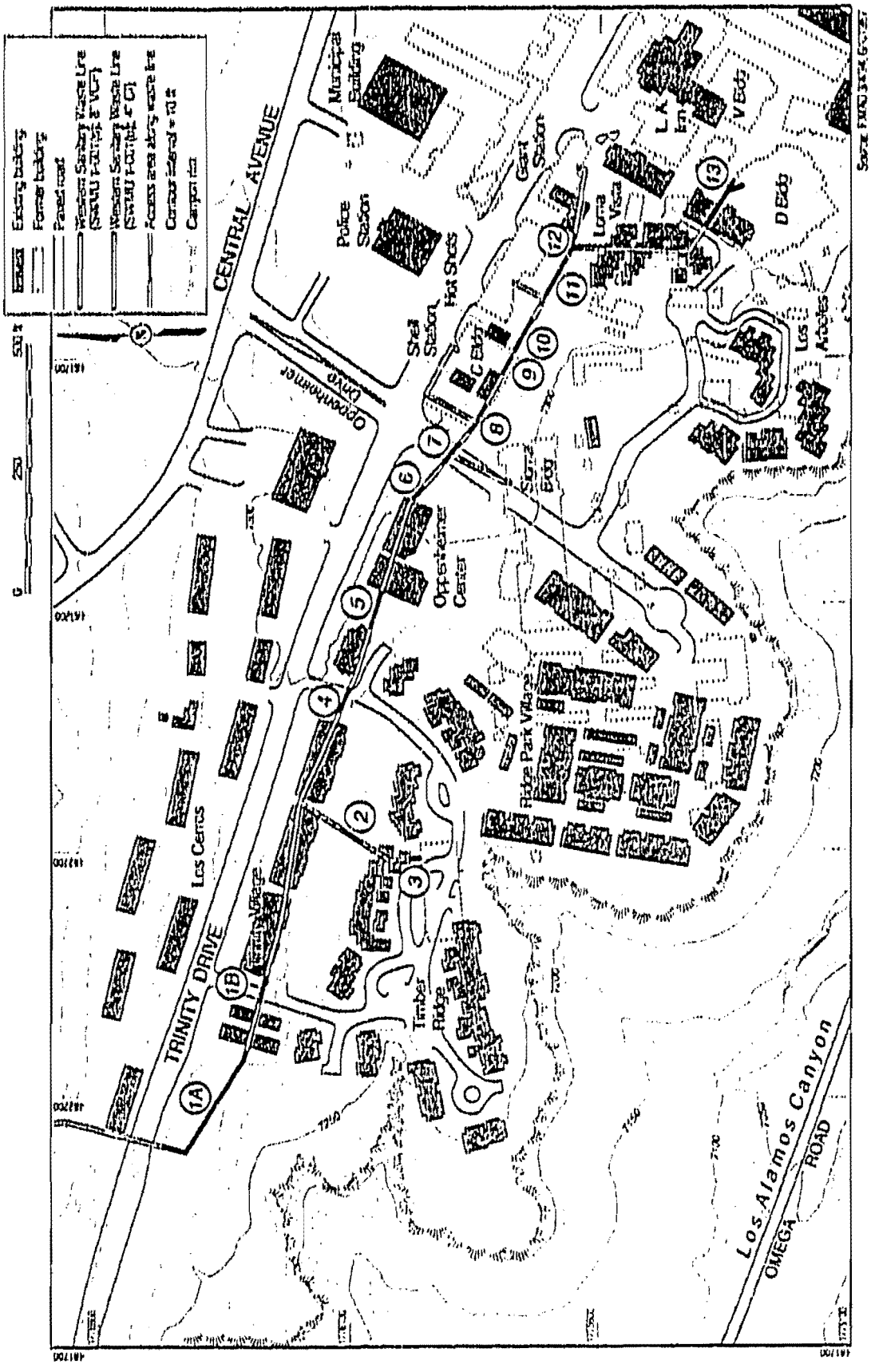


Fig. 1.2.1-1. Location of WSWL at Aggregate N, TA-1. Numbers refer to access areas.

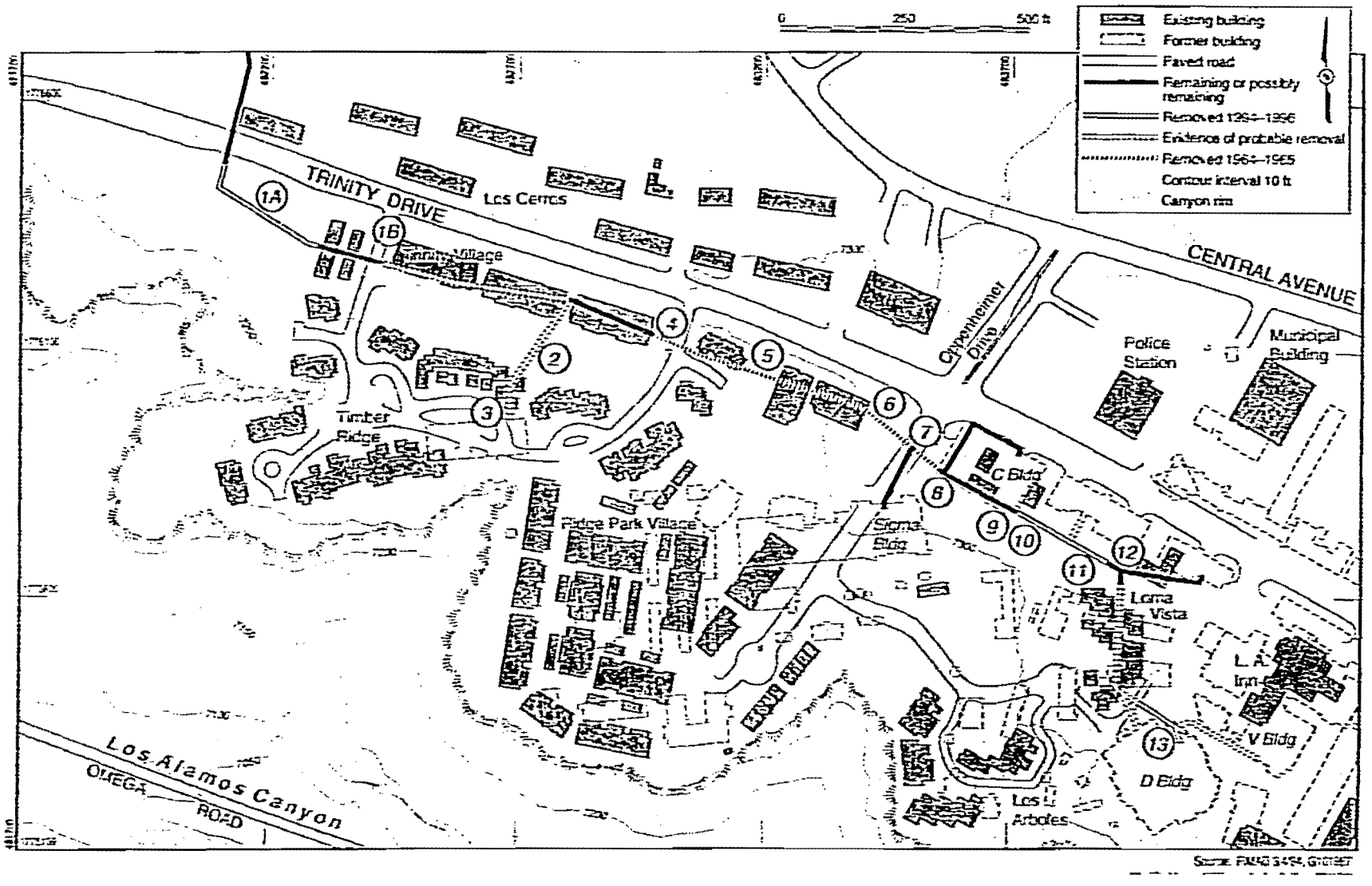


Fig. 1.2.1-2. Current status of Western Sanitary Waste Line at Aggregate N, TA-1. Numbers refer to access areas.

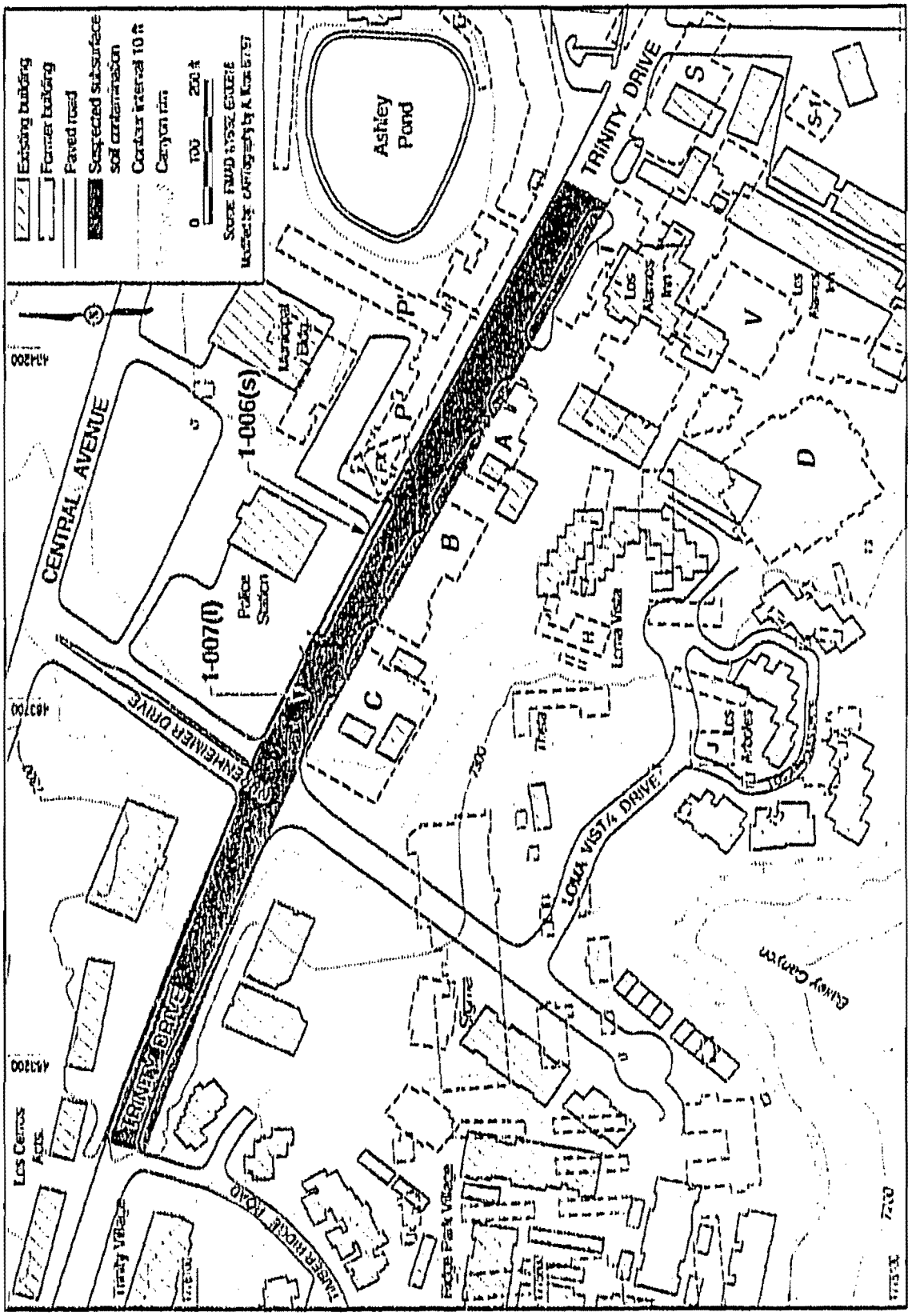


Fig. 1.2.2-1. Location of Aggregate P, TA-1.

1.3 Field Activities

1.3.1 Aggregate N

Field activities at Aggregate N were conducted in February/March 1994, July 1994, November/December 1994, and June 1996. These activities were conducted in accordance with the RFI Work Plan for OU 1078, the August 1993 Sampling and Analysis Plan (SAP), the November 1994 addendum to this SAP, Interim Action Plan for PRS 1-001(a) at TA-1, DOE and LANL directives and policies, and LANL Environmental Restoration (ER) Project Standard Operating Procedures (SOPs) (LANL 1992, 0782; LANL 1993, 09-0531; LANL 1994, 09-0532; LANL, 1996 09-0528; LANL 1997, 0875). All applicable LANL ER SOPs were followed, unless otherwise noted in Chapter 5.

Field activities included the following:

- At Locations 1A, 2, 8, and 13, geophysical surveys, trenching, drilling, and sampling activities were conducted to locate the WSWL and to assess any residual contamination associated with soils outside of the WSWL.
- At Locations 1A, 10, 11, and 13, sampling activities were conducted inside the WSWL to provide RFI characterization data for other WSWL sections that are inaccessible and cannot be removed. Excavation and WSWL removal activities were conducted to eliminate any potential sources of contamination. Sampling activities were conducted outside the WSWL to provide RFI characterization data for WSWL sections that were removed.
- At six locations (1B, 4, 5, 6, 7, and 12) the field activities were solely geophysical surveys.

1.3.2 Aggregate P

Phase I RFI sampling at Aggregate P, PRS 1-007(l), was conducted in September 1993 and July 1996 in accordance with the RFI Work Plan for OU 1078, the SAP for PRS 1-007(l), DOE and LANL directives and policies, and LANL ER Project SOPs (LANL 1992, 0782; LANL 1993, 09-0531; LANL 1997, 0875). All applicable LANL ER SOPs were followed, unless otherwise noted in Chapter 5. Seven subsurface soil samples were collected at PRS 1-007(l) within the fill material beneath Trinity Drive.

2.0 ENVIRONMENTAL SETTING

The environmental setting of the Laboratory is described in Section 2.4 of the Installation Work Plan (IWP) for the ER Project (LANL 1995, 1164). A detailed discussion of the environmental setting for TA-1, including climate, geology, hydrology, and a conceptual hydrogeologic model for the area and its surroundings, is presented in the RFI Work Plan for OU 1078 (LANL 1992, 0782). 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 to range from 50°F to 90°F. During the winter, temperatures typically range from 15°F to 50°F. Normal annual precipitation in Los Alamos, including rainfall and water-equivalent snowfall, is 18 in. Of this total, approximately 40% occurs as brief, intense thunderstorms during July and August. Stream flow in canyons can occur as a result of these storms. Spring snowmelt runoff may also induce stream flow in area canyons. Winter snowfall averages 51 in. annually (ESG 1989, 0308). Wind speeds are less than 2.5 m/s (5.6 mph) about 40% of the time and greater than 5 m/s (11 mph) about 20% of the time. Strong winds occur mainly in the spring. The predominant wind direction is from the south-southwest.

2.2 Geology

2.2.1 Geologic Setting

A detailed discussion of the geology of the entire Los Alamos area can be found in Subsection 2.5.1.3 of the IWP (LANL 1995, 1164). Los Alamos townsite, which encompasses TA-1, is located on the Pajarito Plateau at an elevation of about 7 300 ft. The area is bounded on the south by Los Alamos Canyon and on the north by Pueblo Canyon. Bedrock underlying the site is Bandelier Tuff (Fig. 2.2.1-1), composed of fallout and ash flow deposits of silicic volcanic rock that erupted 1.2–1.6 million years ago.

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, 1164). The soil at TA-1 is composed of moderately well-developed B and C horizons on Bandelier Tuff, a compacted fallout and ash-flow deposit of silicic volcanic rock (Fig. 2.2.1-1), or on thin units of alluvium or colluvium. Soils belong to either the Carjo or Pogna

Soil Series (Nyhan et al. 1978, 0161). Carjo soils consist of moderately deep, well-drained, and moderately developed soils that form an A-B-C horizon sequence. Soil textures can range from clay loam to fine, sandy loams. The Pogna soils consist of shallow, well-drained, and weakly developed soils that comprise an A-C horizon sequence. The texture of Pogna soil is usually fine, sandy loams. The substrate underlying these may range from Bandelier Tuff to alluvium/ colluvium interstratified with poorly developed to well-developed buried soils.

2.3 Hydrology

2.3.1 Surface Water

While there are no natural surface water bodies present in TA-1, storm water runoff flows from the mesa top down the hillsides into an ephemeral stream located in Los Alamos Canyon during summer thunderstorms and spring snowmelt. However, this mechanism for the movement of contaminants does not occur from Aggregates N and P as neither site possesses a surface component. Aggregate N consists of an underground waste line and Aggregate P consists of fill material beneath Trinity Drive.

2.3.2 Ground Water

The main aquifer beneath TA-1 is at an elevation of approximately 5 900 ft (determined in Test Well 2 in Pueblo Canyon, and Otowi 4 in Los Alamos Canyon), chiefly within sediments of the Puye and Totavi Formations (Purtymun 1995, 1293; Broxton and Eller 1995, 1162). Thus, for mesa-top sites at TA-1, about 1 200 ft of unsaturated tuff and volcaniclastic sediments separate the surface from the main aquifer. No perched aquifers are known to exist directly beneath TA-1. Although perched alluvial aquifers have been discovered below canyon bottoms more than one mile downgradient from TA-1, it is unlikely that transport pathways exist between Aggregate N and P PRSs (more than 300 ft above the Los Alamos Canyon bottom) and alluvial aquifers.

2.4 Biological Surveys

Comprehensive plant and animal inventories are required by the Federal Endangered Species Act of 1973; the New Mexico Wildlife Conservation Act; Executive Order 11990, "Protection of Wetlands;" Executive Order 11988, "Floodplain Management;" Code of Federal Regulation (CFR) 10 CFR 1022, Compliance with Floodplain/Wetlands Environmental Review Requirements (DOE 1979, 0633); and DOE Order 5400.1, General Environmental Protection Program (DOE 1988, 0075). The mesa top at TA-1 has undergone heavy commercial and urban development

since the decommissioning and decontamination activities of the mid-1970s. Comprehensive plant and animal inventories were not performed for the mesa top because it is heavily developed. The wildlife habitats on the mesa top can be characterized as urban plant and animal communities.

2.6 Cultural Surveys

A cultural resource survey has been conducted in the area of TA-1, as required by the National Historic Preservation Act (amended). LANL's Environmental Protection Group conducted this survey in February 1992 and identified two archaeological sites that are numbered 86546 and 86547. No soil sampling was conducted at either location.

3.0 APPROACH TO SAMPLE ANALYSES AND DATA ASSESSMENT

The approach to data assessment used by the ER Project is described in the policy document Risk-Based Corrective Action Process (Dorries 1996, 1297). The approach includes

- sampling and analysis design,
- field investigation and collection of field and quality assurance (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 sets,
- exploratory data analysis,
- focused validation when necessary to further assess questionable data,
- comparison of validated analytical results with LANL background data,
- comparison of validated analytical results with screening action levels (SALs),
- evaluation of sufficiency of data sets 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 RFI report.

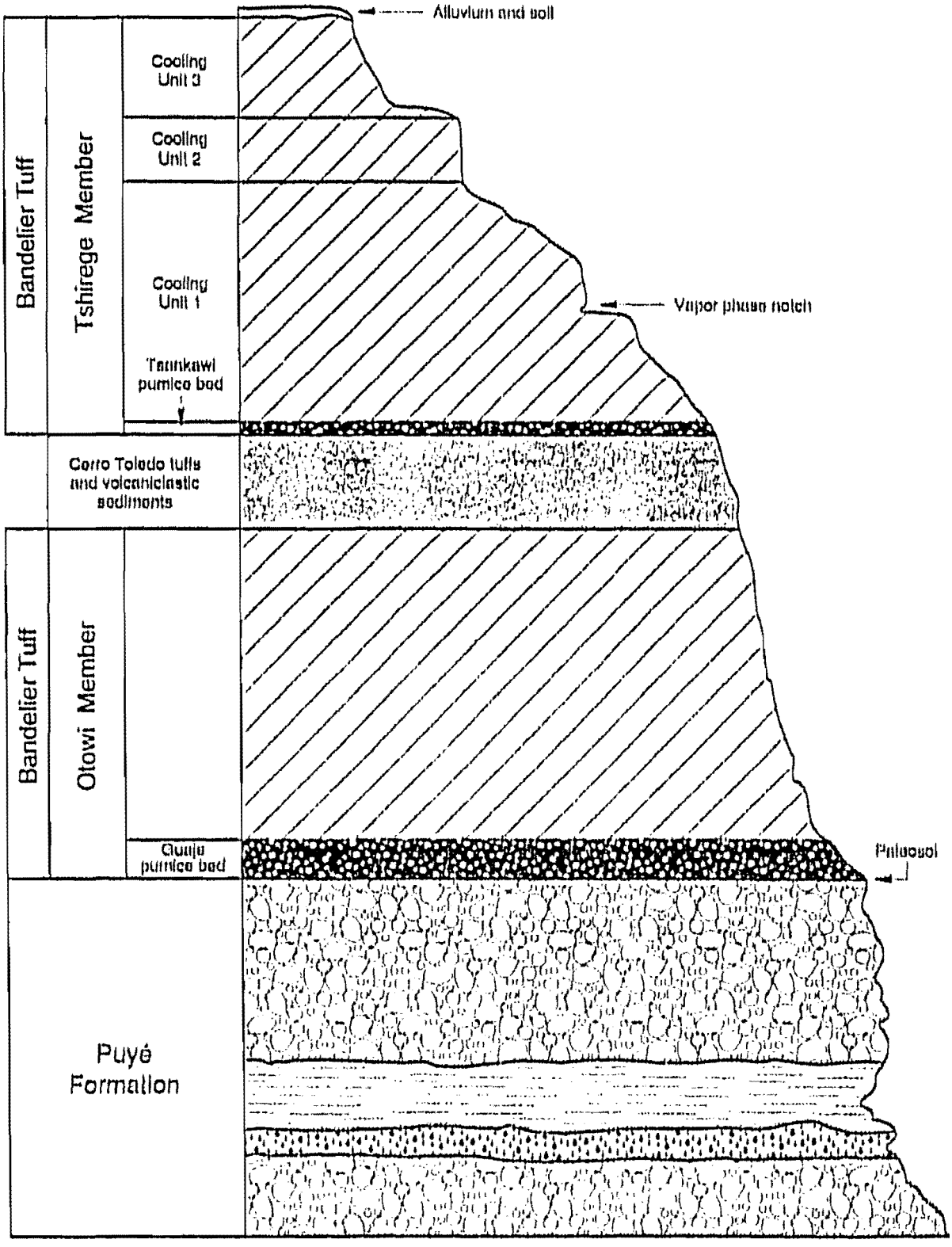


Fig. 2.2.1-1. Generalized stratigraphy at TA-1.

3.1 Sample Analyses

Samples were collected in accordance with the sampling design specified in the RFI Work Plan for OU 1078 (LANL 1992, 0782). All samples requiring chemical and radiochemical analyses and chain-of-custody documentation were submitted to the sample management office (SMO) and/or to the mobile radiological analysis laboratory (MRAL) and/or to a mobile chemical analytical laboratory (MCAL) for analyses. In 1994 the Waste Site Studies section of the Environmental Protection Group received samples for measurements of gross radioactivity in soils in the EM-8 MRAL trailer and for x-ray fluorescence (XRF) measurements of inorganics in the EM-8 MCAL trailer at TA-59. The MRAL trailer has a Berthold LB770™ counter for gross alpha and gross beta measurements, and a deepwell counter for gross gamma measurements. The XRF in the MCAL trailer is a Spectrace 9000™ manufactured by TN Technologies, Inc. Only the fixed laboratory analyses are used for determining the nature and extent of contamination.

3.1.1 Analytical Methods

The following analytical suites were used for the sample analyses in this RFI report: inorganic chemicals, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), tritium, polychlorinated biphenyls (PCBs), pesticides, cesium-137, isotopic plutonium, isotopic uranium, and gamma spectroscopy, and americium-241 by alpha spectroscopy.

All samples were analyzed by contract analytical laboratories using methods specified in ER SMO analytical subcontracts (LANL 1995, 1278). The allowed methods are current Environmental Protection Agency (EPA) SW-846 and Contract Laboratory Program (CLP) methods or equivalent for inorganic chemicals, VOCs, and SVOCs. Before analyses for inorganic chemicals, solid samples were digested according to EPA SW-846 method 3050 or equivalent (EPA 1992, 1207). The subcontracts specify LANL-approved methods for radiochemical analyses according to the technologies identified in the subcontract (americium-241 by alpha spectroscopy, tritium by liquid scintillation, or multiple isotopes by gamma spectroscopy). Analytical method selection is described in Appendix IV of the ER Project Quality Assurance Project Plan Requirements for Sampling and Analysis (QAPP) (LANL 1996, 1292). 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 QAPP along with the target analytes for each analytical suite.

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 contain the information necessary to determine data sufficiency for decision-making. For analytical data used for decisions discussed in this RFI report, baseline data validation under the ER protocol was performed as described in the QAPP (LANL 1996, 1292).

This process produced validation reports, with data qualifiers 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.

Data were qualified (a marker was attached to the data results) for a variety of reasons during the baseline validation process. The baseline validation procedure used for routine analytical services provides information about the reason the qualifier was applied and its potential impact on the affected data. 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 LANL ER Project baseline validation process are as follows.

- "A" signifies that the data required for data review and evaluation are not available.
- "U" signifies that the analyte was not positively identified in the sample, and the associated value is the sample-specific EQL/EDL.
- "J" signifies that 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+" signifies that the analyte was positively identified, and the result is likely to be biased high.
- "J-" signifies that the analyte was positively identified, and the result is likely to be biased low.
- "UJ" signifies that the analyte was not positively identified in the sample, and the associated value is an estimate of the sample-specific EQL/EDL.

- "RPM" signifies that without further review of the raw data, the sample results are unusable due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. Presence or absence cannot be verified. Any results qualified as RPM must be evaluated for relevance to data use.

- "P" signifies that professional judgment should be applied to using the data in decision-making.

- "PM" signifies that 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 (1) the variability or uncertainty of the reported data, or (2) data quality before making a data-use decision because of anomalies detected in a data set.

Details of quality assurance/quality control (QA/QC) activities are presented in Chapter 4 of this RFI report. Qualifiers resulting from baseline and focused validation are shown in the analytical results tables included in Section 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 Section 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 COPCs

3.2.1 Inorganic Chemicals

Detected inorganic chemicals are compared with natural background distributions to determine whether they should be retained as chemicals of potential concern (COPCs) or eliminated from further consideration. The inorganic background data used in this RFI report are from the following sources:

- soil, sediment, and/or tuff samples collected throughout Los Alamos County for which chemical analyses were performed for certain inorganic (metal) chemicals (Longmire et al. 1995, 1142; Longmire et al. 1995, 1266). PRS samples were collected from fill material, and the all-soil-horizons background data set was used because the soil master horizon cannot be identified in disturbed material.

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), the maximum reported concentration, or, in the case of nondetected chemicals, the detection limit. These background screening values are derived from LANL-wide soil, sediment, and/or tuff background data, and details on the calculation of these values are presented in Longmire et al. (1995, 1266). Certain inorganic chemicals in certain media have no LANL-wide background data. For these exceptions, PRS sample-specific detection limits are used as nominal background screening values. In this report, silver is the only chemical that lacks background data.

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, are used for these evaluations. The Gehan test is best suited for assessing complete shifts in distribution in a statistically robust manner, whereas the Quantile test is better suited for assessing shifts of a subset of the data. Between the two tests, most types of differences between distributions can be captured. 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, 1210; Ryti et al. 1996, 1298). Observed significance levels (p-values) for these tests are presented in Sections 5.1.5.2, 5.1.5.3, and 5.1.5.4 of this report. If a p-value is less than a

specified probability, typically 0.05 or 5%, then there is some reason to suspect that there is a difference between the background and site distributions; otherwise, no difference is indicated. The results of these statistical tests, when available, are used in addition to the results of the comparison with background screening values to determine whether a chemical is considered greater than 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 naturally occurring radionuclides.

The LANL 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 (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 RFI report are from the following sources:

- soil, sediment, and/or tuff samples collected throughout Los Alamos County for which chemical analyses were performed for certain naturally occurring radioactive chemicals (Longmire et al. 1995, 1142; Longmire et al. 1995, 1266).
- background concentrations of radioactive chemicals associated with global fallout from atmospheric nuclear testing (plutonium, cesium, strontium, and tritium) reported in LANL Environmental Surveillance reports (Purtymun et al. 1987, 0211; ESG 1988, 0408; ESG 1989, 0308; Environmental Protection Group 1990, 0497; Environmental Protection Group 1992, 0740).

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 LANL-wide soil, sediment, and/or tuff background data, and details on the calculation of these values are presented in Longmire et al. (1995, 1266). Certain radionuclides in certain media have no LANL-wide background data. For these exceptions, PRS sample-specific minimum detectable activities are used as nominal background screening values.

Laboratory contaminants are sometimes found in method blanks used by the analytical laboratories during organic analyses. When this occurs, there is a potential for samples to also be contaminated. To account for method blank contamination in samples, the "ten times" and "five times" rules are applied (EPA 1994, 1205). The "ten times" rule states that when a common laboratory contaminant is found in the method blank, any values of that analyte detected in the samples at levels less than ten times the method blank concentration should be considered nondetected and a "U" qualifier should be added to the data. Common laboratory contaminants for VOC analysis include acetone, methylene chloride, and 2-butanone; common laboratory contaminants for SVOC analysis include the common phthalates. The "five times" rule states that when an analyte that is not a common laboratory contaminant is found in the method blank, any values of that analyte detected in the samples at levels less than five times the method blank concentration should be considered nondetected and a "U" qualifier should be added to the data. These rules were used in addressing the data quality as discussed in Section 4.0 of this report.

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 RFI 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. In general, SALs represent a concentration that, given the Region 9 residential exposure assumptions, is associated with a one in one million lifetime excess cancer risk or a hazard quotient of one for carcinogens and noncarcinogens, respectively.

SALs for radionuclides are calculated using the RESRAD computer code (Version 5.61) and a target dose level of 10 mrem/year. 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, 1297). 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 3.3.1-1 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, 1307). 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. (UTLs and maximum concentration values are identical to those described in Section 3.2.1, Inorganic Chemicals.)

The background risks based on the LANL SAL residential exposure model are provided in Table 3.3.1-1. Risks due to background concentrations 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.

Three of the background inorganic chemicals provided in Table 3.3.1-1 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, 0559).

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.

TABLE 3.3.1-1

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	5×10^{-5}	1×10^{-5}
Cadmium[g]	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 Longmire et al. all-soil-horizons data set (1995, 1142).
[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.

3.3.2 Risk Assessment

The human health risk assessments presented in Section 5.1.9 follow the process outlined in the policy document Risk-Based Corrective Action Process (Dorries 1996, 1297). This process consists of the following steps:

- data evaluation,
- exposure assessment,
- toxicity assessment, and
- risk characterization.

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 QUALITY ASSURANCE/QUALITY CONTROL ACTIVITIES

4.1 Aggregate N

4.1.1 Inorganic Analysis

1994 Sampling

Sixty-four samples were analyzed for metals under nineteen separate requests. For requests 16772, 16382, 16783, 16862, 20467, 20487, 20561, and 20627, there were no quality control (QC) problems that require qualification of the data. Therefore, all data for these requests are valid and usable without qualification.

For request 16831, the recovery of the post digestion spike for selenium in sample AAB8308 was below allowed limits. Therefore, selenium is qualified UJ for this sample. All other data are valid and usable without qualification.

For requests 16838 and 16845, arsenic, thallium, and silver all had low recoveries (45–75%) in the QC sample. Data for these analytes are qualified UJ in the samples associated with these requests. All other data are valid and usable without qualification.

For request 16876, there were a number of elements that had low recoveries in the post-digestion spikes. For sample AAB8365, lead, selenium, and thallium had low recoveries. For sample AAB8270, lead, antimony, and thallium had low recoveries. For sample AAB8273, thallium had a low recovery. Silver had a low recovery in the QC sample. Because of the low recoveries, all data for these analytes are qualified UJ for the associated samples. All other data are valid and usable without qualification.

For request 17154, there were problems because of a heterogeneous sample (AAB8321). In the duplicate analysis, nickel, barium, lead, and mercury differed from the original analysis by a factor of two or more. While the problem was a sample problem and not an analytical one, the data for these elements are qualified J because of the great uncertainty in the actual concentrations in the sample. All other data are valid and usable without qualification.

For request 18318, antimony and arsenic had low recoveries in the matrix spike sample and are qualified J or UJ. Beryllium, cadmium, nickel, lead, mercury, and silver had high recoveries in the matrix spike sample and all detects for these analytes are qualified J. Cadmium, mercury, and lead showed significant heterogeneity in sample AAB6085, which may be the cause of the high recoveries in the matrix spike samples. All other data are valid and usable without qualification.

For request 20368, arsenic, silver, cadmium, chromium, potassium, sodium, and nickel all had high recoveries in the QC sample or the laboratory control sample (LCS). All detects for these analytes are qualified J for possible high bias. All other data are valid and usable without qualification.

For request 20482, sodium is qualified J or UJ for low recovery in the QC sample. Chromium detects are qualified J for a high recovery in the QC sample. All other data are valid and usable without qualification.

For request 20538, mercury and antimony data are qualified J for low recoveries in the QC sample. Zinc and magnesium detects are qualified J for high recoveries in the QC sample. All other data are valid and usable without qualification.

For request 20557, chromium data are qualified J or UJ for low recovery in the QC sample. All other data are valid and usable without qualification.

For request 20805, mercury data are qualified J for sample AAC0899 for exceeding the extraction holding times for water samples. All other data are valid and usable without qualification.

1996 Sampling

One soil sample was analyzed for target analyte list (TAL) metals in request 2256. There were two QC problems with this request. The first was that selenium, antimony, and thallium had recoveries in the matrix spike sample of less than 75%. All data for these analytes are qualified UJ. Secondly, six analytes (mercury, antimony, cadmium, manganese, silver, and thallium) had duplicate results that differed from the original by greater than 20%. This indicates that the sample was possibly heterogeneous. The data are not qualified for the duplicate problems due to sample heterogeneity, which is common in ER soil samples. Therefore, all data are valid and usable without qualification.

Two soil samples were analyzed for TAL metals in request 2259. There were two QC problems with this request. The first was that selenium, antimony, and thallium had recoveries in the

matrix spike sample of less than 75%. All data for these analytes are qualified J- or UJ. Secondly, five analytes (antimony, cadmium, manganese, silver, and thallium) had duplicate results that differed from the original by greater than 20%. This indicates that the sample was possibly heterogeneous. The data are not qualified for the duplicate problems due to sample heterogeneity, which is common in ER soil samples. Therefore, all data are valid and usable without qualification.

Three soil samples were analyzed for TAL metals in request 2268. There were two QC problems with this request. The first was that selenium, antimony, and thallium had recoveries in the matrix spike sample of less than 75%. All data for these analytes are qualified J- or UJ. Secondly, five analytes (antimony, cadmium, beryllium, silver, and thallium) had duplicate results that differed from the original by greater than 20%. This indicates that the sample was possibly heterogeneous. The data are not qualified for the duplicate problems due to sample heterogeneity, which is common in ER soil samples. Therefore, all data are valid and usable without qualification.

Four soil samples were analyzed for TAL metals in request 2285. There were two QC problems with this request. The first was that antimony had a recovery in the matrix spike sample of less than 30%. All data for this analyte are qualified R. Secondly, 12 analytes (antimony, cadmium, chromium, cobalt, copper, iron, magnesium, manganese, nickel, potassium, silver, and vanadium) had duplicate results that differed from the original by greater than 20%. This indicates that the sample was possibly heterogeneous. The data are not qualified for the duplicate problems due to sample heterogeneity, which is common in ER soil samples. Therefore, all data are valid and usable without qualification.

Five soil samples were analyzed for TAL metals in request 2305. There were two QC problems with this request. The first was that antimony, barium, beryllium, cadmium, chromium, cobalt, copper, nickel, silver, vanadium, and zinc had recoveries in the matrix spike sample of less than 75%. All data for these analytes are qualified J- or UJ. Secondly, selenium had duplicate results that differed from the original by greater than 20%. This indicates that the sample was possibly heterogeneous. The data are not qualified for the duplicate problems due to sample heterogeneity, which is common in ER soil samples. Therefore, all data are valid and usable without qualification.

Two soil samples were analyzed for TAL metals in request 2320. There were several QC problems with this request. The first was that selenium, antimony, and thallium had recoveries in the matrix spike sample of less than 75%. All data for these analytes are qualified J- or UJ. In addition, cadmium, lead, and zinc had high recoveries in the QC sample (greater than 125%).

All detects for these analytes are qualified J+. Also, eight analytes (aluminum, antimony, cadmium, copper, iron, lead, magnesium, manganese, potassium, and mercury) had duplicate results which differed from the original by greater than 20%. This indicates that the sample was possibly heterogeneous. The data are not qualified for the duplicate problems due to sample heterogeneity, which is common in ER soil samples. Therefore, all data are valid and usable without qualification.

4.1.2 Organic Analysis

4.1.2.1 PCBs/Pesticides

Thirty-nine samples were analyzed for PCBs/pesticides under fifteen separate requests. For requests 16776 (PCBs only), 16773, 16820, 16844, 20466, 20479, 20484, 20535, 20554, 20558, and 20619, there were no QC problems that require qualification of the data. Therefore, all data for these requests are valid and usable without qualification.

For request 16834 (sample AAB6274), all data are qualified UJ because of poor initial calibrations, low surrogate recoveries, and lack of adequate QC documentation.

For request 16873, there was a problem in one sample, AAB6273. All pesticide detects are qualified J because of possible false positive results from the presence of Aroclor-1254™. All other data are valid and usable without qualification.

For request 20365, there were several QC problems. For samples AAB6070 and AAB6077, Aroclor-1254™ results are qualified J because the percent difference for the values from the two columns are greater than 25%. In samples AAB6072 and AAB6076, the detection limit for Endosulfan-II was raised because the presence of Aroclor-1254™ in the sample interfered with the identification of Endosulfan-II. In sample AAB6072, the detection limits for aldrin and dieldrin were also raised because of the interferences from Aroclor-1254™. All other data are valid and usable without qualification.

For request 20604, all data for sample AAC0999 (the only sample in the request) are qualified R because the extraction holding time for water samples for pesticides was exceeded by 16 days.

4.1.2.2 SVOCs

1994 Sampling

Thirty-nine samples were analyzed for SVOCs under fourteen separate requests. For requests 16775, 16829, 16834, 16844, 16873, 20465, 20535, 20554, 20556, and 20619, there were no QC problems that required qualification of the data. Therefore, all data for these requests are valid and usable without qualification.

For request 20365, there were several QC problems. There were low recoveries (10–50%) for 14 analytes in the QC soil sample. These analytes were 1,2-dichlorobenzene, 1,4-dichlorobenzene, 2-methylphenol, 4-methylphenol, 2,4-dichlorophenol, 1,2,4-trichlorobenzene, naphthalene, 2,4,6-trichlorophenol, 2,4-dinitrotoluene, 2,6-dinitrotoluene, pentachlorophenol, anthracene, chrysene, and benzo(a)pyrene. Data from the soil samples for all fourteen analytes are qualified J or UJ. In the water sample, the recoveries for the base/neutral compounds were below allowed limits. All base/neutral compounds in the water sample are qualified J or UJ. Also, 4-hydroxy-4-methyl-2-pentanone was found in the method blank and several samples. The detection limits will be raised for samples in which the detected concentration is less than 10 times the amount found in the method blank. All other data are valid and usable without qualification.

For request 20479, there were low recoveries for all analytes in the QC sample as well as high internal standards and low surrogate recoveries. This may have been caused by evaporation of the internal standard spiking solutions at the contract laboratory. Because of these problems, all data are qualified J or UJ for possible low bias of the data.

For request 20484, two of the surrogates, phenol-d5 and 2-fluorphenol, had recoveries of less than 10%. Because of this, the following analytes associated with these surrogates are qualified R for the extremely low recoveries: 4-chloro-3-methylphenol, o-chlorophenol, 2,4-dichlorophenol, 2,4-dimethylphenol, 2,4-dinitrophenol, 2-methyl,4,6-dinitrophenol, 2-methylphenol, 4-methylphenol, 2-nitrophenol, 4-nitrophenol, pentachlorophenol, phenol, 2,4,5-trichlorophenol, and 2,4,6-trichlorophenol. All other data are valid and usable without qualification.

For request 20804, all data for sample AAC0099 (the only sample in the request) are qualified R because the extraction holding time for water samples for SVOCs was greatly exceeded.

1996 Sampling

One soil sample was analyzed for semivolatile compounds in request 2255. There were no QC problems with this request; therefore all data are valid and usable without qualification.

Two soil samples were analyzed for semivolatile compounds in request 2258. The only QC problem with this request was that di-n-butylphthalate was found in the method blank (125 µg/kg). Therefore all data for this analyte which are less than ten times the blank level (with dilution factors being taken into account) are qualified as U, not detected. All other data are valid and usable without qualification.

Two soil samples were analyzed for semivolatile compounds in request 2267. There were no QC problems with this request; therefore all data are valid and usable without qualification.

Three soil samples were analyzed for semivolatile compounds in request 2284. There were no QC problems with this request; therefore all data are valid and usable without qualification.

Five soil samples were analyzed for semivolatile compounds in request 2304. There were no QC problems with this request; therefore all data are valid and usable without qualification.

Two soil samples were analyzed for semivolatile compounds in request 2319. The only QC problem with this request was that bis(2-ethylhexyl)phthalate was found in the method blank (93 µg/kg). Therefore all data for this analyte which are less than ten times the blank are qualified as U, not detected. All other data are valid and usable without qualification.

4.1.2.3 VOCs

Eight samples under three requests were analyzed for VOCs. In request 16775, acetone was found in the blank samples and the QC sample (where it was not supposed to be) at 27, 32, and 46 µg/kg. In request 16834, acetone was found at a concentration of 24 µg/kg in the method blank. The detection limits were raised for samples in which the detected concentration of acetone was less than ten times the amount found in the method blank (taking dilution into account). All other data are valid and usable without qualification.

In request 16873, the last internal standard was below allowed limits for samples AAA8265 and AAA8270. The following analytes associated with the internal standard are qualified UJ: bromobenzene, n-butylbenzene, sec-butylbenzene, tert-butylbenzene, o-chlorotoluene, p-chlorotoluene, o-dichlorobenzene, m-dichlorobenzene, p-dichlorobenzene, isopropylbenzene, 4-isopropyltoluene, 1,2,3-trichloropropane, 1,2,4-trimethylbenzene, and 1,2,5-trimethylbenzene. All other data are valid and usable without qualification.

4.1.3 Radiochemical Analysis

1994 Sampling

Sixty-two samples under seventeen requests were analyzed for various radiological analytes including tritium, cesium-137, uranium-234, uranium-235, uranium-238, plutonium-238, and plutonium-239. For requests 16774, 16861, 16880, 17302, 18417, 20468, 20488, 20489, 20540, 20559, and 20566 there were no QC problems that require qualification of the data. Therefore, all data for these requests are valid and usable without qualification.

For request 16781 the recoveries for uranium isotopes in the QC sample were very high. The analytical laboratory attributed this to contamination of the QC sample during analysis. The samples were rerun along with an LCS, but the QC sample could not be rerun. The LCS was within allowed limits on the second run. Because of the problem with the QC sample, all uranium data are qualified J. All other data are valid and usable without qualification.

For request 16830, plutonium and uranium isotopes were found at low levels in the method blanks. The samples contained these analytes at the same levels as found in the blank. Following the rationale used in EPA SW846 for inorganic analytes in a method blank, all of the data for uranium and plutonium will be considered nondetects. Therefore, all data are valid and usable without further qualification.

For requests 16861 and 16856, the uranium tracer was not added to the LCS or the method blanks. Because the uranium tracer is necessary for quantitation, the uranium data are qualified J. All other data are valid and usable without qualification.

For request 18372 there was a problem with sample heterogeneity for all of the plutonium samples. Plutonium results varied by factors greater than 200. Because of the sample heterogeneity, all plutonium results are qualified J. All other data are valid and usable without qualification.

For request 20375, there was a problem with sample heterogeneity in the soil samples, this time for uranium. Because of the heterogeneity as well as low tracer recovery, all uranium data for soil samples are qualified J or UJ. All other data are valid and usable without qualification.

For request 20800 there was a problem with the tracer recovery for uranium. The recovery was low; therefore, the uranium data are qualified J. All other data are valid and usable without qualification.

1996 Sampling

One soil sample was analyzed in request 2257 for the following analytes: isotopic uranium and plutonium by alpha spectroscopy and gamma activity by gamma spectroscopy. There were no QC problems with this request; therefore all data are valid and usable without qualification.

Two soil samples were analyzed in request 2260 for the following analytes: isotopic uranium and plutonium by alpha spectroscopy and gamma activity by gamma spectroscopy. There were no QC problems with this request; therefore all data are valid and usable without qualification.

Three soil samples were analyzed in request 2269 for the following analytes: isotopic uranium and plutonium by alpha spectroscopy and gamma activity by gamma spectroscopy. There were no QC problems with this request; therefore all data are valid and usable without qualification.

Four soil samples were analyzed in request 2283 for the following analytes: isotopic uranium and plutonium by alpha spectroscopy and gamma activity by gamma spectroscopy. The only QC problem with this request was that plutonium-239/240 had a large difference in the original and duplicate values (greater than 75%). Therefore all plutonium values are qualified J. All other data are valid and usable without qualification.

Five soil samples were analyzed in request 2306 for the following analytes: isotopic uranium and plutonium by alpha spectroscopy and gamma activity by gamma spectroscopy. There were no QC problems with this request; therefore all data are valid and usable without qualification.

Two soil samples were analyzed in request 2323 for the following analytes: isotopic uranium and plutonium by alpha spectroscopy and gamma activity by gamma spectroscopy. The only QC problem with this request was that americium-241 in the gamma analysis had an extremely large difference in the original and duplicate values for sample 0101-96-0032 (202 pCi/g vs. less than 0.1 pCi/g). Because of the large differences in these values, the sample (both original and duplicate) were counted again with the same results. Because of the large differences all americium values are qualified J. All other data are valid and usable without qualification.

The high americium-241 value in sample 0101-96-0032 caused us to be concerned about americium-241 at the site. Since only several samples collected in 1996 had detectable americium-241, samples collected in 1995 were looked at for americium-241. The 1995 samples were analyzed by gamma spectroscopy, but only cesium-137 was reported (as requested). The old spectra and lab printouts from gamma spectroscopy were looked at and semiquantitative values were determined for each of the samples. The data are presented in Section 5 of this report.

4.2 Aggregate P

4.2.1 Inorganic Analysis

Three samples were analyzed under requests 15799 and 15932 for TAL metals. There was one minor QC problem with request 15932. Silver was falsely identified in the QC sample. Because silver was not detected in any of the samples, the data are not affected. All data are valid without qualification.

Three samples were analyzed under request 2371 for TAL metals. There were several minor QC problems with this request. Selenium and antimony had recoveries of less than 75% in the matrix spike sample. Data for selenium and antimony are qualified J or UJ for the low recoveries. Also, aluminum, cadmium, and thallium had duplicate values that differed by greater than 20%. Because the LCS and the post digestion spikes were within allowed limits for these elements, this difference is an indication of heterogeneity in the samples rather than analytical difficulties. Therefore, data for these elements are not qualified. All other data are valid without qualification.

4.2.2 Organic Analysis

Three samples were analyzed for SVOCs under requests 15800 and 15927. All QC parameters for these requests were within allowed limits and all data are valid without qualification.

Three samples were analyzed for VOCs under requests 15800 and 15927. Acetone was detected in the method blank for request 15800 at 31 µg/kg. Because acetone was not detected in any of the samples, the data are not affected. All other QC parameters for these requests were within allowed limits, and all data are valid without qualification.

4.2.3 Radiochemical Analysis

Three samples were submitted for uranium-234, uranium-235, uranium-238, plutonium-238, plutonium-239/240, percent moisture, and cesium-137 analyses under requests 15802 and 15928. All QC parameters for these requests were within allowed limits and all data are valid without qualification.

Three samples were submitted for uranium-234, uranium-235, uranium-238, plutonium-238, plutonium-239/240, and gamma spectroscopy analyses under request 2372. All QC parameters for these requests were within allowed limits and all data are valid without qualification.

5.0 SPECIFIC RESULTS, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Aggregate N

Aggregate N, also known as the WSWL, consists of two former sanitary waste lines: PRSs 1-001(s) and 1-001(u). PRS 1-001(s) was a gravity main that served Buildings A, B, C, D, G, M, V, Sigma, and Boiler House No. 2, while PRS 1-001(u) was a forced main that served only Building J-2. Thirteen locations along the WSWL were initially considered physically accessible for field investigation. These locations were identified in the sampling plan because they have at least 20 ft of continuous access in directions both parallel and perpendicular to the WSWL and do not contain restraints such as buildings and related structures, retaining walls, concrete drives and walks, buried utilities, or plants on private property. Asphalt was judged to be repairable and as such is not considered a restraint. Intrusive field activities were conducted at six of these 13 locations along the WSWL initially considered accessible for investigation (Fig. 1.2.1-1).

5.1.1 History

Aggregate N is discussed in detail in Section 6.16 of the RFI Work Plan for OU 1078 (LANL 1992, 0782).

As mentioned above, PRS 1-001(s) served former Buildings A, B, C, D, G, M, V, Sigma, and Boiler House No. 2, and PRS 1-001(u) served only Building J-2 (Fig. 5.1.1-1). Detailed descriptions of each of these buildings are included in Table 1.6-3 of the RFI Work Plan for OU 1078 (LANL 1992, 0782) and are supplemented in a 1977 report (Alquist et al, 1977, 0016). The following descriptions outline each building's use.

- Building A was used for administrative offices. No radioactive materials were used or stored on the premises.
- Building B was used for administrative offices. Electronic and metallurgical laboratories in the basement housed a concrete vault in which small amounts of thorium-232, uranium-235, and uranium-238 foils were stored.
- Building C contained machining operations, including a uranium machine shop in the southeast section of the building.
- Building D was used primarily to process plutonium.

- Building G contained the Sigma Pile, a small pile constructed of graphite and uranium. Leak testing of radium sources was also performed in this structure.
- Building J-2, which was connected to PRS 1-001(s) via PRS 1-001(u), housed fission product radiochemistry operations and a tracer laboratory where plutonium experiments occurred.
- Building M was used as a chemical laboratory that processed and recovered enriched uranium (uranium-235).
- Building V was the original machine shop for machining uranium and beryllium at TA-1. Dry grinding of boron was also conducted in this building (H-Division 1952, 0756).
- Sigma Building was used for plutonium, uranium, and thorium machining, casting, and powder metallurgy.
- Boiler House No. 2 supplied steam to the buildings of TA-1 (Kennedy 1987, 09-0007). Chemicals typical of boiler house and cooling tower operations, possibly including chromates, were used in this building.

PRS 1-001(s), the main WSWL, managed liquid sanitary waste from Buildings A, B, C, D, G, M, V, Sigma, and the Boiler House. Because these buildings housed most of the plutonium and uranium processing and production operations in the early years of LANL's operation, it is possible that PRS 1-001(s) may have been contaminated with uranium-234, uranium-235, uranium-238, plutonium-238, plutonium-239/240, radium, thorium-232, beryllium, and various hazardous chemicals. Memorandum from LANL personnel stated that the entire WSWL was radioactively contaminated (Tribby 1946, 09-0030; Drager 1946, 09-0038). Likely exceptions to this declaration are branches of the WSWL from office buildings (Building A) and residences (Sundt Apartments between Trinity Street and Finch Street). The main WSWL exited Building D, ran parallel to the main industrial (acid) waste disposal line (PRS 1-002), and passed by the southwest corner of Building C. It then proceeded west along Finch Street and turned to the north between former Buildings T-221 and T-225. The line then connected to Septic Tank 5, located on the mesa top above Acid Canyon, where it discharged (COE 1943, 09-0051). Septic Tank 5 is now known as PRS 0-030(g) and was removed.

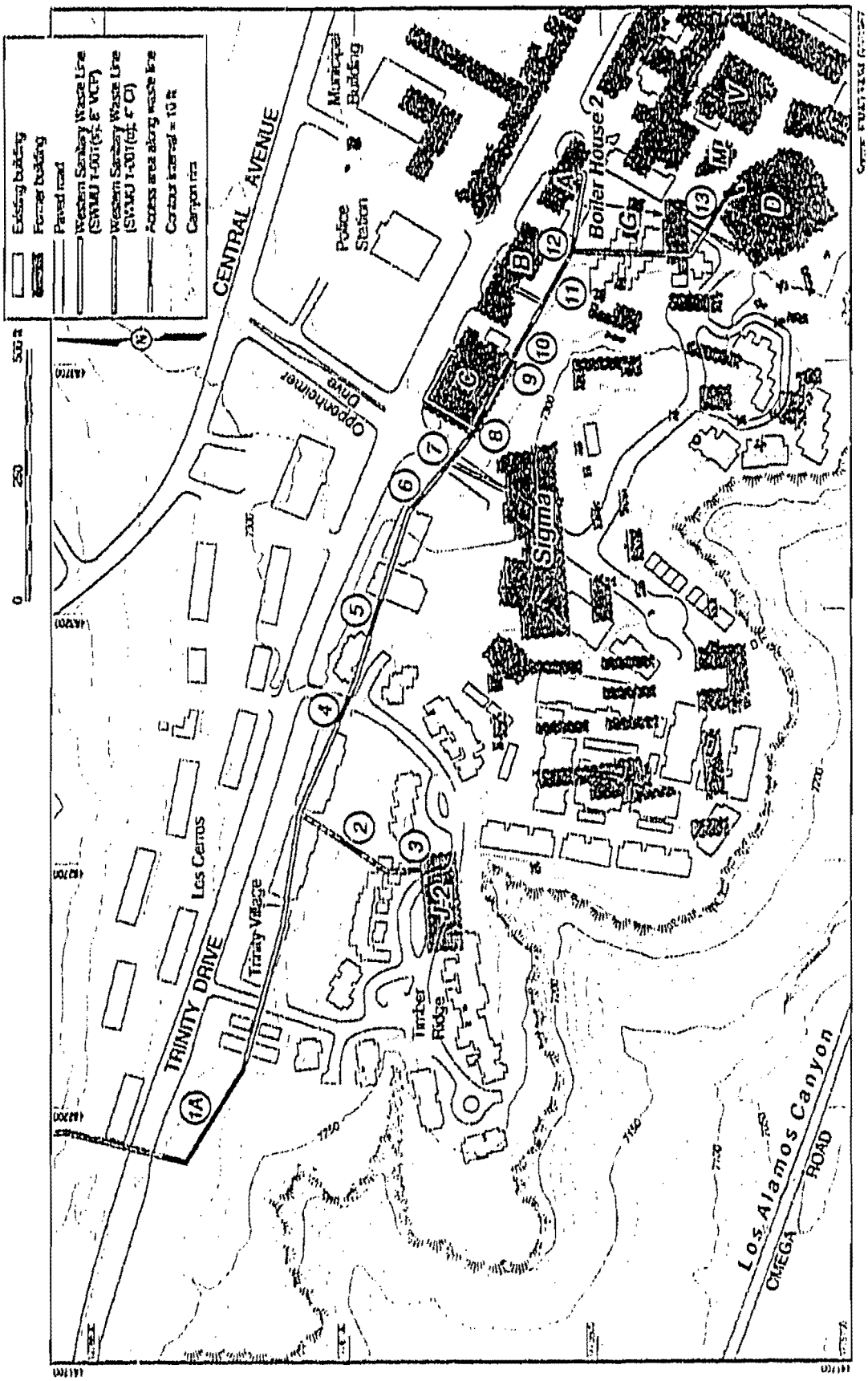


Fig. 5.1.1-1. Location of Western Sanitary Waste Line (highlights former Laboratory buildings).

PRS 1-001(u) was a branch of the main WSWL. It connected Building J-2 with the main WSWL at a junction near Finch Street. This PRS was not removed during TA-1 decontamination on the basis of soil samples and portable beta-gamma instrument survey, because it was not considered contaminated (LASL 1958, 09-0048; Ahlquist et al. 1977, 0016). It may have been removed by the developers of Timber Ridge. There were no COPCs identified for PRS 1-001(u) in the RFI Work Plan for OU 1078 (LANL 1992, 0782).

5.1.2 Description

Aggregate N is located south of Trinity Drive between areas currently occupied by the Los Alamos Inn to the east and the Timber Ridge Condominiums complex to the west. This aggregate contains only a mesa-top component. All former TA-1 buildings served by these two sanitary waste lines have been removed, and the area is presently occupied by various retail stores, office buildings, and residences (Figure 5.1.1-1).

5.1.3 Previous Investigations

A 1973 memo from Carl Buckland reported the removal of a portion of the WSWL (Buckland 1973, 09-0008). The memo notes, "By 11/23/65, a sanitary sewer leading from 'C' Shop to the intersection of Finch and 29th Street was removed since 2 000 to 5 000 c/m alpha was found in this pipe. Forty more feet of line beyond this point was excavated and monitored and found free from contamination." The removal went as far west as the east end of the eastern building of the Trinity Village Apartments. The architectural plans for Trinity Village, approved by Los Alamos County on June 8, 1973, show building lengths at 160 ft. Therefore, one-quarter of the sewer pipe within the footprint of the east building was "found free of contamination." The last buildings along this portion of the WSWL were six Sundt apartment buildings. Earlier the sanitary line from Building J-2, PRS 1-001(u), joined WSWL at a manhole near the western end of the eastern building of the Trinity Village apartments. Building J-2 was also connected to the Acid (Industrial) Sewer Waste Line, PRS 1-002, but there is no assurance that radiological and hazardous waste constituents wastes were not disposed in the sanitary sewer line at any time. Building J-2 was removed in 1958, 15 years before the construction of the Trinity Village apartments. The grading plan and the building foundation plan for Trinity Village indicate that the WSWL would have been removed beneath the central and western Trinity Village buildings before construction, but it would not have been necessary to remove the pipe beneath the eastern building.

PRS 1-001(u) was located near Building J-2 during the 1976 decontamination of TA-1 (Ahlquist et al. 1977, 0016). According to the Ahlquist report, the cast iron pipe of the forced main

sanitary sewer line "was uncontaminated (on the basis of soil samples and portable beta-gamma instrument survey)." No records have been found that indicate that the cast iron pipe was ever removed. However, according to a 1959 Zia Company drawing, Z-1801, Removal of Acid Sewer, Contaminated Sanitary Sewer & Contaminated Concrete, the pipe was reported to be plugged at the WSWL manhole between Finch Street and Trinity Drive. The Timber Ridge condominiums were built above and around PRS 1-001(u) in the late 1970s, and the cast iron pipe may have been removed at that time. Comparing the likely elevations of the cast iron pipe with the present elevation contours, it appears that if the pipe were still present in the backyard of a Timber Ridge home, it would be about 3 ft above the lawn. Other locations would be subgrade, but at 1–2 ft below grade, it is likely that the pipe would have been removed for most, if not all, of its length during the Timber Ridge construction.

6.1.4 Field Investigation at Aggregate N

Intrusive field activities were conducted Locations 1A, 2, 8, 10, and 13 along the WSWL. The field investigations at these five locations were conducted in two phases. The objectives of the first phase were to locate the WSWL and assess any residual contamination associated with the soils surrounding Locations 1A, 2, 8, and 13. The objectives of the second phase were to characterize any contamination inside and outside the WSWL and to remove and dispose of sections of the WSWL at Locations 1A, 10, 11, and 13.

- Field activities at Location 1A were conducted in February/March 1994, July 1994, and June 1996.
- Field activities at Locations 2 and 8 were conducted in February/March 1994.
- Field activities at Locations 10 and 11 were conducted in June 1996.
- Field activities at Location 13 were conducted in February/March and November/December 1994.

As discussed previously, the generic conceptual site model presented in the RFI Work Plan for OU 1078 was intended to encompass a wide variety of PRSs within TA-1 and contains components that are not applicable to Aggregate N. Residual contamination associated with the WSWL would be present in subsurface soil or tuff, if at all. The primary receptors to this

residual contamination would be construction or maintenance workers as a result of intruding into subsurface soil or tuff in the vicinity of the WSWL. The primary exposure routes associated with this type of construction or maintenance activity would be inhalation, ingestion, dermal contact, and/or external irradiation. Conceptual site models that are specific to one or more locations within Aggregate N were developed as necessary in Section 5.1.9 of this report.

5.1.4.1 Location 1A

The field investigations at Location 1A, west of present-day Trinity Village apartment complex, were conducted in February/March 1994, July 1994, and June 1996.

Location 1A, February/March 1994 Field Activities

The objectives of the February/March 1994 field activities at Location 1A were to locate the WSWL by conducting geophysical surveys and drilling boreholes. Any residual contamination associated with the surrounding soils was assessed by collecting screening and analytical samples during drilling activities.

Geophysical surveys were conducted at Location 1A using an electromagnetic induction unit (Geonics EM-31™), a ground penetrating radar (GPR) unit (a GSSI SIR System 4™ with a 300 MHz antenna), and a radio detection unit (RD 400™). Following the geophysical surveys, eight boreholes were drilled and Manhole (MH) 52 was uncovered and opened (Fig. 5.1.4.1-1). Trenches were excavated to positively identify the location of the WSWL.

Samples were collected during drilling activities outside the WSWL and submitted to the MRAL for gross radiological activity screening and to the MCAL for XRF analysis (one sample was also collected from inside MH-52). Samples were submitted for additional analyses at a fixed laboratory. A summary of the samples collected from Location 1A in February/March 1994 and the subsequent analyses is presented in Table 5.1.4.1-1.

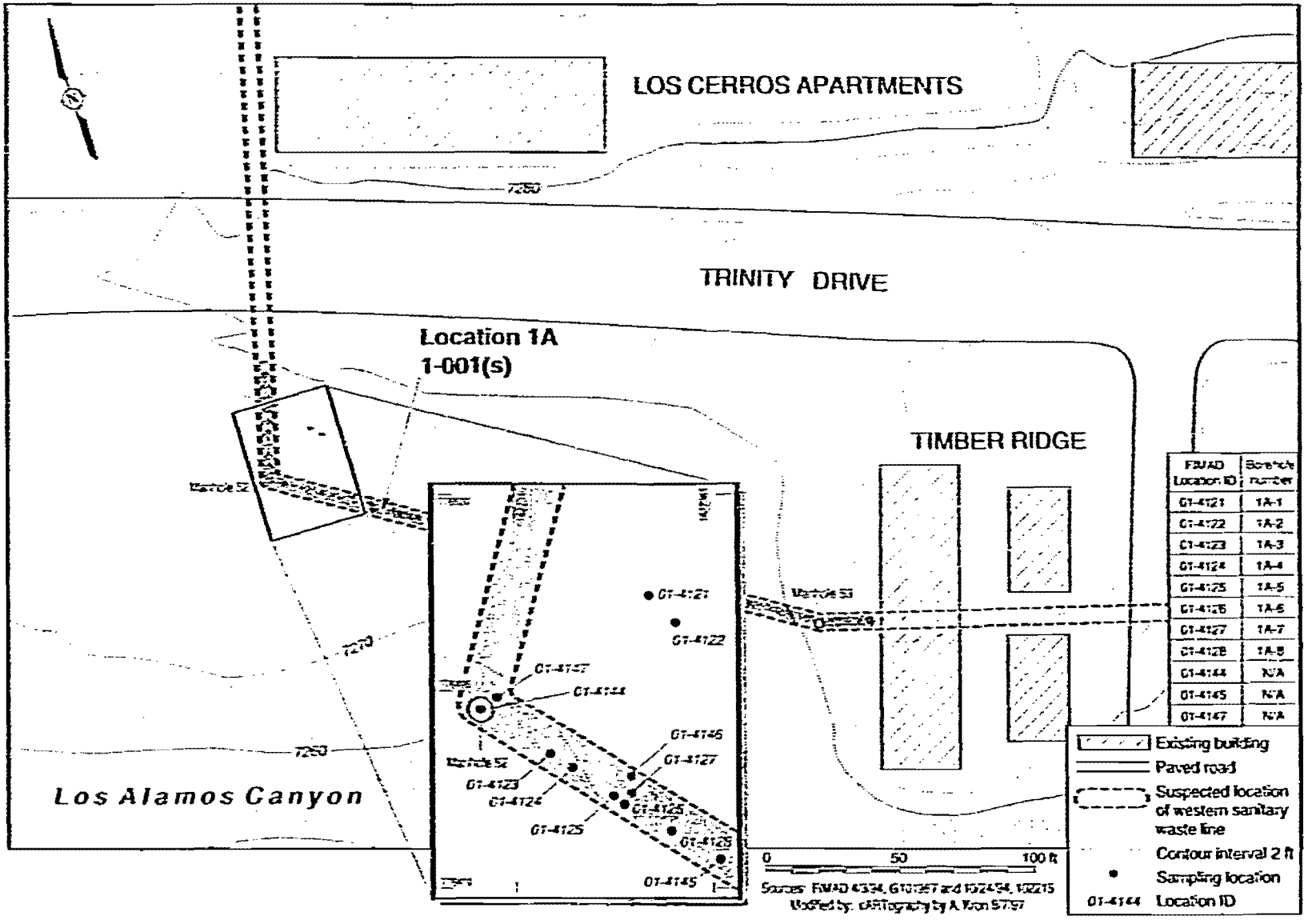


Fig. 5.1.4.1-1. Location of boreholes at Location 1A, Aggregate N.

TABLE 5.1.4.1-1

SUMMARY OF SAMPLES COLLECTED IN FEBRUARY/MARCH 1994 AT AGGREGATE N, LOCATION 1A

SAMPLE INFORMATION				ANALYSES							
LOCATION ID	SAMPLE ID	DEPTH (ft bgs)[d]	MATRIX	RCRA METALS	VOCs	SVOCs	CESIUM-137	ISOTOPIC PLUTONIUM	ISOTOPIC URANIUM	PCBs	PESTICIDES
01-4124	AAA8311	5.0-6.0	Soil	16845[a]	–[b]	16844	16911	16856	16856	16844	16844
01-4127	AAA8281	N/A[c]	Liquid (Rinsate)	16831	–	16829	-	16830	16830	16829	16829
01-4144	AAA8273	0.5-4.0	Soil	16876	16873	16873	-	16860	16860	16873	16873
01-4144	AAA8320	0.5-2.5	Chips from MH-52	–	–	–	16915	–	–	–	–
01-4144	AAA8321	N/A	Soil	17154	–	-	16915	17362	–	–	–
01-4145	AAA8265	0.5-4.5	Soil	16876	16873	16873	-	16860	16860	16873	16873
01-4146	AAA8317	0.5-4.5	Soil	–	–	–	–	–	–	–	–
01-4147	AAA8270	0.5-4.5	Soil	16876	16873	16873	-	16860	16860	16873	16873
01-4147	AAA8319	N/A	Liquid (Tip Blank)	–	16873	–	–	–	–	–	–

[a] X = Analysis conducted.
[b] – = No analysis conducted.
[c] N/A = Not applicable.
[d] bgs = below ground surface.

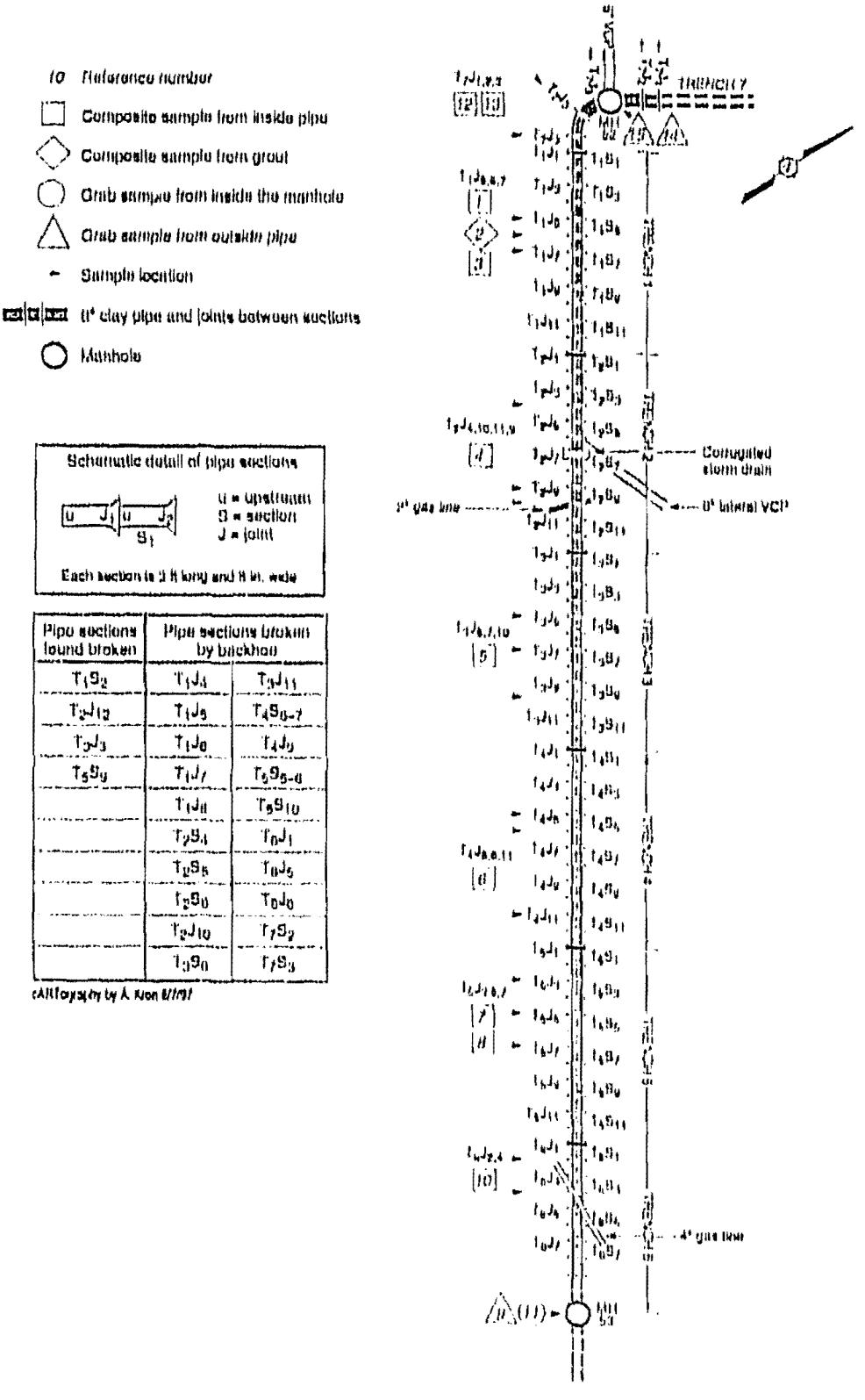
Real-time field monitoring for organic vapors, mercury vapor, combustible gases, aerosols, and radiological contaminants was conducted during drilling and sampling activities at Location 1A. A Photovac Microtip 2000™ photoionization detector (PID) with a 10.6 eV and 11.7 eV lamp was used to monitor for organic vapors, and mercury vapor was monitored with a Jeromo™ mercury vapor analyzer (MVA). Combustible gases were monitored during drilling operations using an MSA MX-251™ combustible gas indicator (CGI). Aerosols were monitored using a hand-held MIE-PDM-3 MiniRAM™. Beta/gamma contamination was monitored using an Eberline ESP-1™ with an HP260 Geiger-Muller™ pancake probe. Alpha contamination monitoring was conducted using a Ludlum 139™ with an air proportional probe and a Ludlum M-13™ with a 43-32 probe. No elevated levels of organic vapors, mercury vapors, or particulate aerosols were detected during field screening activities conducted at Location 1A. Elevated alpha, beta, and gamma activity was detected in soil collected from localized areas of the interior floor surface in MH-52. All of these localized areas of elevated soil activity were sampled and submitted for fixed laboratory analysis before removal.

Location 1A, July 1994 Field Activities

The objectives of the July 1994 field activities at Location 1A were to assess the physical integrity of the line, to remove and dispose of the WSWL, and to characterize any contamination within the WSWL and surrounding soils.

Six consecutive trenches were excavated using a backhoe along the trend of the WSWL between MH-52 and MH-53, while a seventh trench was excavated north of MH-52. After the entire length of pipe in a trench was uncovered, radiological field screening was conducted along the outside of the pipe and in the surrounding soil.

Samples were collected from materials inside WSWL sections. In order to collect enough material for analysis, samples were composited from several pipe sections (3 ft long each) from each trench (Fig. 5.1.4.1-2). The pipe sections selected for soil sampling were determined according to their radioactivity level: the pipe sections with the highest, middle, and lowest radioactivity measured with a hand-held beta/gamma meter were selected for each composite samples. Two grab samples of soils near Manholes 52 and 53 were also collected for analyses (sample ID nos. AAB6091, AAB6092). Samples were first sent to the TA-59 count trailer for gross radiological activity screening to select samples for fixed laboratory analyses and to address transportation requirements. A Berthold LB770™ gas proportional counter was used to screen samples for gross alpha and beta activity. A summary of samples collected from Location 1A in July 1994 and the subsequent analyses is presented in Table 5.1.4.1-2.



Pipe sections found broken	Pipe sections broken by backhoe	
T_1S_2	T_1J_4	T_3J_{11}
T_2J_{12}	T_1J_5	T_4S_{6-7}
T_3J_3	T_1J_6	T_4J_9
T_5S_9	T_1J_7	T_5S_{5-6}
	T_1J_8	T_5S_{10}
	T_2S_4	T_6J_1
	T_2S_5	T_6J_5
	T_2S_6	T_6J_6
	T_2J_{10}	T_7S_2
	T_3S_6	T_7S_3

Fig. 5.1.4.1-2. Location 1A sampling locations (by reference number).

TABLE 6.1.4.1-2

SUMMARY OF SAMPLES COLLECTED IN JULY 1994 AT AGGREGATE N, LOCATION 1A

SAMPLE INFORMATION				ANALYSES			
REFERENCE NUMBER	SAMPLE ID	DEPTH (ft bgs)	MATRIX	METALS	TRITIUM	ISOTOPIC PLUTONIUM	ISOTOPIC URANIUM
REF. 1	AAB60098	N/A	Soil[a]	-	18417	-	-
REF. 2	AAB60096	N/A	Grout (Rinsate)	-	-	-	-
REF. 3	AAB60094	N/A	Soil[b]	18381	-	18372	18372
REF. 4	AAB60095	N/A	Soil[a]	18381	-	18372	18372
REF. 5	AAB60100	N/A	Soil[b]	18382	-	18372	18372
REF. 6	AAB60094	N/A	Soil[a]	18382	-	18372	18372
REF. 7	AAB60093	N/A	Soil (Replicate)[b]	18382	-	18372	18372
REF. 8	AAB60080	N/A	Soil[b]	18382	-	18372	18372
REF. 9	AAB60091	>8	Soil	18382	-	18372	18372
REF. 10	AAB60093	N/A	Soil[a]	18382	-	18372	18372
REF. 11	AAB60090	N/A	Soil[b]	18382	-	18372	18372
REF. 12	AAB60088	N/A	Soil[b]	18382	-	18372	18372
REF. 13	AAB60095	N/A	Soil (Replicate)[a]	18382	-	18372	18372
REF. 14	AAB60092	3.5-5.5	Soil	18382	-	18372	18372
REF. 15	AAB60087	3.5-5.5	Soil	-	18372	-	-

[a] Soil/sediment sample collected from within the pipe.
[b] Soil/sediment sample collected from Manhole 52.
N/A = Not available.

VOC monitoring was conducted using an HNu™ hand-held PID to detect potential hazards to site personnel and to screen sample locations for detectable organic vapors. Mercury vapor was monitored with an MVA, and no vapor was detected. Real-time aerosol field monitoring was conducted in the active work area (the breathing zone of site workers and the area of the excavation trenches) using a hand-held MIE-PDM-3 MiniRAM™. Radiological screening for beta/gamma activity was conducted using an Eberline ESP-1™ with an HP260™ pancake probe. A Ludlum 12™ with a 44-40 probe was used for beta/gamma screening. During the entire investigation of Location 1A, a Ludlum 139™ with a 43-32 rate meter was used to surface monitor alpha radiation.

After field screening and sample collection, all pipe sections were labeled, photographed, double wrapped in 6-mil plastic, sealed with duct tape, and placed in a lined dump truck that was secured on-site. After all pipe sections and MH-52 were removed, the bottom of the entire excavation was screened using hand-held radiation and organic vapor monitoring meters. Readings were below background levels on the sides and bottom of all trenches, which were subsequently backfilled and compacted. After completing all field activities, the entire excavation area was regraded to restore the original topography.

Location 1A, June 1996 Field Activities

The objectives of the June 1996 Interim Action field activities at Location 1A were to assess the physical integrity of the line, to remove and dispose of the WSWL, and to characterize any contamination within the WSWL and surrounding soils (LANL 1996, 09-0528; LANL 1996, 09-0533).

Field activities at Location 1A in June 1996 were a continuation of excavation and removal activities that occurred in July 1994. The remainder of the accessible portion of the WSWL at Location 1A (near the former location of MH-52 and extending northward toward Trinity Drive) was removed and sampled. After several exploratory trenches were excavated using a backhoe, approximately 12 ft of vitrified clay pipe (VCP) fragments were encountered and exposed within Trench 9 approximately 5 ft below ground surface (bgs) (Fig. 5.1.4.1-3). The trench walls were benched to allow personnel to enter the trench during removal and sampling activities.

After removing pipe fragments from the trench, one composite sample was collected from materials outside the WSWL and one composite sample (adhering to VCP fragments) was collected from materials inside the WSWL. Both samples were submitted to the MRAL for gross alpha, beta, and gamma radiation analysis for transportation requirements and submitted to the MCAL for XRF analysis for backfilling decisions. After MRAL and MCAL screening, all samples were submitted to a fixed laboratory for analysis. A summary of samples collected from Location 1A in June 1996 and subsequent analyses is presented in Table 5.1.4.1-3.

Fragments of VCP recovered during field activities were field screened for radioactive contamination using a Ludlum 139™ with a 43-4 air proportional probe to detect gross alpha radiation and a Ludlum 2™ with a 44-40 GM probe to detect gross beta/gamma radiation. Results for alpha radiation ranged between 0 and 100 counts per minute (cpm) while beta/gamma radiation was not detected. After field screening was completed, VCP fragments were placed in doubled 5-mil plastic bags, labeled, secured with duct tape, and placed in B-25 boxes for storage and disposal off-site.

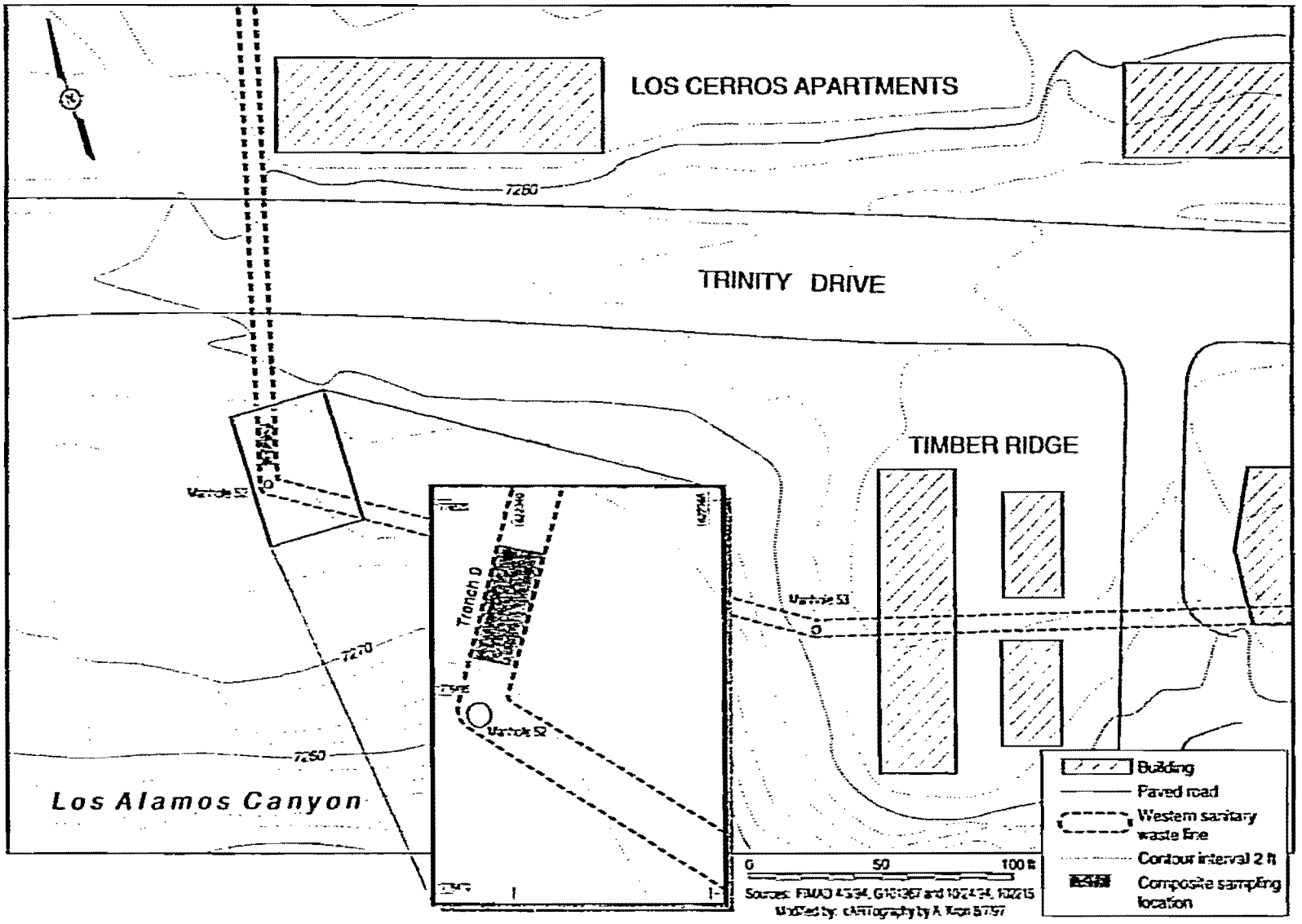


Fig. 5.1.4.1-3. Location of samples collected in June 1996 at Aggregate N, Location 1A.

TABLE 5.1.4.1-3

SUMMARY OF SAMPLES COLLECTED IN JUNE 1996 AT AGGREGATE N, LOCATION 1A.

SAMPLE INFORMATION				ANALYSES				
LOCATION ID	SAMPLE ID	DEPTH (ft bgs)	MATRIX	METALS	SVOCs	ISOTOPIC PLUTONIUM	ISOTOPIC URANIUM	AMERICIUM-241
01-10114	0101-96-0032	0	Soil	2320	2319	2323	2323	2323
01-10115	0101-96-0030	N/A	Soil*	2320	2319	2323	2323	2323

*Soil/sediment sample collected from within the pipe.

Because XRF results were not received in a timely manner, backfilling decisions were based on radiological field screening methods. A Ludlum 2221™ with a 43-1 zinc-sulfide scintillation probe was used to detect gross alpha radiation in the soils underlying the WSWL. Screening samples were collected from the bottom of trenches on a minimum 10-ft spacing and placed in aluminum pans to air dry. The 43-1 probe was placed directly on the screening sample and counted for five minutes. The established contamination criterion was set at three times the standard deviation above site background levels. Because radiological field screening measurements did not exceed the contamination criterion, Trench 9 was backfilled and compacted with the excavated material.

5.1.4.2 Locations 10 and 11

The field investigation at Locations 10 and 11, the property formerly occupied by Hot Shots Restaurant (west lot) and the adjacent vacant lot (east lot), was conducted in June 1996. The objectives of the June 1996 Interim Action at Locations 10 and 11 were to assess the physical integrity of the line, to remove and dispose of the WSWL, and to characterize any contamination within the WSWL and surrounding soils (LANL 1996 09-0528; LANL 1996, 09-0533).

A series of north-south trending exploratory trenches were excavated using a backhoe on the paved portion of the west lot (behind the former Hot Shots Restaurant) to locate the pipeline and to evaluate the procedures necessary to expose and remove the pipe. Locations of exploratory trenches were based on reviewing historical site maps and the results of a geophysical survey performed in May 1996. Underground structures initially encountered included an intact asphalt road bed, a concrete curb, a sidewalk approximately 5 ft below ground surface (bgs) and an abandoned, east-west trending, cast iron water pipeline approximately 10 ft bgs. The east-west trending WSWL pipeline, comprised of 3-ft long sections of 8-in. (inside diameter) VCP, was located at a depth approximately 10 ft bgs on the west lot.

On the east lot, four trenches (1, 2, 3, and 8) were excavated 5–8 ft wide and 12–13 ft deep to allow for VCP removal and sample collection (Fig. 5.1.4.2-1). Due to the presence of an unmarked sewer line and an adjacent utility corridor, excavation and removal activities were discontinued approximately 10 ft west of the eastern property line. Four trenches (4 through 7) were also excavated on the paved west lot; trenches were typically 5–8 ft wide and 10–12 ft deep (Fig. 5.1.4.2-1). Approximately 25 ft southeast of the southeast corner of the Hot Shots building, a brick and masonry manhole (MH-59) was exposed, broken into pieces, and removed. Due to the presence of an underground electrical cable near the western property line, excavation and pipeline removal was terminated approximately 5 ft east of the Hot Shots' property line.

Samples were collected from materials outside and inside the WSWL. Ten samples (and one duplicate sample) were collected directly beneath the pipeline and four samples were collected from materials within the WSWL (Fig. 5.1.4.2-1). Typically, samples from material outside the WSWL were collected at 20- to 25-ft intervals and directly from the trackhoe bucket as personnel were unable to safely enter the excavated trenches. WSWL sections were generally free of accumulated material, but on rare occasions enough volume existed to collect a discrete sample, or a composite sample from adjacent sections. All samples were screened for radioactivity and submitted to a fixed laboratory for analysis, as outlined in Section 5.1.4.1. A summary of the samples collected from Locations 10 and 11 in June 1996 and the subsequent analyses is presented in Table 5.1.4.2-1.

Intact sections of VCP, fragments of VCP, and manhole pieces recovered during field activities were field screened for radioactive contamination as outlined in Section 5.1.4.1. Results for alpha radiation ranged between 250 and 2 500 cpm, while results for beta/gamma radiation ranged between 400 and 500 cpm. After field screening was completed, intact VCP sections were double-wrapped with 6-mil plastic sheeting and VCP fragments and manhole pieces were placed in doubled 6-mil plastic bags. For tracking purposes, plastic sheeting and bags containing VCP sections, VCP fragments, and manhole pieces were labeled, secured with duct tape, and placed in B-25 boxes for storage and disposal off-site.

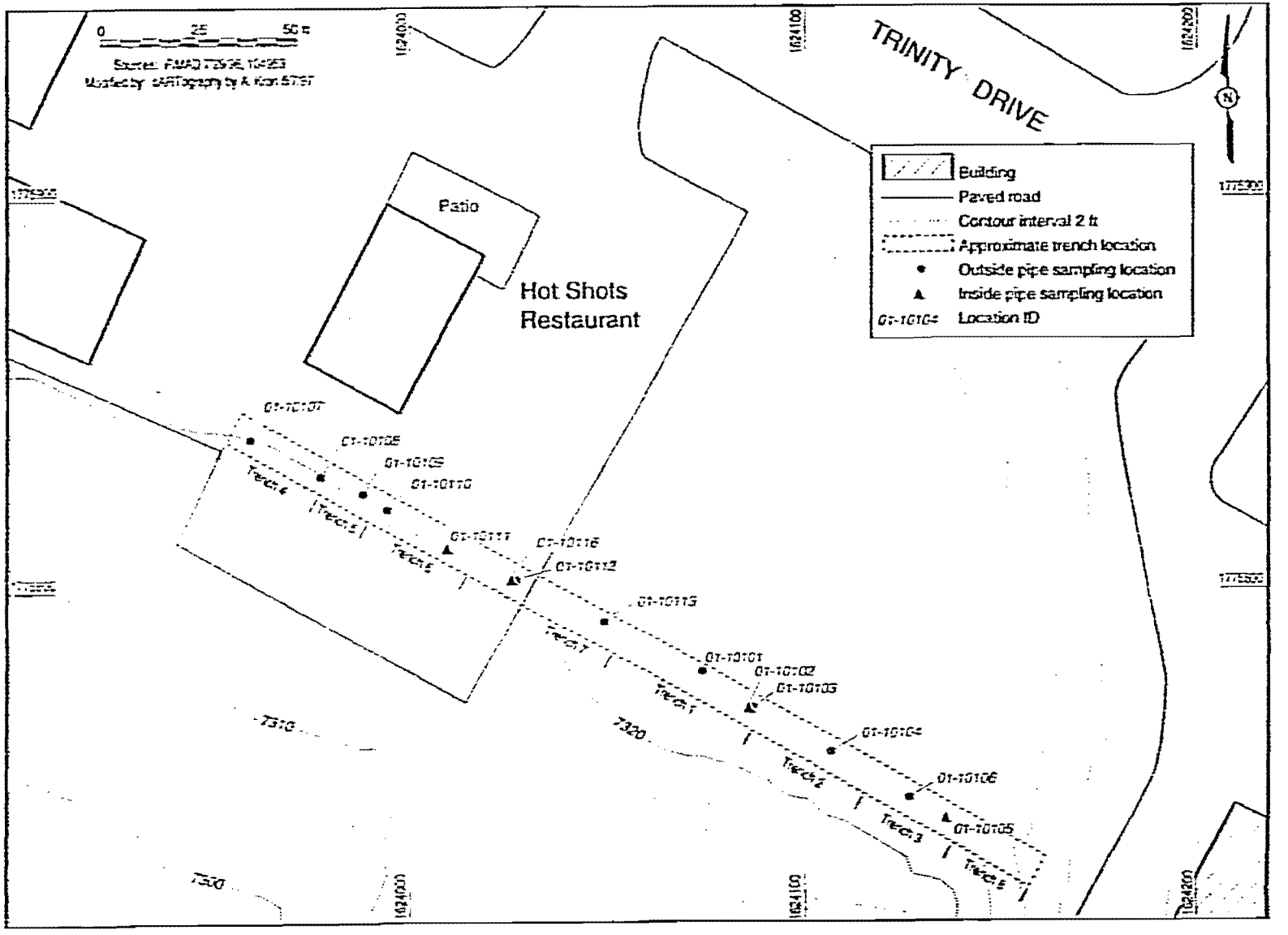


Fig. 5.1.4.2-1. Location of samples collected in June 1996 at Aggregate N, Location 10 and 11.

TABLE 5.1.4.2-1

SUMMARY OF SAMPLES COLLECTED IN JUNE 1996
AT AGGREGATE N, LOCATIONS 10 AND 11

SAMPLE INFORMATION				ANALYSES				
LOCATION ID	SAMPLE ID	DEPTH (ft bgs)	MATRIX	METALS	SVOCs	ISOTOPIC PLUTONIUM	ISOTOPIC URANIUM	AMERICIUM-241
01-10101	0101-96-0021	13	Soil	2256	2255	2257	2257	2257
01-10102	0101-96-0022	N/A	Soil*	2259	2258	2260	2260	2260
01-10103	0101-96-0023	13	Soil	2259	2258	2260	2260	2260
01-10104	0101-96-0024	12	Soil	2268	2267	2269	2269	2269
01-10105	0101-96-0025	N/A	Soil*	2268	2267	2269	2269	2269
01-10106	0101-96-0026	11	Soil	2268	2267	2269	2269	2269
01-10107	0101-96-0027	12.5	Soil	2285	2284	2283	2283	2283
01-10107	0101-96-0221	12.5	Soil	2285	2284	2283	2283	2283
01-10108	0101-96-0028	12.0	Soil	2285	2284	2283	2283	2283
01-10109	0101-96-0029	12.5	Soil	2285	2284	2283	2283	2283
01-10110	0101-96-0030	13	Soil	2305	2304	2306	2306	2306
01-10111	0101-96-0031	N/A	Soil*	2305	2304	2306	2306	2306
01-10112	0101-96-0035	11.5	Soil	2305	2304	2306	2306	2306
01-10113	0101-96-0033	8	Soil	2305	2304	2306	2306	2306
01-10114	0101-96-0032	6	Soil	2320	2304	2323	2323	2323
01-10116	0101-96-0034	N/A	Soil*	2305	2304	2306	2306	2306

*Soil/sediment sample collected from within the pipe.

Radiological field-screening methods used before backfilling trenches was discussed in Section 5.1.4.1. Once field screening determined that no elevated readings were associated with the underlying soils, all trenches were backfilled and compacted with the excavated material.

5.1.4.3 Location 13

The field investigations at Location 13, the Los Alamos Inn parking lot, were conducted in February/March 1994 and November/December 1994.

Location 13, February/March 1994 Field Activities

The objectives of the February/March 1994 field activities at Location 13 were to locate the WSWL by conducting geophysical surveys and drilling boreholes and to assess any residual contamination associated with the surrounding soils by collecting screening and analytical samples during drilling activities.

Geophysical surveys at Location 13 were conducted as previously presented in Section 5.1.4.1. Subsequent to the geophysical surveys, several exploratory trenches were excavated using a trencher to physically locate the WSWL. However, no piping associated with the WSWL was encountered. The trenches were backfilled following identification of pipe fragments assumed to be associated with the WSWL. Twelve boreholes were then drilled and sampled (Fig. 5.1.4.3-1). Boreholes 13-1, 13-2, 13-3, 13-4, and 13-5 were drilled in locations thought to transect the WSWL trench. Four more boreholes (13-6 through 13-9) were drilled along the suspected trend of the WSWL trench at the western portion of Location 13 while three boreholes (13-10 through 13-12) were drilled in a straight line across an area suspected of containing a southern branch of the WSWL.

Soil samples were collected from materials outside the WSWL and were submitted to the MRAL for gross radiological activity screening and to the MCAL for XRF analysis. Samples were submitted for additional analyses at a fixed laboratory. A summary of the samples collected from Location 13 in February/March 1994 and the subsequent analyses requested is presented in Table 5.1.4.3-1.

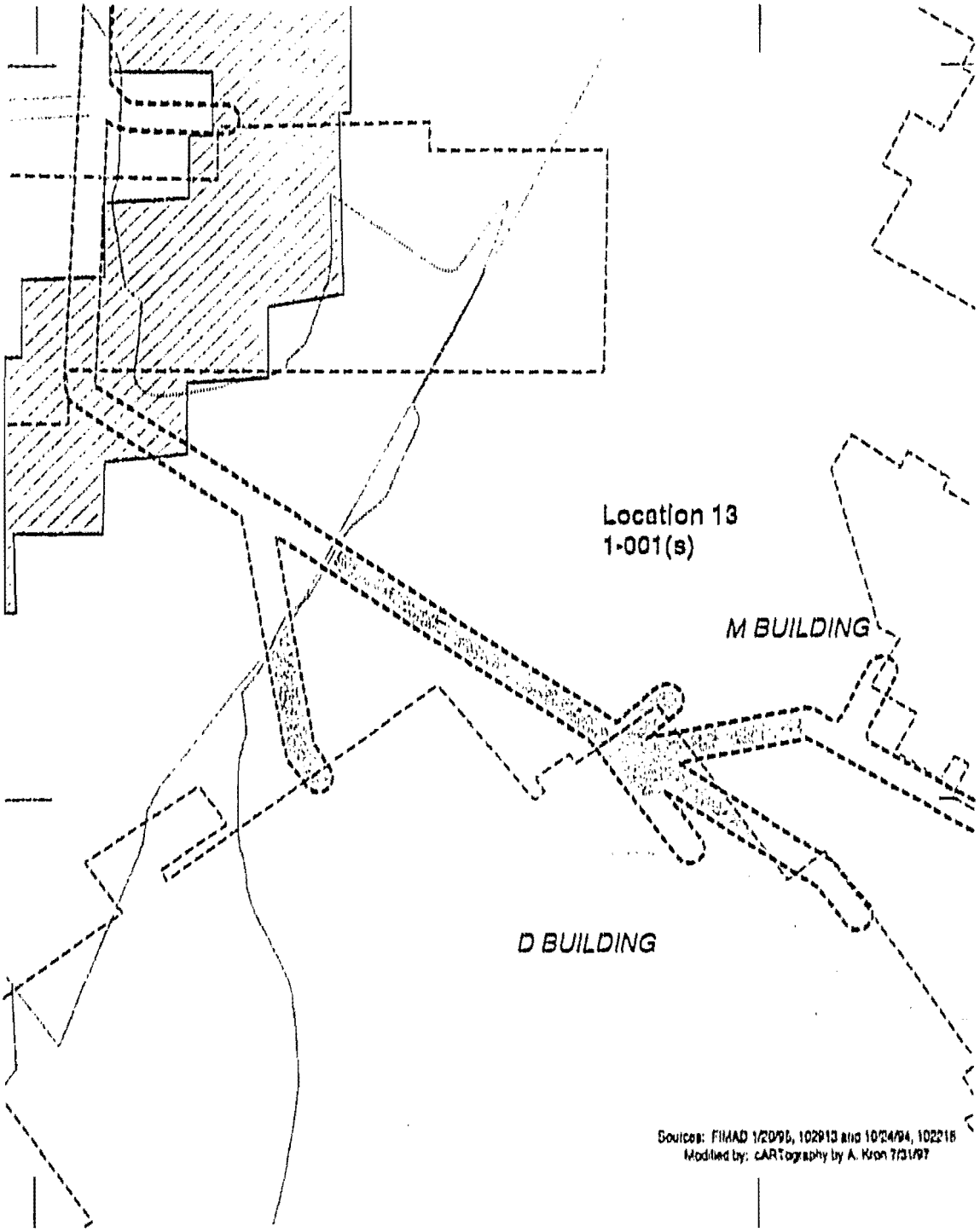


Fig. 5.1.4.3-1. Locations of boreholes at Aggregate N, Location 13.

TABLE 5.1.4.3-1

SUMMARY OF SAMPLES COLLECTED IN FEBRUARY/MARCH 1994 AT AGGREGATE N, LOCATION 13

SAMPLE INFORMATION				ANALYSES							
LOCATION ID	SAMPLE ID	DEPTH (ft bgs)	MATRIX	METALS	VOA	SVOCs	CESIUM-137	ISOTOPIC PLUTONIUM	ISOTOPIC URANIUM	PCBs	PESTICIDES
01-4105	AAA8267	4.75-5.75	Soil	16772	16775	16775	17391	16774	16774	16775	16773
01-4105R	AAA8269	4.75-5.75	Soil	16772	16775	16775	17391	16774	16774	16775	16773
01-4105	AAA8279	N/A	Liquid	16772	16775	16775	-	16774	16774	16775	16773
N/A	AAA8297	N/A	Liquid	-	16775	-	-	-	-	-	-
01-4107	AAA8269	0-5.0	Soil	-	-	-	16811	-	-	-	-
01-4108	AAA8265	0-3.0	Soil	-	-	-	16811	-	-	-	-
01-4108	AAA8266	3.0-5.0	Soil	-	-	-	-	-	-	-	-
01-4108	AAA8268	5-6.5	Soil	-	-	-	16811	-	-	-	-
01-4109	AAA8272	5-6.5	Soil	16763	-	-	16781	16781	16781	-	-
01-4109	AAA8262	N/A	Liquid	16662	-	-	-	16661	16661	-	-
01-4110	AAA8267	5-6.5	Soil	-	-	-	16765	-	-	-	-
01-4111	AAA8290	0-3.0	Soil	-	-	-	16910	-	-	-	-
01-4111	AAA8291	5.0-10.0	Soil	-	-	-	16910	-	-	-	-
01-4112	AAA8292	3.0-5.0	Soil	-	-	-	16910	-	-	-	-
01-4112	AAA8293	5.0-10.0	Soil	-	-	-	16910	-	-	-	-
01-4113	AAA8294	3.0-5.0	Soil	-	-	-	16910	-	-	-	-
01-4113	AAA8298	5.0-10.0	Soil	-	-	-	16910	-	-	-	-

Real-time field monitoring for organic vapors, mercury vapor, combustible gases, aerosols, and radiological contaminants was conducted as previously discussed in Section 5.1.4.1. Field screening for organic vapors, mercury vapor, and particulate aerosols indicated no elevated levels of hazardous constituents. Elevated beta/gamma readings were noted after completing a survey of excavated trench sidewalls; however, alpha activity was not detected. An on-site survey of VCP fragments found during excavation activities did not detect any radioactivity.

Location 13, November/December 1994 Field Activities

The objectives of the November/December 1994 field activities at Location 13 were to assess the physical integrity of the line, to remove and dispose of the WSWL, and to characterize any contamination within the WSWL and surrounding soils.

Four trenches were excavated using a backhoe at Location 13 (Fig. 5.1.4.3-2). The first exploratory trench to locate the WSWL connection to former Building D was excavated in a north-south direction near the western site boundary fence for Location 13. The main VCP, which was originally connected to Building D, was uncovered approximately 10 ft south of the origin of the trench and at a depth of 3 ft. The second trench (Trench 1) was excavated in an effort to follow the WSWL to its terminus at former Building D (Figs. 5.1.4.3-2 and 5.1.4.3-3). This trench ran perpendicular to the exploratory north-south trench. Trench 1 split into two sections at its east end, where a southern branch of the WSWL was located and subsequently sampled and removed. Two additional exploratory trenches (Trench 2 and Trench 3) were also excavated along the western portion of the site in an effort to locate the southern branch of the WSWL. Trench 2 was excavated in a north-south direction near the western site boundary and to the south of Trench 1 while Trench 3 was excavated between Trench 2 and the initial exploratory north-south trench. Excavating Trench 2 and Trench 3 did not reveal another southern branch of the WSWL; therefore no further investigation was conducted.

As the WSWL was exposed, it was screened, labeled, sampled, separated at the joints into individual sections, double-wrapped in 6-mil plastic, removed from the trench, and placed in an on-site B-25 box. Samples were collected from inside the WSWL, outside the WSWL, the bottom of the excavation trench, excavated soils, and grout between pipe sections. Samples were submitted to the MRAL for analysis of gross alpha, beta, and gamma radiation for transportation requirements. Samples were submitted for additional analyses at a fixed laboratory. A summary of the samples collected from Location 13 in November/December 1994 and the subsequent analyses is presented in Table 5.1.4.3-2.

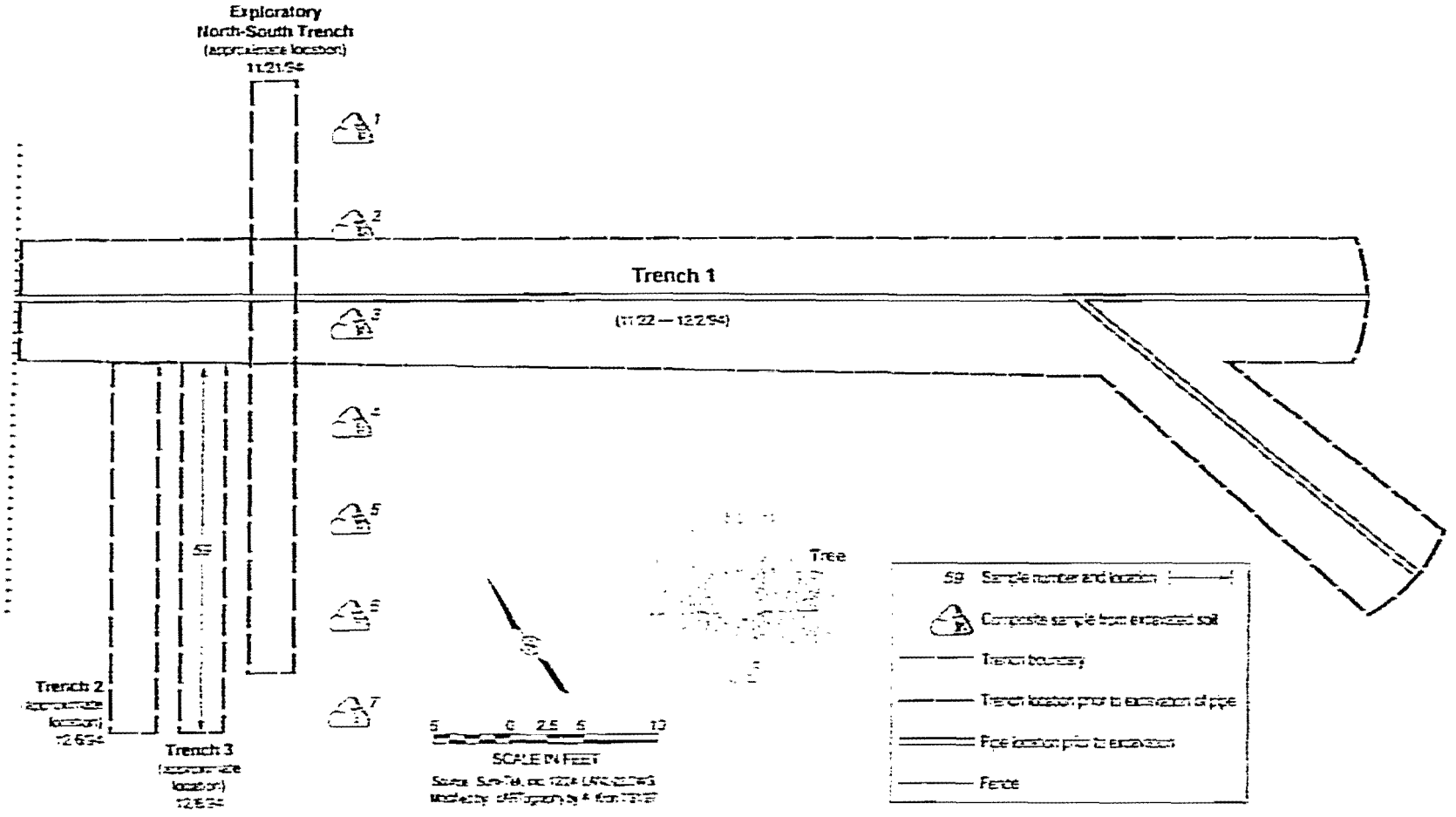


Fig. 5.1.4.3-2. Location 13 samples collected cross-trenches.

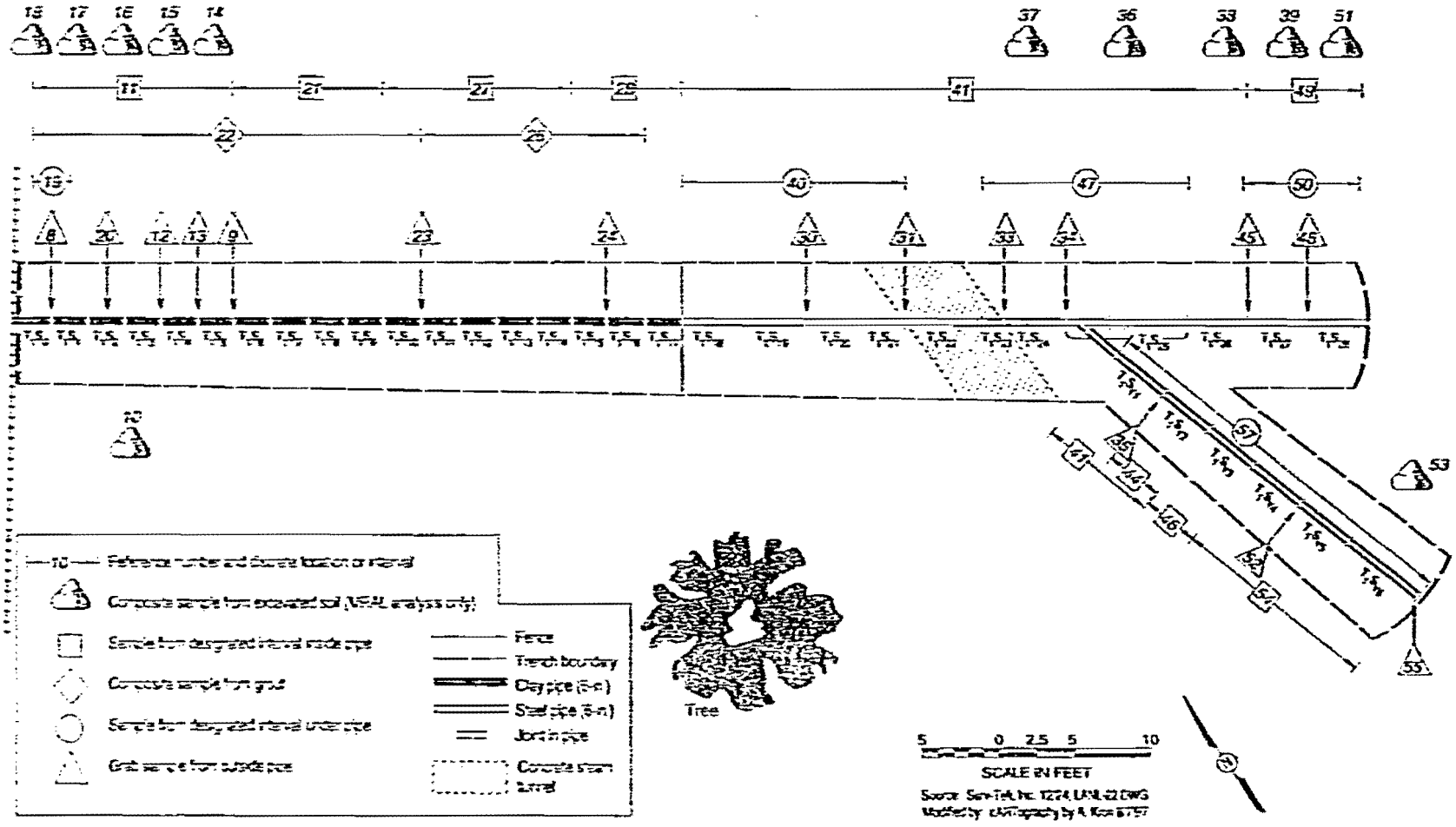


Fig. 5.1.4.3-3. Sampling locations and intervals at Location 13, Aggregate N.

TABLE 5.1.4.3-2

SUMMARY OF SAMPLES COLLECTED IN NOVEMBER/DECEMBER 1994 AT AGGREGATE N, LOCATION 13

SAMPLE INFORMATION				ANALYSES							
LOCATION ID	SAMPLE ID	DEPTH (ft bgs)	MATRIX	METALS	SVOCs	CESIUM-137	TRITIUM	ISOTOPIC PLUTONIUM	ISOTOPIC URANIUM	PCBs	PESTICIDES
REF. 1	AAC0354	0-4	Soil	–	–	–	–	–	–	–	–
REF. 2	AAC0519	0-4	Soil	–	–	–	–	–	–	–	–
REF. 3	AAC0356	0-4	Soil	–	–	–	–	–	–	–	–
REF. 4	AAC0355	0-4	Soil	–	–	–	–	–	–	–	–
REF. 5	AAC0518	0-4	Soil	–	–	–	–	–	–	–	–
REF. 6	AAB6079	0-4	Soil	–	–	–	–	–	–	–	–
REF. 7	AAC0520	0-4	Soil	–	–	–	–	–	–	–	–
01-4317/REF. 8	AAB7440	0-4	Soil	20368	20365	20375	20375	20375	20375	20365	20365
01-4320/REF. 9	AAC0517	0-4	Soil	20368	20365	20375	20375	20375	20375	20365	20365
01-4260-4265/REF. 11	AAB6076	N/A	Soil*	20368	20365	20375	20375	20375	20375	20365	20365
01-4318/ REF. 12	AAC2063	0-4	Soil	–	–	–	–	–	–	–	–
01-4319/ REF. 13	AAC2064	0-4	Soil	–	–	–	–	–	–	–	–
REF. 14	AA2065	0-5	Soil	–	–	–	–	–	–	–	–
REF. 15	AAC2066	0-5	Soil	–	–	–	–	–	–	–	–
REF. 16	AAC2067	0-5	Soil	–	–	–	–	–	–	–	–
REF. 17	AAC2068	0-5	Soil	–	–	–	–	–	–	–	–
REF. 18	AAC2069	0-5	Soil	–	–	–	–	–	–	–	–
01-4260/REF. 19	AAC0514	0-4	Soil	20368	20365	20375	20375	20375	20375	20365	20365
01-4261-4262/REF. 20	AAC0516	0-4	Soil	20368	20365	20375	20375	20375	20375	20365	20365
01-4265-4269/REF. 21	AAB6077	N/A	Soil*	20368	20365	20375	–	20375	20375	20365	20365
01-4260-4271/REF. 22	AAC2061	N/A	Grout	20368	–	20375	–	20375	20375	–	–
01-4321/REF. 23	AAB7450	0-4	Soil	20368	20365	20375	20375	20375	20375	20365	20365
01-4322/REF. 24	AAB7438	0-4	Soil	20368	20365	20375	20375	20375	20375	20365	20365
01-4283/REF. 25	AAB7449	0-0.5	Soil	–	–	–	20375	–	–	–	–
01-4271-4276/REF. 26	AAB7439	0-4	Grout	20368	–	20375	–	20375	20375	–	–
01-4269-4274/REF. 27	AAB6078	N/A	Soil*	20368	20365	20375	–	20375	20375	20365	20365

TABLE 5.1.4.3-2 (continued)

SUMMARY OF SAMPLES COLLECTED IN NOVEMBER/DECEMBER 1994 AT AGGREGATE N, LOCATION 13

SAMPLE INFORMATION				ANALYSES							
LOCATION ID	SAMPLE ID	DEPTH (ft bgs)	MATRIX	METALS	SVOCs	CESIUM-137	TRITIUM	ISOTOPIC PLUTONIUM	ISOTOPIC URANIUM	PCBs	PESTICIDES
01-4274-4277/REF. 28	AAB6072	N/A	Soil	20368	20365	20375	–	20375	20375	20365	20365
REF. 29	AAC0351	N/A	Liquid (Rinsate)	20368	20365	20375	20375	20375	20375	20365	20365
01-4323/REF. 30	AAC0513	5	Soil	20467	20465	20468	20468	20468	20468	20465	20465
01-4324/REF. 31	AAC0515	4–5	Soil	20467	20465	20468	20468	20468	20468	20465	20465
01-4325/REF. 33	AAB6073	4–5	Soil	20467	20465	20468	20468	20468	20468	20465	20465
01-4327/REF. 34	AAB6070	0–5	Soil	20482	20479	20488	20488	20488	20488	20479	20479
01-4329/REF. 35	AAB6069	0–5	Soil	20482	20479	20488	20488	20488	20488	20479	20479
REF. 37	AAC2073	0–5	Soil	–	–	–	–	–	–	–	–
REF. 36	AAC2074	0–5	Soil	–	–	–	–	–	–	–	–
REF. 38	AAC2075	0–5	Soil	–	–	–	–	–	–	–	–
REF. 39	AAC2076	0–5	Soil	–	–	–	–	–	–	–	–
01-4277-4281/REF. 40	AAB6071	0–5	Soil	20482	20479	20488	–	20488	20488	20479	20479
01-4277-4281, 4284-4289, 4293-4294/REF. 41	AAB6075	N/A	Soil	20482	20479	20488	–	20488	20488	20479	20479
REF. 43	AAC0352	N/A	Liquid (Rinsate)	20487	20484	–	20489	20489	20489	20484	20484
01-4293-4294/ REF. 44	AAC2081	N/A	Soil	20538	–	20540	–	20540	20540	–	–
01-4328/REF. 45	AAC2078	0–5	Soil	20538	20535	20540	20540	20540	20540	20535	20535
01-4294-4295/REF. 46	AAB6074	N/A	Soil	20538	20535	20540	–	20540	20540	20535	20535
01-4284-4289/REF. 47	AAC2082	0–5	Soil	20538	–	20540	–	20540	20540	–	–
01-4326/REF. 48	AAC2080	0–5	Soil	20538	20535	20540	20540	20540	20540	20535	20535
01-4290-4292/REF. 49	AAC2084	N/A	Soil	20538	20535	20540	–	20540	20540	20535	20535
01-4290-4292/REF. 50	AAC2085	0–5	Soil	20538	20535	20540	–	20540	20540	20535	20535
REF. 51	AAC2086	0–5	Soil	–	–	–	–	–	–	–	–
01-4330/REF. 52	AAC2090	0–5	Soil	20557	–	20559	–	20559	20559	–	–
REF. 53	AAC2091	0–5	Soil	–	–	–	20559	–	–	–	–

TABLE 5.1.4.3-2 (continued)

SUMMARY OF SAMPLES COLLECTED IN NOVEMBER/DECEMBER 1994 AT AGGREGATE N, LOCATION 13

SAMPLE INFORMATION				ANALYSES							
LOCATION ID	SAMPLE ID	DEPTH (ft bgs)	MATRIX	METALS	SVOCs	CESIUM-137	TRITIUM	ISOTOPIC PLUTONIUM	ISOTOPIC URANIUM	PCBs	PESTICIDES
01-4295-4296/REF. 54	AAC2086	N/A	Soil*	20557	20556	20559	–	20559	20559	20556	20556
01-4331/REF. 55	AAC2079	0–5	Soil	20557	20556	20559	20559	20559	20559	20556	20556
01-4287, 4293-4298/REF. 57	AAC2087	0–5	Soil	20557	20556	20559	–	20559	20559	20556	20556
REF. 58	AAC0353	N/A	Liquid (Rinsate)	20561	20554	–	20566	20566	20566	20554	20554
01-4282/REF. 59	AAC2089	0–4	Soil	20627	20619	20629	20629	20629	20629	20619	20619
REF. 60	AAC0999	N/A	Liquid (Disposal)	20805	–	–	20806	20806	20806	–	–

*Soil/sediment sample collected from within the pipe.

Organic vapor monitoring was conducted using an HNu PID to assess potential hazards to site personnel and to screen sample locations for the presence of detectable organic vapors. Real-time aerosol field monitoring was conducted in the active work area using a hand-held MIE-PDM-3 MiniRAM™. Radiological screening was conducted with an Eberline ESP-1™ beta/gamma meter equipped with a GM 260™ pancake probe and a Ludlum™ alpha meter equipped with a scintillation probe.

After removing the WSWL, the bottom of each trench was field screened for organic constituents and alpha, beta, and gamma radioactivity with portable field instruments. Levels above background were not detected for any hazardous or radioactive constituents. The trench was then backfilled with the excavated soil.

5.1.4.4 Locations 2 and 8

Field investigations at Location 2, near the Trinity Village Apartments, and Location 8, behind the present-day Shell Station, were conducted in February/March 1994. The objectives of the field activities at Locations 2 and 8 were to locate the WSWL by conducting geophysical surveys and drilling boreholes and to assess any residual contamination associated with the surrounding soils by collecting screening and analytical samples during drilling activities.

Geophysical surveys were conducted at Locations 2 and 8 as previously presented in Section 5.1.4.1. Because cast iron pipe was suspected at Location 2, a magnetometer (GEM GSA 19™ or EG&G Geometric Cesium Vapor Magnetometer™) was used in addition to the other geophysical methods. Following the geophysical surveys, 15 boreholes were drilled at Location 2 and seven boreholes were drilled at Location 8. No piping associated with the WSWL or former trench material was encountered at either location. Boreholes 8-1 through 8-6 encountered concrete and debris (believed to be from demolition of former Building C) at depths of less than 4.5 ft. Borehole 8-7 was drilled to a total depth of 20 ft to locate the fill/tuff interface, but the interface was never encountered. Although no evidence of the WSWL was encountered, samples were collected from borehole materials and were submitted to the MRAL for gross radiological activity screening and to the MCAL for XRF analysis. Some samples were submitted for additional analyses at a fixed laboratory, even though no evidence of the WSWL or associated trench was identified.

Real-time field monitoring for organic vapors, mercury vapor, combustible gases, aerosols, and radiological contaminants was conducted as previously discussed in Section 5.1.4.1. No elevated levels of organic vapors, mercury vapors, or particulate aerosols were detected

during field screening activities conducted at Locations 2 and 8. No elevated levels of radioactivity was detected at Location 8; however, slightly elevated beta/gamma readings were noted for samples collected from boreholes 2-14 and 2-15 at Location 2. No alpha activity was detected for any of the boreholes from Locations 2 and 8.

Deviations

The following deviations from the RFI Work Plan for OU 1078 occurred during the field activities at Aggregate N.

- In July 1994 at Location 1A, it was not possible to remove MH-53 as planned due to safety concerns. The trench could not be properly shored because of the 14-ft depth of the manhole, and there was a limited space available for maneuvering the backhoe. Instead of removing the entire manhole, the concrete manhole cover slab was removed, wrapped in 6-mil plastic, and stored in the same manner as the pipe sections. The manhole was field screened with radiological field instruments; no readings above background were measured. MH-53 was then broken up using the backhoe, collapsed, and covered with clean fill from trenching activities.

- In June 1996 at Location 1A, one composite sample (rather than a discrete sample) was collected over the length of the trench to provide coverage of the entire 12-ft trench.

- In June 1996 at Locations 10 and 11, narrow trenches were excavated to safely expose and removed the pipeline (rather than enter the trenches). Confirmation samples were then collected from the backhoe bucket. After evaluating the condition of the initial excavation and the instability of the crushed tuff fill material, it was determined that sloping or benching the material to allow for safe entry into the excavation was impractical due to safety concerns and the limited space available. The use of shoring and a trench box were also evaluated, but eventually eliminated from further consideration due to costs, limited availability, and safety concerns. Additionally, all samples (rather than just half) were submitted for SVOC analysis in order to provide sufficient data for evaluation. Lastly, XRF results were not received in a timely manner so excavation backfilling decisions were based on radiological field screening.

- In November/December 1994 at Location 13, the WSWL was not broken during excavation activities and confirmation samples were not collected from the backhoe bucket. Because the trench depth was less than 4 ft and it was benched to allow easy access, collecting samples and separating pipe segments was done manually. In addition, the cast-iron pipe was cut with a hand-held saw rather than broken by the backhoe. In accordance with the November 22, 1994 addendum to the SAP, samples were collected from material at the ends of each 3-ft section of pipe and composited over 15 ft of pipe. This procedure was followed for the VCP sections of the WSWL until the VCP section of piping joined into a cast-iron section of piping. At that point, the pipe was cut into 4-ft lengths and material was collected from inside the entire length of pipe.

5.1.5 Evaluation of Inorganics

5.1.5.1 Location 1A

The following samples were analyzed for inorganics and uranium: four soil samples collected at Location 1A in February 1994, three additional soil samples collected outside the pipe in July 1994, and one additional confirmation soil sample collected outside the pipe in June 1996. For this evaluation of inorganics, the highest detected value was used for samples where a laboratory duplicate was analyzed. In addition, the reported values for isotopic uranium were converted to an estimate of total uranium when total uranium data were not available. Six inorganics (cadmium, copper, lead, mercury, uranium, and zinc) were detected at levels greater than their respective background screening values. Because there are not sufficient data to conduct further statistical tests on these data, these six inorganics 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 six inorganics are shown in Table 5.1.5.1-1.

5.1.5.2 Locations 10 and 11

Eleven confirmation samples collected outside the pipe at Locations 10 and 11 in June 1996 were analyzed for inorganics (Fig. 5.1.5.2-1). In addition, the reported values for these eleven samples for isotopic uranium were converted to an estimate of total uranium. Six inorganics (calcium, copper, mercury, thallium, uranium, and zinc) were detected at levels greater than their respective background screening values.

Further background comparisons were conducted for calcium, copper, and zinc. Mercury, thallium, and uranium were not subjected to further background comparisons because the background data for those metals are inadequate to support other statistical tests; therefore, mercury, thallium, and uranium are carried forward to the screening assessment.

Because the data for the other three metals (calcium, copper, and zinc) do not appear to satisfy normality assumptions, nonparametric tests were preferred for further background comparisons. The Gehan modification to the Wilcoxon Rank Sum test and the Quantile test were used for these evaluations (Ryti et al. 1996, 1298). The Gehan test is best suited for assessing complete shifts in distribution, whereas the Quantile test is better suited for assessing partial shifts. These two tests can detect most types of differences between distributions. Observed significance levels (p-values) for these tests are presented in Table 5.1.5.2-1. If a p-value is less than some small probability (0.05) in at least one of these statistical tests, then there is some reason to suspect that there is a difference between the background and site distributions; otherwise, no difference is indicated.

TABLE 5.1.5.1-1

INORGANICS WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT AGGREGATE N, LOCATION 1A[a]

LOCATION ID[b]	SAMPLE ID	DEPTH (ft bgs)	CADMIUM (mg/kg)	COPPER (mg/kg)	LEAD (mg/kg)	MERCURY (mg/kg)	URANIUM (mg/kg)	ZINC (mg/kg)
		UTL	2.0	15.5	23.3	0.1[c]	5.45	50.8
		SAL	38	2800	400	23	230	23 000
Reference 11	AAB6090	4.5-5.5	4.1	NA[d]	120	10.8	27.2[e]	NA
Reference 9	AAB6091	4.5-5.5	2.6	NA	65.1	3	26.7[e]	NA
Reference 14	AAB6092	3.5-5.5	0.21 (U)	NA	9.6	0.18	4.9[e]	NA
01-4124	AAA8311	5.0-6.0	0.44 (U)	NA	0.8	0.39	3.9[e]	NA
01-4144	AAA8273	0.5-4.0	1.0	NA	47.5	2.1	54.0[e]	NA
01-4145	AAA8205	0.5-4.5	0.43 (U)	NA	2.4 (U)	0.26	5.6[e]	NA
01-10114	0101-96-0032	5	3.8	100	56 (J+)	3.4	16.6[e]	72

* The data qualifiers in this table are defined in Section 3.1.2. These qualifiers were assigned during baseline data validation. However, as discussed in Section 4.1.1, the data are considered usable for site-specific decisions.
[b] In some cases, a reference number is listed in lieu of a location ID.
[c] Value represents the maximum reported background in soil.
[d] NA = Not analyzed.
[e] Value represents isotopic uranium data converted to total uranium data.
BOLDED concentrations are above background screening values.

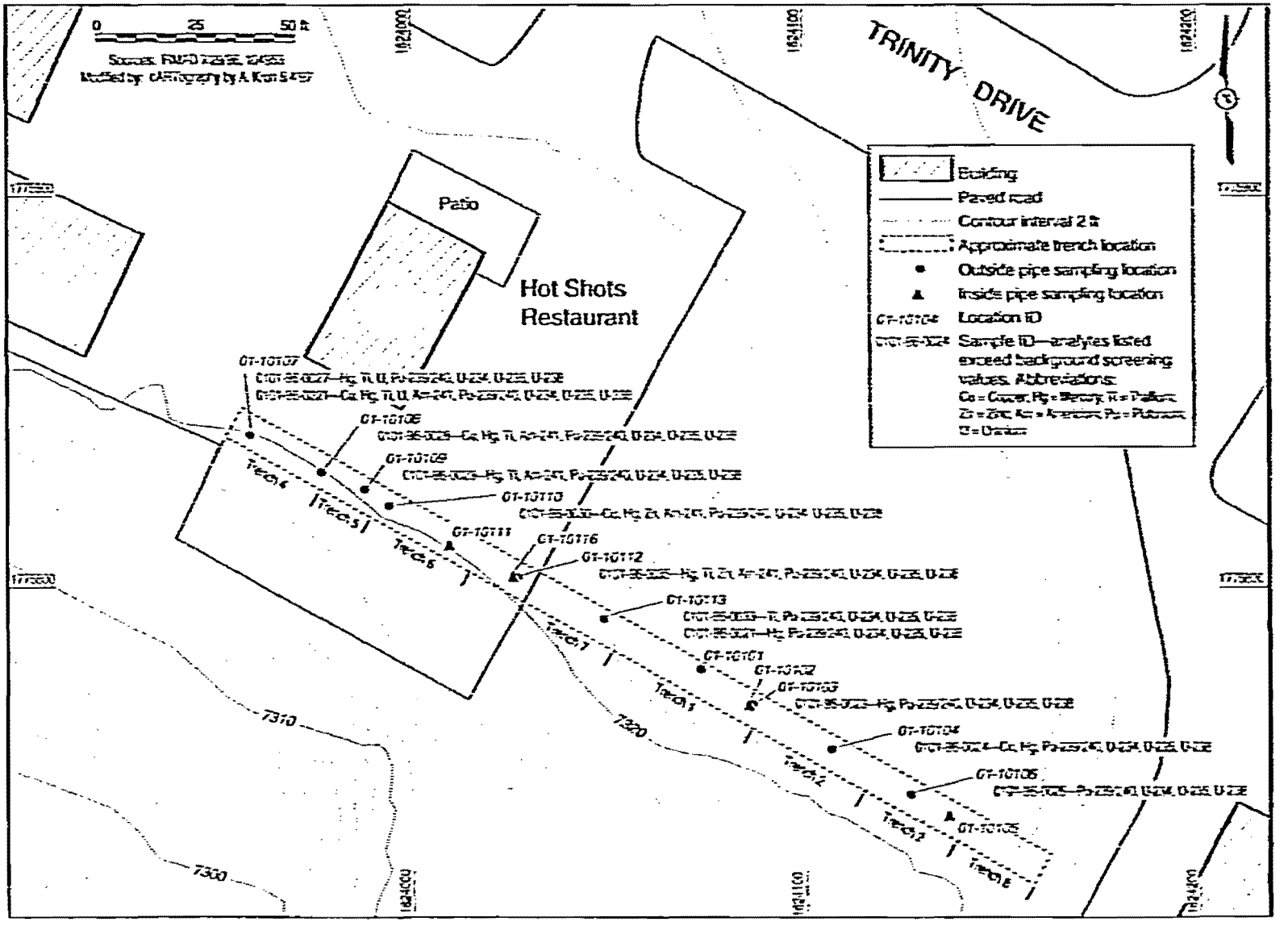


Fig. 5.1.5.2-1. Chemicals with concentrations above background screening values at Locations 10 and 11.

TABLE 5.1.5.2-1

STATISTICAL TESTS FOR BACKGROUND COMPARISONS AT AGGREGATE N, LOCATIONS 10 AND 11

ANALYTE	GEHAN TEST P-VALUE	QUANTILE TEST P-VALUE
Calcium	0.55	0.92
Copper	0.0044	0.0014
Zinc	0.017	0.0012

The results for calcium are indicative of site concentrations that are not statistically elevated above background. The results for copper and zinc are indicative of site concentrations that are greater than background.

Based on the background comparisons and further statistical tests conducted to compare site and background data, copper, mercury, thallium, uranium, 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 those four inorganics are shown in Table 5.1.5.2-2.

TABLE 5.1.5.2-2

INORGANICS WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT AGGREGATE N, LOCATIONS 10 and 11[a]

LOCATION ID	SAMPLE ID	DEPTH (ft bgs)	COPPER (mg/kg)	MERCURY (mg/kg)	THALLIUM (mg/kg)	URANIUM (mg/kg)	ZINC (mg/kg)
		UTL	15.5	0.1[b]	1[b]	5.45	50.8
		SAL	2 800	23	5.4	230	23 000
01-10101	0101-98-0021	13	4.8	0.12	1.5 (UJ)	3.6 [c]	23
01-10103	0101-98-0023	13	6	0.21	1.4 (UJ)	3.9 [c]	26
01-10104	0101-98-0024	12	21	1.5	1.4 (UJ)	3.5 [c]	29
01-10107	0101-98-0027	12.5	10 (J)	0.26 (J)	1.5	8.2 [c]	48
01-10108	0101-98-0028	12	16 (J)	0.6 (J)	1.4	2.6 [c]	43
01-10109	0101-98-0029	12.5	9.4 (J)	0.22 (J)	1.4	4.6 [c]	48
01-10110	0101-98-0030	13	29 (J-)	0.48 (J-)	1.4 (U)	3.3 [c]	89
01-10113	0101-98-0033	8	2.8 (J-)	0.11 (U)	1.4	2.3 [c]	21
01-10112	0101-98-0035	11.5	15 (J-)	0.68	1.5	2.3 [c]	56
01-10107	0101-98-0221	12.5	29 (J)	0.21 (J)	1.4	10.5 [c]	45

[a] The data qualifiers in this table are defined in Section 3.1.2. These qualifiers were assigned during baseline data validation. However, as discussed in Section 4.1.1, the data are considered usable for site-specific decisions.
[b] Value represents the maximum reported background concentration in soil.
[c] Value represents isotopic uranium data converted to total uranium data.

BOLDED concentrations are above background screening values.

5.1.5.3 Location 13

Three soil samples collected at Location 13 in February 1994 were analyzed for twelve inorganics (antimony, arsenic, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, and thallium). Ten soil samples collected outside the pipe in July 1994 were analyzed for the same twelve inorganics and an additional eleven inorganics (aluminum, calcium, cobalt, copper, iron, magnesium, manganese, potassium, sodium, vanadium, and zinc). In addition, the reported values for these 13 samples for isotopic uranium were converted to an estimate of total uranium. For this evaluation of inorganics, the highest detected value was used for samples where a laboratory duplicate was analyzed. Six inorganics (copper, lead, mercury, silver, uranium, and zinc) were detected at concentrations above their respective background screening values.

Further background comparisons were conducted for copper, lead, and zinc. Mercury, silver, and uranium were not subjected to further background comparisons because the background data for these metals are inadequate to support other statistical tests; therefore, mercury, silver, and uranium are carried forward to the screening assessment.

Similar to Locations 10 and 11, nonparametric tests were preferred for further background comparisons because the data for the other three metals (copper, lead, and zinc) do not appear to satisfy normality assumptions. As stated previously, the Gehan modification to the Wilcoxon Rank Sum test was used to assess complete shifts in distribution, whereas the Quantile test was used to assess partial shifts (Ryti et al. 1996, 1208). Observed significance levels (p-values) in at least one of these statistical tests for these tests are presented in Table 5.1.5.3-1. If a p-value is less than some small probability (0.05), then there is some reason to suspect that there is a difference between the background and site distributions; otherwise, no difference is indicated.

TABLE 5.1.5.3-1

STATISTICAL TESTS FOR BACKGROUND COMPARISONS AT AGGREGATE N, LOCATION 13

ANALYTE	GEHAN TEST P-VALUE	QUANTILE TEST P-VALUE
Copper	0.0001	0.0006
Lead	<0.00005	<0.00005
Zinc	0.0001	0.0047

The results for copper, lead, and zinc are indicative of site concentrations that are greater than background. Based on the background comparisons and further statistical tests conducted to compare site and background data, copper, mercury, lead, silver, uranium, and zinc are carried forward to the screening assessment. The data for these analytes are presented in Table 5.1.5.3-2.

TABLE 5.1.5.3-2

INORGANICS WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT AGGREGATE N, LOCATION 13[a]

LOCATION ID[b]	SAMPLE ID	DEPTH (ft bgs)	COPPER (mg/kg)	LEAD (mg/kg)	LEAD, SILVER (mg/kg)	SILVER (mg/kg)	URANIUM (mg/kg)	ZINC (mg/kg)
		UTL	15.6	23.3	0.1	n/a	5.45	50.8
		SAL	2 800	400	23	380	230	23 000
01-4105	AAA8267	4.75-5.75	NA	12	1.3	1(U)	2.4	NA
01-4105	AAA8269	4.75-5.75	NA	14	0.8	1(U)	2.4	NA
01-4109	AAA8272	5-0.5	NA	22.7	0.36	1.1(U)	7.3	NA
Reference 8	AAB7440	0-4	8.5	20.3	0.88	0.6(J)	3.8	38.1
Reference 9	AAC0517	0-4	6.8	22	1.4	0.60(U)	2.9	37.1
Reference 19	AAC0514	0-4	19.3	28.8	1.6	0.76(U)	6.9	44.3
Reference 20	AAC0516	0-4	6.9	18.5	6.7	0.81(U)	30.8	33.9
Reference 23	AAB7450	0-4	13.5	55.2	9.1	0.63(U)	4.2	144
Reference 24	AAB7438	0-4	29	30.1	0.91	0.65(U)	3.3	46.7
Reference 47	AAC2082	0-5	8.3	1 050	4.6(J)	0.22(U)	3.1	36.9(J)
Reference 50	AAC2085	0-5	10.1	1 030	1.4(J)	0.23(U)	2.9	42(J)
Reference 57	AAC2087	0-5	12.9	61.8	6	0.22(U)	3.7	70.4

[a] The data qualifiers in this table are defined in Section 3.1.2. These qualifiers were assigned during baseline data validation. However, as discussed in Section 4.1.1, the data are considered usable for site-specific decisions.

[b] In some cases, a reference number is listed in lieu of a location ID.

BOLDED concentrations are above background screening values.

5.1.5.4 Inside the Pipe

Ten soil samples from Location 1A, four soil samples from Locations 10 and 11, and nine soil samples from Location 13 collected inside the pipe were analyzed for inorganics. In addition, the reported values for these 23 samples for isotopic uranium were converted to an estimate of total uranium. Aluminum, magnesium, potassium, selenium, and sodium were the only inorganics that did not have any concentrations above background screening values. Nineteen inorganics (antimony, arsenic, barium, beryllium, calcium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, silver, thallium, uranium, vanadium, and zinc) have at least one concentration above their respective background screening values.

Further background comparisons were conducted for arsenic, barium, beryllium, calcium, chromium, cobalt, copper, iron, lead, manganese, nickel, vanadium, and zinc. Antimony, cadmium, mercury, silver, and thallium were not subjected to further background comparisons because the background data for these metals are inadequate to support other statistical tests; therefore, these inorganics are carried forward to the screening assessment.

Because the data for the other thirteen metals (arsenic, barium, beryllium, calcium, chromium, cobalt, copper, iron, lead, manganese, nickel, vanadium, and zinc) do not appear to satisfy normality assumptions, nonparametric tests were preferred for further background comparisons. The Gehan modification to the Wilcoxon Rank Sum test and the Quantile test were used for these evaluations (Ryti et al. 1996, 1998). Observed significance levels (p-values) for these tests are presented in Table 5.1.5.4-1. If a p-value is less than some small probability (0.05), then there is some reason to suspect that there is a difference between the background and site distributions; otherwise, no difference is indicated.

TABLE 5.1.5.4-1

STATISTICAL TESTS FOR BACKGROUND COMPARISONS AT AGGREGATE N, INSIDE THE PIPE

ANALYTE	GEHAN TEST P-VALUE	QUANTILE TEST P-VALUE
Arsenic	0.0148	0.0009
Barium	0.2825	0.2932
Beryllium	0.999	0.9664
Calcium	<0.00005	<0.00005
Chromium	0.0053	0.0002
Cobalt	0.3787	0.2866
Copper	<0.00005	<0.00005
Iron	0.0166	0.008
Lead	<0.00005	<0.00005
Manganese	0.8723	0.8077
Nickel	0.0001	<0.00005
Vanadium	0.3083	0.1147
Zinc	<0.00005	<0.00005

The results for barium, beryllium, cobalt, manganese, and vanadium are indicative of site concentrations that are not statistically elevated above background. The results for arsenic, calcium, chromium, copper, iron, lead, nickel, and zinc are indicative of site concentrations that are greater than background. Based on the background comparisons and further statistical tests conducted to compare site and background data, antimony, arsenic, cadmium, calcium, chromium, copper, iron, lead, mercury, nickel, silver, thallium, uranium, and zinc are carried forward to the screening assessment. The data for these analytes are presented in Table 5.1.5.4-2. Based on the results shown in Table 5.1.5.4-1, representative samples were collected from the investigation-derived wastes for waste classification purposes. These wastes were managed and disposed of in accordance with applicable regulations.

Based on the Table 5.1.5.4-2 results, the investigation derived wastes were representative sampled for waste classification and were managed and disposed according to the results per regulations.

TABLE 5.1.5.4-2

INORGANICS WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT AGGREGATE N, INSIDE THE PIPE

			SAL	31	n/a	5360	n/a	n/a	38	210	4560	2800
			UTL	Ta	7.82	315	1.55	6120	2.6a	19.3	19.2	15.5
Location	Location ID	Depth (ft bgs)	Sample ID	Antimony	Arsenic	Barium	Beryllium	Calcium	Cadmium	Chromium	Cobalt	Copper
1A	ref 7	4-6	AAB6083	0.51 Uc	2.3 Uc	106 c	0.53 Uc	NA	4.8 c	8.1 c	NA	NA
1A	ref 10	4.5-6.5	AAB6093	0.27 U	1.6 U	128	1.1 U	NA	0.56 U	8.1	NA	NA
1A	ref 12	3.5-5.5	AAB6088	0.31 U	2.2	151	0.77 U	NA	4.4	6.7	NA	NA
1A	ref 13	3.5-5.5	AAB6095	0.43 U	2.2 U	155	0.78 U	NA	3.8	8.3	NA	NA
1A	ref 3	3-5	AAB6094	9.4 U	9.9	202	1.1	NA	660	47.8	NA	NA
1A	ref 4	3-5.5	AAB6085	1.4 Uc	13.2 c	182 c	1.5 c	NA	6355 c	18.5 c	NA	NA
1A	ref 5	3-5.5	AAB6100	7.2 U	16.1	343	0.77 U	NA	95.1	172	NA	NA
1A	ref 6	4-6	AAB6084	6.5 U	14	309	0.6 U	NA	146	350	NA	NA
1A	ref 8	4-6	AAB6089	0.49 U	2.3	123	0.55 U	NA	12.6	7.3	NA	NA
13	ref 11	0-4	AAB6076	0.32 U	2.8	79	0.62 U	2920	1.7	8.7	24.2	57.2
13	ref 21	0-4	AAB6077	1.1 U	4	96.4	0.6 U	6510	4.5	12.5	20	181
13	ref 27	0-4	AAB6078	0.28 Uc	3.3 c	66.6 c	0.63 Uc	4130 c	2.8 c	10 c	4.1 Uc	43.2 c
13	ref 28	0-4	AAB6072	0.27 U	4.8	99.4	0.81 U	7280	4	13.1	9.2 U	376
13	ref 41	0-5	AAB6075	1.6 U	62.5	115	0.8 U	4910	1.6	34.9	14.6	264
13	ref 44	0-5	AAC2081	0.29 U	8.4	101	0.44 U	9810	0.41 U	5.2	4.4 U	17.2
13	ref 46	0-5	AAB6074	0.29 Uc	2.6 Uc	74.4 c	0.48 Uc	7237 c	0.15 Uc	3 c	2.6 Uc	8.1 c
13	ref 49	0-5	AAC2084	0.39 U	5	77.9	0.41 U	10400	0.2 U	4.6	3.1 U	21.4
13	ref 54	0-5	AAC2089	0.29 U	3.1	79	0.68 U	3590	0.2 U	3.6	3.5 U	19.6
9.10.11	01-10102	N/A	0101-96-0022	18 J-	23	290	2.7 U	6300	12	130	6.7	1600
9.10.11	01-10105	N/A	0101-96-0025	54 UJ	81	300	2.7 U	23000	120	120	9.1	5100
9.10.11	01-10111	N/A	0101-96-0031	63 UJ	71	150	3.1 UJ	5900	15	190 J-	7.4 J-	4500
9.10.11	01-10116	N/A	0101-96-0034	57 UJ	18	360	2.9	11000	24	150 J-	11 J-	4300 J-
1A	01-10115	N/A	0101-96-0035	11 UJ	18	140	0.69	3400	190	19	9.9	4100

TABLE 5.1.5.4-2 (continued)

INORGANICS WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT AGGREGATE N, INSIDE THE PIPE

			SAL	n/a	400	3200	23	1500	360	5.4	230	540	23000
			UTL	21300	23.3	714	0.1a	15.2	n/a b	1a	5.45	41.9	50.8
Location	Location ID	Depth (ft bgs)	Sample ID	Iron	Lead	Manganese	Mercury	Nickel	Silver	Thallium	Uranium	Vanadium	Zinc
1A	ref 7	4-6	AAB6083	NA	133 c	NA	12.1 c	24 c	1.1 U,c	0.21 U,c	18.3 d	NA	NA
1A	ref 10	4.5-6.5	AAB6093	NA	59.9	NA	16	7 U	1.9 U	0.21 U	46.1 d	NA	NA
1A	ref 12	3.5-5.5	AAB6088	NA	59.1	NA	1.7	19.3	0.64 U	0.21 U	10.2 d	NA	NA
1A	ref 13	3.5-5.5	AAB6095	NA	66	NA	1.9	16.7	0.63 U	0.21 U	11.7 d	NA	NA
1A	ref 3	3-5	AAB6094	NA	8070	NA	542	139	103	0.22 U	1147 d	NA	NA
1A	ref 4	3-5.5	AAB6085	NA	1759 c	NA	46.5 c	75.6 c	9.3 c	0.38 U,c	349 d	NA	NA
1A	ref 5	3-5.5	AAB6100	NA	7340	NA	117	116	143	0.57 U	289 d	NA	NA
1A	ref 6	4-6	AAB6084	NA	9080	NA	990	234	114	0.76 U	627 d	NA	NA
1A	ref 8	4-6	AAB6089	NA	126	NA	11.2	15	0.72 U	0.21 U	19.3 d	NA	NA
13	ref 11	0-4	AAB6076	9600	29.6	250	36.9	7.4 U	1 U	1 U	135 d	14.3	98.4
13	ref 21	0-4	AAB6077	13700	179	349	196	12.8	2.5	0.98 U	309 d	18.3	184
13	ref 27	0-4	AAB6078	10459 c	32.3 c	245 c	19.9 c	6.9 U,c	9.3 c	1.46 U,c	20.3 d	13.2 c	61.9 c
13	ref 28	0-4	AAB6072	15100	190	337	155	11.9	2.5	0.66 U	98 d	17.9	178
13	ref 41	0-5	AAB6075	150	265	926	59.4	23.5	2.1 U	0.9 U	165 d	50.6	243
13	ref 44	0-5	AAC2081	22500	74.8	280	7.4	6.8 U	0.66 U	0.91 U	5.6 d	18.8	60.9
13	ref 46	0-5	AAB6074	10229 c	45.1 c	202 c	0.94 c	4.5 U,c	0.34 U,c	0.91 U,c	6.1 d	13.4 c	46.3 c
13	ref 49	0-5	AAC2084	16800	1750	227	1.5	6.5 U	5.4	0.9 U	3.9 d	15.2	53.3
13	ref 54	0-5	AAC2088	10400	83.2	233	31.5	6 U	0.22 U	0.92 U	3.3 d	14.4	84.2
9,10,11	01-10102	N/A	0101-96-0022	130000	2700	230	240	35	16	1.4 W	16.6 d	59	1200
9,10,11	01-10105	N/A	0101-96-0025	110000	4000	310	730	190	69	1.3 W	112 d	45	7500
9,10,11	01-10111	N/A	0101-96-0031	210000	830	260	86	35 J-	13 U	1.6	42.6 d	140	1300
9,10,11	01-10116	N/A	0101-96-0034	140000	3800	470	0.64	110 J-	110 J-	1.4	44.7 d	62	2000
1A	01-10115	N/A	0101-96-0036	12000	1600 J+	220	26	240	21 W	1.4 W	267 d	18	810

All results are in mg/kg.
a Value represents the maximum reported background in soil.
b NA = Not available. Detection limit is used as a background screening value for silver.
c Value represents the maximum of a sample concentration and its laboratory duplicate.
d Value represents isotopic uranium data converted to total uranium data.

ref is the reference number for the samples along the pipe (see reference numbers in field summary report tables.)
BOLDED numbers are above UTL.
Outlined cells are numbers above SAL.

5.1.6 Evaluation of Radionuclides

5.1.6.1 Location 1A

Four soil samples collected at Location 1A in February 1994 were analyzed for isotopic plutonium and isotopic uranium. Four additional soil samples were collected outside the pipe in July 1994. Three of these samples were analyzed for isotopic plutonium and isotopic uranium. The fourth sample was only analyzed for tritium. One additional confirmation soil sample collected outside the pipe at Location 1A in June 1996 was analyzed for isotopic plutonium, isotopic uranium, americium-241, and cesium-137. For this evaluation of radionuclides, the highest detected value was used for samples where a laboratory duplicate was analyzed. Seven radionuclides (americium-241, plutonium-238, plutonium-239/240, tritium, uranium-234, uranium-235, and uranium-238) were detected above their respective background screening values. These seven radionuclides 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 seven radionuclides are shown in Table 5.1.6.1-1.

5.1.6.2 Locations 10 and 11

Eleven confirmation samples collected outside the pipe at Locations 10 and 11 in June 1996 were analyzed for americium-241, cesium-137, isotopic plutonium, and isotopic uranium. Americium-241, plutonium-239/240, uranium-234, uranium-235, and uranium-238 were detected above background screening values. The data for these radionuclides are presented in Table 5.1.6.2-1. These seven radionuclides are carried forward to the screening assessment.

TABLE 5.1.6.1-1

RADIONUCLIDES WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT AGGREGATE N, LOCATION 1A[a]

LOCATION ID[b]	SAMPLE ID	DEPTH (ft bgs)	AMERICIUM-241 (pCi/g)	PLUTONIUM-238 (pCi/g)	TRITIUM (pCi/g)	PLUTONIUM-239/240/240 (pCi/g)	URANIUM-234 (pCi/g)	URANIUM-235 (pCi/g)	URANIUM-238 (pCi/g)
		UTL	n/a[c]	n/a[c]	n/a[c]	n/a[c]	n/a[c]	n/a[c]	n/a[c]
		SAL	22	27	260	24	13	10	67
Reference 11	AAB6090	4.5-6.5	NA[d]	0.06	NA	19.1	62.4	2.61	8.72
Reference 10	AAB6091	4.5-6.5	NA	0.06	NA	12.4	20.4	1	8.61
Reference 14	AAB6092	3.5-5.5	NA	0.01	NA	2.5	1.9	0.1	1.62
Reference 15	AAB6087	3.5-5.5	NA	NA	0.066	NA	NA	NA	NA
01-4124	AAA6311	5.0-6.0	NA	1.04	NA	1.4	1.42	-0.010 (U)	1.32
01-4144	AAA6273	0.5-4.0	NA	0.41[e]	NA	1.53[e]	25.9[e]	4.22[e]	17.6[e]
01-4145	AAA6265	0.5-4.5	NA	0.06	NA	0.65	2.25	0.171	1.81
01-4147	AAA6270	0.5-4.5	NA	0.09	NA	-0.082 (U)	1.38	0.024	1.06
01-10114	0101-96-0032	6	202 (J) [e]	0.07[e]	NA	10.1[e]	13.4[e]	0.48[e]	5.47[e]

[a] The data qualifiers in this table are defined in Section 3.1.2. These qualifiers were assigned during baseline data validation. However, as discussed in Section 4.1.3, the data are considered usable for site-specific decisions.

[b] In some cases, a reference number is listed in lieu of a location ID.

[c] Minimum detectable activity used as a background screening value.

[d] NA = Not analyzed.

[e] Value represents the maximum of a sample and its laboratory duplicate.

n/a = Not available.

BOLDED concentrations are above background screening values.

TABLE 5.1.6.2-1

RADIONUCLIDES WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT AGGREGATE N, LOCATIONS 10 AND 11[a]

LOCATION ID	SAMPLE ID	DEPTH (ft bgs)	AMERICIUM-241 (pCi/g)	PLUTONIUM-239/240 (pCi/g)	URANIUM-234 (pCi/g)	URANIUM-235 (pCi/g)	URANIUM-238 (pCi/g)
		UTL	n/a[b]	n/a[b]	n/a[b]	n/a[b]	n/a[b]
		SAL	22	24	13	10	67
01-10101	0101-96-0021	13	-0.038 (U)[c]	0.109[c]	1.23[c]	0.07[c]	1.19[c]
01-10103	0101-96-0023	13	-0.021 (U)	0.444	1.25	0.05	1.31
01-10104	0101-96-0024	12	0.139 (U)[c]	0.69[c]	1.12[c]	0.08[c]	1.18[c]
01-10106	0101-96-0026	11	-0.079 (U)	0.02	0.62	0.03	0.78
01-10107	0101-96-0027	12.5	0.195 (U)[c]	1.2 (J)	2.69	0.15	2.74
01-10108	0101-96-0028	12	0.178	1.66 (J)	1.57	0.07	0.65
01-10109	0101-96-0029	12.5	0.094	2.65 (J)	1.5	0.04	1.54
01-10110	0101-96-0030	13	1.13	4.33[c]	1.77[c]	0.06[c]	1.11[c]
01-10113	0101-96-0033	8	-0.048 (U)	0.14	0.74	0.04	0.77
01-10112	0101-96-0035	11.5	0.15	3.09	1.19	0.05	0.75
01-10107	0101-96-0221	12.5	0.143	0.91 (J)[c]	3.33[c]	0.15[c]	3.51[c]

[a] The data qualifiers in this table are defined in Section 3.1.2. These qualifiers were assigned during baseline data validation. However, as discussed in Section 4.1.1, the data are considered usable for site-specific decisions.

[b] Minimum detectable activity used as a background screening value.

[c] Value represents the maximum of a sample concentration and its laboratory duplicate.

BOLDED concentrations are above background screening values.

5.1.6.3 Location 13

Three soil samples collected at Location 13 in February 1994 were analyzed for isotopic plutonium and isotopic uranium. Ten soil samples collected outside the pipe in November/ December 1994 were analyzed for isotopic plutonium, isotopic uranium, and cesium-137. The spectra for these ten soil samples were also reviewed for americium-241 peaks (see Section 4.1.3 of this report). Six soil samples collected outside the pipe in November/December 1994 were also analyzed for tritium. Seven radionuclides (americium-241, plutonium-238, plutonium-239/240, tritium, uranium-234, uranium-235, and uranium-238) were detected above background screening values in at least one sample. Therefore, these seven radionuclides are carried forward to the screening assessment. The data for each sample that had at least one detected concentration above background screening values for these radionuclides are presented in Table 5.1.6.3-1.

5.1.6.4 Inside the Pipe, Location 13

Ten soil samples from Location 1A, four soil samples from Locations 10 and 11, and nine samples from Location 13 were analyzed for isotopic plutonium and isotopic uranium. One sample at Location 1A and four samples at Locations 10 and 11 were also analyzed for americium-241 and cesium-137. The nine soil samples collected at Location 13 were analyzed for cesium-137. These spectra were also reviewed for americium-241 peaks (see Section 4.1.3). One soil sample from Location 1A was analyzed for tritium only.

Eight radionuclides (americium-241, cesium-137, plutonium-238, plutonium-239/240, tritium, uranium-234, uranium-235, uranium-238) were detected above background screening values in at least one sample. Therefore, these eight radionuclides are carried forward to the screening assessment. The data for each sample that had at least one detected concentration above background screening values for these radionuclides are presented in Table 5.1.6.4-1.

TABLE 5.1.6.3-1

RADIONUCLIDES WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT AGGREGATE N, LOCATION 13[a]

LOCATION ID[b]	SAMPLE ID	DEPTH (Ft bgs)	AMERICIUM-241 (pCi/g)	PLUTONIUM-238 (pCi/g)	PLUTONIUM-239/240 (pCi/g)	TRITIUM (pCi/g)	URANIUM-234 (pCi/g)	URANIUM-235 (pCi/g)	URANIUM-238 (pCi/g)
		UTL	n/a[c]	n/a[c]	n/a[c]	n/a[c]	n/a[c]	n/a[c]	n/a[c]
		SAL	22	27	24	260	13	10	67
01-4105	AAAS269	4.75-5.75	NA[e]	0.009	0.167	NA	1.07	0.032	0.802
01-4109	AAAS272	5-6.5	NA	-0.005 (U)	4.39	NA	3.86 (J)[d]	0.196 (J)[d]	2.43 (J)[d]
Reference 6	AAS7440	0-4	ND[f]	0.009	0.421	0.05 (U)	1.57 (J)	0.081 (J)	1.25 (J)
Reference 9	AAC0517	0-4	ND	0.002	1.45	0.009 (U)	1.23 (J)	0.086 (J)	0.973 (J)
Reference 19	AAC0514	0-4	ND	-0.004 (U)	0.565	0.002 (U)	2.42 (J)	0.097 (J)	2.29 (J)
Reference 20	AAC0516	0-4	ND	0.009	0.164	0.005 (U)	10.23 (J)	0.428 (J)	10.3 (J)
Reference 23	AAS7450	0-4	ND	0.034	9.7	0.072	3.002 (J)	0.113 (J)	1.41 (J)
Reference 24	AAS7438	0-4	ND	0 (U)	0.626	0.228	1.41 (J)	0.045 (J)	1.1 (J)
Reference 40	AAE6071	0-5	ND	-0.004 (U)	0.14	NA	1.76	0.08	1.5
Reference 47	AAC2082	0-5	ND	0.009	2.11	NA	1.72	0.079	1.02
Reference 50	AAC2085	0-5	ND	0.029	3.42	NA	1.17	0.047	0.966
Reference 57	AAC2087	0-5	0.013	0.165[d]	75.6[d]	NA	1.49[d]	0.098[d]	1.23[d]

[a] The data qualifiers in this table are defined in Section 3.1.2. These qualifiers were assigned during baseline data validation. However, as discussed in Section 4.1.3, the data are considered usable for site-specific decisions.

[b] In some cases, a reference number is listed in lieu of a location ID.

[c] Minimum detectable activity used as a background screening value.

[d] Value represents the maximum of a sample concentration and its laboratory duplicate.

[e] NA = Not analyzed.

[f] ND = Not detected. This was determined by review of the spectra for americium-241. See Section 4.0 of this report for details.

BOLDED concentrations are above background screening values.

TABLE 5.1.6.4-1

RADIONUCLIDES WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT AGGREGATE N, INSIDE THE PIPE

LOCATION	LOCATION ID	DEPTH (ft bgs)	SAMPLE ID	AMERICIUM-241	CESIUM-137	PLUTONIUM-238	PLUTONIUM-239/240	TRITIUM	WATER (UNBOUND)	URANIUM-234	URANIUM-235	URANIUM-238
			SAL	22	5.1	27	24	260	n/a	13	10	67
			UTL	n/a a	n/a a	n/a a	n/a a	n/a a	n/a	n/a a	n/a a	n/a [a]
1A	ref 7 [c]	4-6	AAB6083	NA	NA	0.028	6.529	NA	NA	11.56	0.4	6.06
1A	ref 1	3-5	AAB6098	NA	NA	NA	NA	0.13865	12.3	NA	NA	NA
1A	ref 10	4.5-6.5	AAB6093	NA	NA	0.1 b	17.06 b	NA	NA	31.36	1.2	15.32
1A	ref 12	3.5-5.5	AAB6088	NA	NA	0.015	6.523	NA	NA	6.83	0.27	3.37
1A	ref 13	3.5-5.5	AAB6095	NA	NA	0.022	5.876	NA	NA	5.27	0.2	3.91
1A	ref 3	3-5	AAB6094	NA	NA	0.081	20.455	NA	NA	551.84	23.78	361.91
1A	ref 4	3-5.5	AAB6085	NA	NA	3.43 b	774.72 b	NA	NA	266.02	11.98	115.39
1A	ref 5	3-5.5	AAB6100	NA	NA	0.23 b	46.54 b	NA	NA	135.36	6.3*	96.16
1A	ref 6	4-6	AAB6084	NA	NA	0.09 b	27.35 b	NA	NA	335.62	14.07	208.66
1A	ref 8	4-6	AAB6089	NA	NA	0.023	5.605	NA	NA	12.56	0.55	6.41
13	ref 11	0-4	AAB6076	NA	0.011 b	0.014 b	16.55 b	NA	NA	56.51 b	2.44 b	55.24 [b]
13	ref 21	0-4	AAB6077	NA	-0.048 (U)	0.315	79.727	NA	NA	105.011	4.169	103.061 [c]
13	ref 27	0-4	AAB6078	NA	0.055	0.011 b	4.869 b	NA	NA	9.27 b	0.459 b	6.78 b
13	ref 28	0-4	AAB6072	NA	0.25	0.218	74.568	NA	NA	40.64	1.937	32.651
13	ref 44	0-5	AAC2081	NA	0.026	0.063	15.11	NA	NA	7.516	0.221	1.863
13	ref 46	0-5	AAB6074	NA	0.029	0.02 b	5.72 b	NA	NA	4.23 b	0.178 b	2.02 b [c]
13	ref 49	0-5	AAC2084	NA	0.011	0.029	8.349	NA	NA	1.462	0.074	1.309
13	ref 54	0-5	AAC2088	NA	0.256	0.036	6.356	NA	NA	1.414	0.07	1.092

*This figure is not an outlined cell. The effect is caused by surrounding cells which are outlined.

TABLE 5.1.6.4-1 (continued)

RADIONUCLIDES WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT AGGREGATE N, INSIDE THE PIPE

LOCATION	LOCATION ID	DEPTH (ft bgs)	SAMPLE ID	AMERICIUM-241	CESIUM-137	PLUTONIUM-238	PLUTONIUM-239/240	TRITIUM	WATER (UNBOUND)	URANIUM-234	URANIUM-235	URANIUM-238
			SAL	22	5.1	27	24	260	n/a	13	10	67
			UTL	n/a a	n/a a	n/a a	n/a a	n/a a	n/a	n/a a	n/a a	n/a [a]
9,10,11	01-10105	N/A	0101-96-0025	21.5	4.67	11.7	1515	NA	NA	510	16.7	34.9
9,10,11	01-10111	N/A	0101-96-0031	87.6	5.25	1.14	228	NA	NA	162	6.5	13.3
9,10,11	01-10116	N/A	0101-96-0034	15.5	2.5	2.2	503	NA	NA	229	7.7	13.8
1A	01-10115	N/A	0101-96-0036	0.272	0.471	0.03	3.28	NA	NA	145	5.01	69

[a] This figure is not an outlined cell. The effect is caused by surrounding cells which are outlined.

5.1.7 Evaluation of Organics

5.1.7.1 Location 1A

Four soil samples collected at Location 1A in February 1994 were analyzed for SVOCs, pesticides, and PCBs. Two of these samples were also analyzed for VOCs. One additional confirmation sample collected outside the pipe at Location 1A in June 1996 was analyzed for SVOCs. Eight organic chemicals (Aroclor-1254™, alpha-chlordane, p,p'-DDD, dieldrin, diethyl phthalate, Endosulfan II, heptachlor epoxide, and 4-methyl-2-pentanone) were detected in these samples. The data for each sample that had at least one detect of these organic chemicals are shown in Table 5.1.7.1-1. These eight organic chemicals are carried forward to the screening assessment.

5.1.7.2 Locations 10 and 11

Eleven confirmation samples collected at Locations 10 and 11 in June 1996 were analyzed for SVOCs. No organic chemicals were detected in these samples. Therefore, no organic chemicals are carried forward to the screening assessment.

5.1.7.3 Location 13

Two soil samples collected at Location 13 in February 1994 were analyzed for SVOCs, VOCs, pesticides, and PCBs. Nine soil samples collected outside the pipe in July 1994 were analyzed for SVOCs, pesticides, and PCBs. Four organic chemicals (benzo[a]anthracene, chrysene, fluoranthene, and pyrene) were detected in at least one sample. The data for each sample that had at least one detect of these organic chemicals are shown in Table 5.1.7.3-1. These four organic chemicals are carried forward to the screening assessment.

TABLE 5.1.7.1-1

ORGANICS WITH DETECTED CONCENTRATIONS AT AGGREGATE N, LOCATION 1A[a]

LOCATION ID	SAMPLE ID	DEPTH (ft bgs)	AROCLOR-1254 (mg/kg)	CHLORDANE [ALPHA-] (mg/kg)	p,p'-DDD (mg/kg)	DIELDRIN (mg/kg)	DIETHYL PHTHALATE (mg/kg)	ENDOSULFAN II (mg/kg)	HEPTACHLOR EPOXIDE (mg/kg)	4-METHYL-2-PENTANONE (mg/kg)
		SAL	0.1	0.34	1.9	0.028	52 000	390	0.049	770
01-4124	AAA6311	5.0-6.0	0.036 (U)	0.002 (U)	0.004 (U)	0.004 (U)	2.7	0.004 (U)	0.002 (U)	NA[b]
01-4144	AAA6273	0.5-4.0	0.663	0.012 (J)	0.005 (J)	0.017 (J)	0.34 (U)	0.006 (J)	0.002 (U)	NA
01-4147	AAA6270	0.5-4.5	0.036 (U)	0.002 (U)	0.004 (U)	0.004 (U)	0.38 (U)	0.004 (U)	0.002 (U)	0.04

[a] The data qualifiers in this table are defined in Section 3.1.2. These qualifiers were assigned during baseline data validation. However, as discussed in Section 4.1.2, the data are considered usable for site-specific decisions.
[b] NA = Not analyzed.

BOLDED concentrations are above detection limits.

TABLE 5.1.7.3-1

ORGANICS WITH DETECTED CONCENTRATIONS AT AGGREGATE N, LOCATION 13[a]

LOCATION ID[b]	SAMPLE ID	DEPTH (ft bgs)	BENZO[A] ANTHRACENE (mg/kg)	CHRYSENE (mg/kg)	FLUORANTHENE (mg/kg)	PYRENE (mg/kg)
		SAL	0.61	61	2 600	1900
Reference 40	AAB6071	0-5	0.36 (UJ)	0.36 (UJ)	0.36 (UJ)	0.38 (J)
Reference 57	AAC2087	0-5	0.43	0.52	0.64	0.63

[a] The data qualifiers in this table are defined in Section 3.1.2. These qualifiers were assigned during baseline data validation. However, as discussed in Section 4.1.2, the data are considered usable for site-specific decisions.
[b] The reference number is listed in lieu of a location ID.

BOLDED concentrations are above background screening values.

5.1.7.4 Inside the Pipe

One soil sample from Location 1A, four soil samples from Locations 10 and 11, and nine soil samples from Location 13 were analyzed for SVOCs. The eight soil samples from Location 13 were also analyzed for pesticides and PCBs. Twenty-two organics (acenaphthene, acenaphthylene, anthracene, Aroclor-1254™, Aroclor-1260™, benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[g,h,i]perylene, benzo[k]fluoranthene, bis(2-ethylhexyl)phthalate, chrysene, 1,4-dichlorobenzene, dibenzo[a,h]anthracene, di-n-butylphthalate, fluoranthene, fluorene, heptachlor epoxide, indeno[1,2,3-cd]pyrene, phenanthrene, phenol, and pyrene) were detected in at least one sample. The data for each sample that had at least one detect of these organic chemicals are shown in Table 5.1.7.4-1. These twenty-two organic chemicals are carried forward to the screening assessment.

5.1.8 Risk-Based Screening Assessment

5.1.8.1 Location 1A

Twenty-one chemicals were carried forward from the evaluations of organic, radionuclide, and inorganic chemicals. Three of these chemicals (americium-241, Aroclor-1254™, and uranium-234) were detected at concentrations greater than SAL at one or more locations, as shown in Tables 5.1.8.1-1 and 5.1.8.1-2 and on Figs. 5.1.8.1-1, 5.1.8.1-2, and 5.1.8.1-3.

The data qualifiers shown in Table 5.1.8.1-2 have been assigned during baseline data validation. However, as discussed in Section 4.1.3, the data are considered usable for site-specific decisions.

TABLE 5.1.7.4-1

ORGANICS WITH DETECTED CONCENTRATIONS AT AGGREGATE N, INSIDE THE PIPE

LOCATION ID	LOCATION ID	DEPTH (ft bgs)	SAMPLE ID	ACENAPHTHENE	ACENAPHTHYLENE	ANTHRACENE	AROCLOR-1254	AROCLOR-1260	BENZO[A] ANTHRACENE	BENZO[A] PYRENE	BENZO [B] FLUORANTHENE
			SAL	2200	n/a	16000	0.1	0.1	0.61	0.061	0.61
13	ref 11	0-4	AAB6076	<0.41	<0.41	<0.41	0.0556	<0.0265	<0.41	<0.41	<0.41
13	ref 21	0-4	AAB6077	<0.4	<0.4	<0.4	0.039	<0.0263	<0.4	<0.4	<0.4
13	ref 27	0-4	AAB6078	<0.37	<0.37	<0.37	<0.0238	<0.0238	<0.37	<0.37	<0.37
13	ref 28	0-4	AAB6072	<0.34	<0.34	<0.34	0.0559	0.0431	1.4	1.1	1.4
13	ref 41	0-5	AAB6075	0.51	0.99	4.6	<0.352	<0.352	<0.35	21	26
13	ref 46	0-5	AAB6074	<0.36	<0.36	<0.36	<0.182	<0.182	1.3	0.95	1.1
13	ref 49	0-5	AAC2084	<0.37	<0.37	<0.37	<0.184	<0.184	2.3	3.1	2.6
13	ref 54	0-5	AAC2088	<0.37	<0.37	<0.37	<0.183	<0.183	1.7	1.4	1.6
10,11	01-10102	N/A	0101-96-0022	<1.1	<1.1	<1.1	NA	NA	<1.1	<1.1	<1.1
10,11	01-10105	N/A	0101-96-0025	<1.1	<1.1	<1.1	NA	NA	<1.1	<1.1	<1.1
10,11	01-10111	N/A	0101-96-0031	<1.2	<1.2	<1.2	NA	NA	<1.2	<1.2	<1.2
10,11	01-10116	N/A	0101-96-0034	<1.3	<1.3	<1.3	NA	NA	<1.3	<1.3	<1.3
1A	01-10115	N/A	0101-96-0035	<0.19	<0.19	<0.19	NA	NA	<0.19	<0.19	<0.19

TABLE 5.1.7.4-1 (continued)

ORGANICS WITH DETECTED CONCENTRATIONS AT AGGREGATE N, INSIDE THE PIPE

LOCATION ID	LOCATION ID	DEPTH (ft bgs)	SAMPLE ID	BENZO [G,H,I]PERYLENE	BENZO (K)FLUORANTHENE	BIS(2-ETHYLHEXYL) PHTHALATE (mg/kg)	CHRYSENE	1,4-DICHLOROBENZENE	DIBENZO [A,H]ANTHRACENE
			SAL	n/a	6.1	32	61	3.6	0.061
13	ref 11	0-4	AAB6076	<0.41	<0.41	<0.41	<0.41	<0.41	<0.41
13	ref 21	0-4	AAB6077	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
13	ref 27	0-4	AAB6078	<0.37	<0.37	<0.37	<0.37	<0.37	<0.37
13	ref 28	0-4	AAB6072	0.55	1.5	<0.34	1.4	<0.34	<0.34
13	ref 41	0-5	AAB6075	2.9	18	<0.35	<0.35	<0.35	2.7
13	ref 46	0-5	AAB6074	0.54	1	<0.36	1.5	<0.36	<0.36
13	ref 49	0-5	AAC2084	1.7	2.6	<0.37	2.3	<0.37	0.79
13	ref 54	0-5	AAC2088	0.65	1.2	<0.37	1.9	<0.37	<0.37
10,11	01-10102	N/A	0101-96-0022	<1.1	<1.1	<1.1	<1.1	2.2	<1.1
10,11	01-10105	N/A	0101-96-0025	<1.1	<1.1	<1.1	<1.1	2.7	<1.1
10,11	01-10111	N/A	0101-96-0031	<1.2	<1.2	<1.2	1.3	3.1	<1.2
10,11	01-10116	N/A	0101-96-0034	<1.3	<1.3	<1.3	<1.3	4	<1.3
1A	01-10115	N/A	0101-96-0036	<0.19	<0.19	0.31	<0.19	<0.19	<0.19

TABLE 5.1.7.4-1 (continued)

ORGANICS WITH DETECTED CONCENTRATIONS AT AGGREGATE N, INSIDE THE PIPE

LOCATION ID	LOCATION ID	DEPTH (FT BGS)	SAMPLE ID	DI-N-BUTYLPHTHALATE	FLUORANTHENE	FLUORENE	HEPTACHLO-EPOXIDE	INDENO [1,2,3CD] PYRENE	PHENANTHRENE	PHENOL	PYRENE
			SAL	65000	2600	2300	0.049	0.61	n/a	39000	1900
13	ref 11	0-4	AAB6076	<0.41	<0.41	<0.41	<0.0339	<0.41	<0.41	<0.41	<0.41
13	ref 21	0-4	AAB6077	<0.4	<0.4	<0.4	<0.0335	<0.4	<0.4	<0.4	<0.4
13	ref 27	0-4	AAB6078	<0.37	<0.37	<0.37	<0.0305	<0.37	<0.37	<0.37	<0.37
13	ref 28	0-4	AAB6072	<0.34	2.3	<0.34	<0.0286	0.65	0.59	<0.34	1.6
13	ref 41	0-5	AAB6075	<0.35	52	0.94	0.0164	4.9	19	0.46	44
13	ref 46	0-5	AAB6074	<0.36	1.5	<0.36	<0.00938	0.7	<0.36	<0.36	1.2
13	ref 49	0-5	AAC2084	<0.37	1.8	<0.37	<0.00947	2.2	0.4	<0.37	1.5
13	ref 54	0-5	AAC2088	<0.37	2.7	<0.37	<0.00945	0.61	0.47	<0.37	2.3
10,11	01-10102	N/A	0101-96-0022	1.5	<1.1	<1.1	NA	<1.1	<1.1	<1.1	<1.1
10,11	01-10105	N/A	0101-96-0025	<1.1	<1.1	<1.1	NA	<1.1	<1.1	<1.1	<1.1
10,11	01-10111	N/A	0101-96-0031	<1.2	<1.2	<1.2	NA	<1.2	<1.2	<1.2	<1.2
10,11	01-10116	N/A	0101-96-0034	<1.3	<1.3	<1.3	NA	<1.3	<1.3	<1.3	<1.3
1A	01-10115	N/A	0101-96-0036	<0.19	<0.19	<0.19	NA	<0.19	<0.19	<0.19	<0.19

DOE-OSOU-4.1

TABLE 5.1.8.1-1

AGGREGATE N, LOCATION 1A CARCINOGENS WITH CONCENTRATIONS IN SOIL THAT EXCEED SALS

SAMPLE ID	LOCATION ID/ REFERENCE NO.	DEPTH (ft bgs)	AROCLOR-1254
SAL	N/A[a]	N/A	0.1
AAA8273	01-4144	0.5-4.0	0.003

[a] N/A = not applicable

Values in BOLD are above SALs.

TABLE 5.1.8.1-2

AGGREGATE N, LOCATION 1A RADIONUCLIDES WITH CONCENTRATIONS IN SOIL THAT EXCEED SALS

SAMPLE ID	LOCATION ID[b]	DEPTH (ft bgs)	AMERICIUM-241 (pCi/g)	URANIUM-234 (PCI/G)
SAL	N/A[a]	N/A	22	13
AAB0090	Rel 11	4.5-6.5	NA[d]	02.4[e]
AAB0091	Rel 10	4.5-6.5	NA	20.4[e]
AAA8273	01-4144	0.5-4.0	NA	25.9[e]
0101-96-0032	01-10114	0.0	202[f] (J)	13.4[e]

[a] The data qualifiers in this table are defined in Section 3.1.2.
[b] In some cases, a reference number is listed in lieu of a location ID.
[c] N/A = not applicable.
[d] NA = not analyzed.
[e] Value represents total uranium data converted to isotopic uranium data.
[f] Value represents the maximum of a sample concentration and its laboratory duplicate.

Values in BOLD are above SALs.

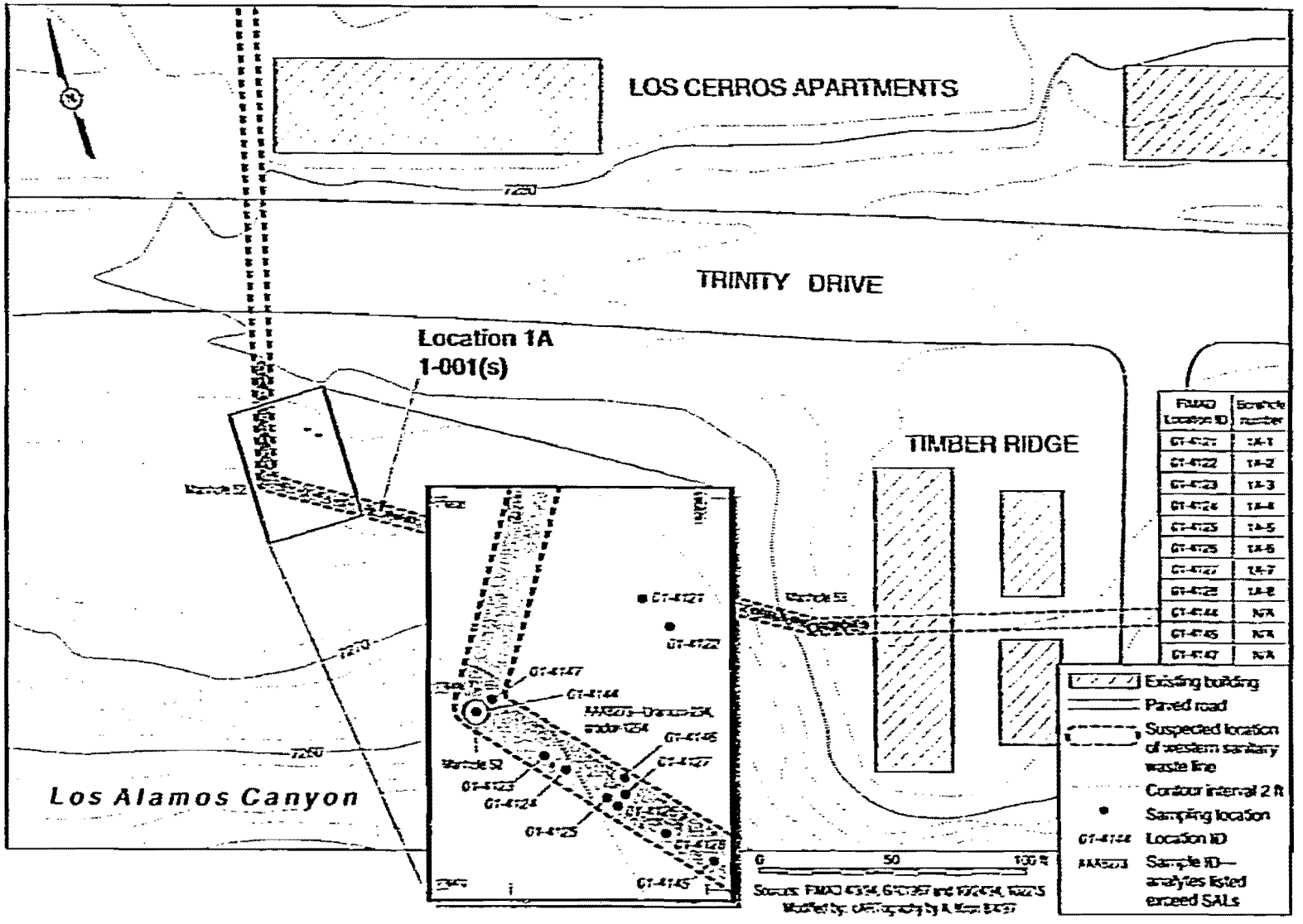
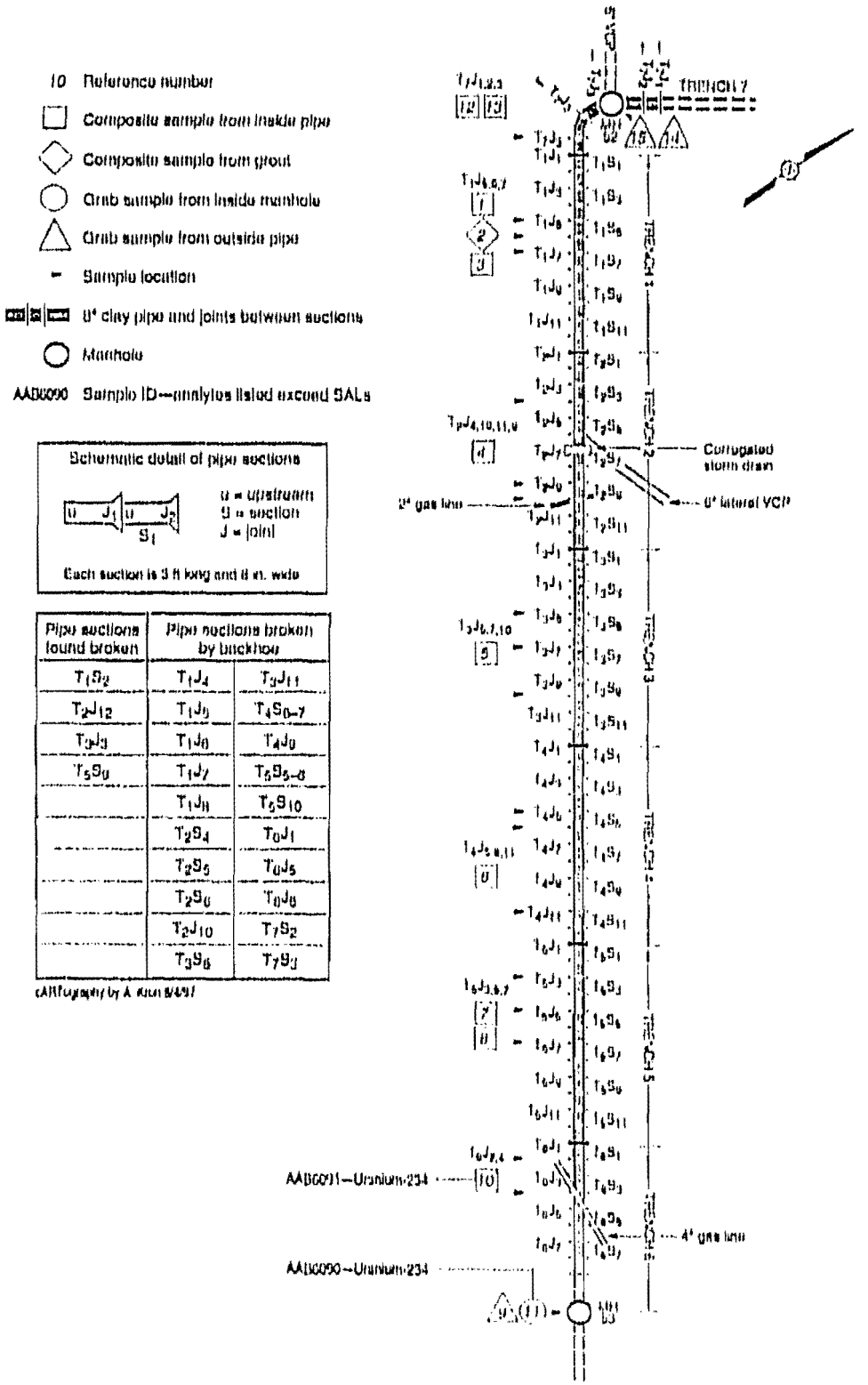


Fig. 5.1.8.1-1. Chemicals with concentrations above screening action levels at Location 1A.



Pipe sections found broken	Pipe sections broken by backhoe	
T_1S_2	T_1J_4	T_3J_{11}
T_2J_{12}	T_1J_5	T_4S_{0-7}
T_3J_3	T_1J_6	T_4J_9
T_5S_9	T_1J_7	T_5S_{5-8}
	T_1J_8	T_5S_{10}
	T_2S_4	T_6J_1
	T_2S_5	T_6J_5
	T_2S_6	T_6J_6
	T_2J_{10}	T_7S_2
	T_3S_6	T_7S_3

(All figures by A. Kumar/ERT)

Fig. 5.1.8.1-2. Chemicals with concentrations above screening action levels at Location 1A.

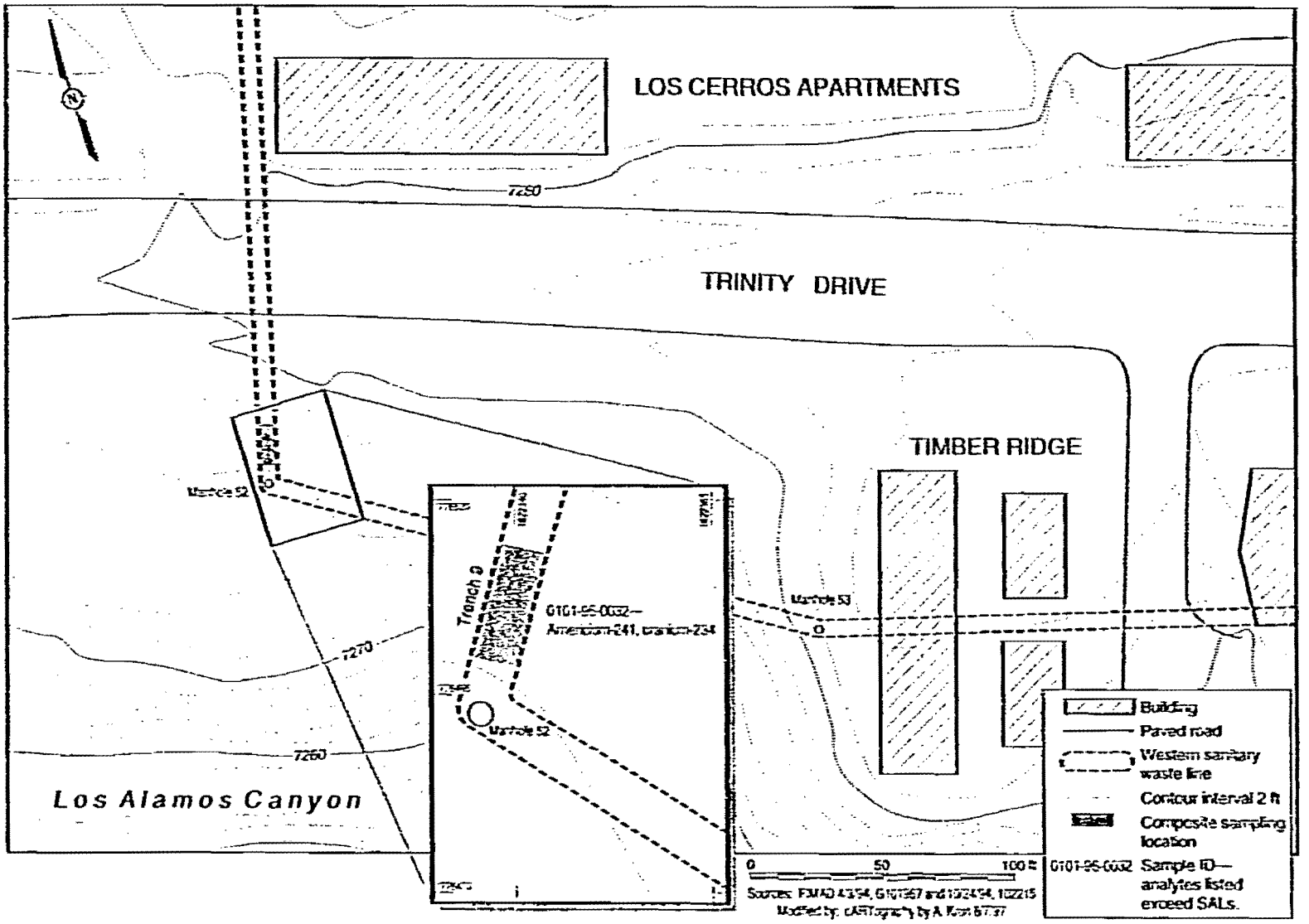


Fig. 5.1.8.1-3. Chemicals with concentrations above screening action levels at Location 1A.

The remaining 18 chemicals (alpha-chlordane, cadmium, copper, p,p'-DDD, dieldrin, diethyl phthalate, Endosulfan II, heptachlor epoxide, lead, mercury, 4-methyl-2-pentanone, plutonium-238, plutonium-239/240, tritium, uranium (total), uranium-235, uranium-238, and zinc) are included in the following multiple chemical evaluation.

A multiple chemical evaluation is performed separately for three classes of analytes: noncarcinogens, carcinogens (nonradioactive), and radionuclides. In this case, all three classes of analytes were identified for the multiple chemical evaluation. Lead is evaluated as a noncarcinogen because, even though it has been identified as a probable human carcinogen, a toxicity value has not been identified for this endpoint.

Table 5.1.8.1-3 presents the results of the multiple chemical evaluation for Aggregate N, Location 1A. The total normalized value is 1.1 for noncarcinogens, 0.69 for carcinogens (nonradioactive), and 1.5 for radionuclides. These results suggest that carcinogenic chemicals included in this multiple chemical evaluation should not pose a noncarcinogenic or carcinogenic health risk; therefore none are identified as COPCs. However, cumulative exposure to noncarcinogens or radionuclides included in this multiple chemical evaluation may pose an unacceptable noncarcinogenic health risk or radiation health hazard under certain conditions. Therefore, those noncarcinogens and radionuclides with individual normalized values greater than 0.1 (cadmium, lead, mercury, plutonium-239/240, total uranium, uranium-235, and uranium-238) are identified as COPCs.

The data qualifiers shown in Table 5.1.8.1-3 have been assigned during baseline data validation. However, as discussed in Section 4.1.2, the data are considered usable for site-specific decisions.

Based on the results of this risk-based screening assessment, ten chemicals (americium-241, Aroclor-1254™, cadmium, lead, mercury, plutonium-239/240, total uranium, uranium-234, uranium-235, and uranium-238) were identified as COPCs for Location 1A. The need for further evaluation of these chemicals is discussed in the following paragraphs.

TABLE 5.1.8.1-3

MULTIPLE CHEMICAL EVALUATION FOR SOIL SAMPLES AT AGGREGATE N, LOCATION 1A

	LOCATION ID[a]	SAMPLE ID	MAXIMUM SAMPLE VALUE (mg/kg) OR (pCi/g)	SOIL SAL (mg/kg) OR (pCi/g)	NORMALIZED VALUE
NONCARCINOGENIC EFFECTS					
Cadmium	Rel 11	AAB6090	4.1	38	0.11
Copper	01-10114	0101-96-0032	100	2800	0.036
Diethyl phthalate	01-4124	AAA8311	2.7	52000	0.000052
Endosulfan II	01-4144	AAA8273	0.006 (J)	390[b]	0.000015
Lead	Rel 11	AAB6090	126	400	0.32
4-Methyl-2-pentanone	01-4147	AAA8270	0.04	770	0.000052
Mercury	Rel 11	AAB6090	10.6	23	0.46
Total uranium	01-4144	AAA8273	54.9	230	0.24
Zinc	01-10144	0101-96-0032	72	23000	0.0031
				Total[c]:	1.1
CARCINOGENIC EFFECTS OF CHEMICALS					
Alpha-chlordane	01-4144	AAA8273	0.012 (J)	0.34[d]	0.035
p,p'-DDD	01-4144	AAA8273	0.005 (J)	1.9	0.0026
Dieldrin	01-4144	AAA8273	0.017 (J)	0.028	0.61
Heptachlor epoxide	01-4144	AAA8273	0.002 (J)	0.049	0.041
				Total[c]:	0.69
CARCINOGENIC EFFECTS OF RADIONUCLIDES					
Plutonium-238	01-4124	AAA8311	1.04	27	0.039
Plutonium-239/240	Rel 11	AAB6090	19.1	24	0.80
Tritium	Rel 15	AAB6087	0.066	260	0.0003
Uranium-235	01-4144	AAA8273	4.22[e]	10	0.42
Uranium-238	01-4144	AAA8273	17.8[e]	67	0.27
				Total[c]:	1.5

[a] In some cases, a reference number is listed in lieu of a location ID.
[b] SAL is for Endosulfan.
[c] Total may not equal sum of normalized values due to rounding.
[d] SAL is for Chlordane.
[e] Value represents the maximum of a sample concentration and its laboratory duplicate.

- Aroclor-1254™ was detected in one of four samples from Location 1A that were analyzed for PCBs at a concentration of 0.663 mg/kg, which is approximately a factor of 6 higher than its SAL of 0.1 mg/kg. Aroclor-1254™ was not detected in the other three samples at a detection limit of 0.036 mg/kg; in addition, no other Aroclor mixtures (Aroclor-1260™) were detected in any of the four samples at similar detection limits. This single detection of Aroclor-1254™ at a relatively low concentration does not represent a human health concern for the following reasons. First, the SAL is based on frequent, long-term exposure by a resident whereas the most likely exposure to subsurface soil at the site would be by a worker during the relatively short time associated with site development. In addition, the extent of Aroclor-1254™ (and PCBs in general) is very limited based on the results of the other samples. Therefore, further evaluation of Aroclor-1254™ at Location 1A is not warranted. The remaining five chemicals are further evaluated in the human health risk assessment presented in Section 5.1.9.

- Cadmium, lead, mercury, and total uranium were identified as COPCs based on the results of the MCE for noncarcinogens, which has a total normalized value of 1.1. However, as stated in Section 3.2.4, SALS are based on a residential exposure scenario, which assumes constant exposure over a long period of time, whereas the affected soil at Location 1A is several feet below ground surface, which means that exposure would be limited to relatively short-term activities requiring intrusion to that depth (e.g., installation or maintenance of utilities). In addition, the average concentrations of these chemicals across an exposure unit would be less than the maximum concentrations and likely significantly less than their respective SALs. Therefore, further evaluation of cadmium, lead, mercury, and total uranium at Location 1A is not warranted based on the potential for noncarcinogenic health effects.

Based on these discussions, americium-241, plutonium-239/240, uranium-234, uranium-235, and uranium-238 are further evaluated in the human health risk assessment presented in Section 5.1.9.

5.1.8.2 Locations 10 and 11

Ten chemicals were carried forward from the evaluations of organic and inorganic chemicals. None of these chemicals were detected at concentrations greater than SAL; therefore,

americium-241, copper, mercury, plutonium-239/240, thallium, uranium (total), uranium-234, uranium-235, uranium-238, and zinc are included in the following multiple chemical evaluation.

A multiple chemical evaluation is performed separately for three classes of analytes: noncarcinogens, carcinogens (nonradioactive), and radionuclides. In this case, two classes of analytes (noncarcinogens and radionuclides) were identified for the multiple chemical evaluation.

Table 5.1.8.2-1 presents the results of the multiple chemical evaluation for Aggregate N, Locations 10 and 11. The total normalized value is 0.4 for noncarcinogens and 0.6 for radionuclides. These results suggest that noncarcinogenic chemicals and radionuclides included in this multiple chemical evaluation should not pose a noncarcinogenic health risk or radiation health hazard; therefore, none are identified as COPCs.

The data qualifiers shown in Table 5.1.8.2-1 have been assigned during baseline data validation. However, as discussed in Section 4.1.1, the data are considered usable for site-specific decisions.

TABLE 5.1.8.2-1

MULTIPLE CHEMICAL EVALUATION FOR SOIL SAMPLES AT AGGREGATE N, LOCATIONS 10 AND 11[a]

	LOCATION ID	SAMPLE ID	MAXIMUM SAMPLE VALUE (mg/kg) OR (pCi/g)	SOIL SAL (mg/kg) OR (pCi/g)	NORMALIZED VALUE
NONCARCINOGENIC EFFECTS					
Copper	01-10110/ 01-10107	0101-06-0030/ 0101-06-0221	29 (J-)/20 (J)	2800	0.010
Mercury	01-10104	0101-06-0024	1.5[b]	23	0.065
Thallium	01-10107/ 01-10112	0101-06-0027/ 0101-06-0035	1.5[b]	5.4	0.28
Total uranium	01-10107	0101-06-0221	10.513	230	0.046
Zinc	01-10110	0101-06-0030	69	23000	0.0030
				Total[c]:	0.4
CARCINOGENIC EFFECTS OF RADIONUCLIDES					
Americium-241	01-10110	0101-06-0030	1.13	22	0.051
Plutonium-239/240	01-10110	0101-06-0030	4.33[b]	24	0.18
Uranium-234	01-10107	0101-06-0221	3.33[b]	13	0.26
Uranium-235	01-10107	0101-06-0027/ 0101-06-0221	0.15[b]	10	0.015
Uranium-238	01-10107	0101-06-0221	3.51[b]	87	0.052
				Total[c]:	0.6

[a] The data qualifiers used in this table are defined in Section 5.1.2.
[b] Value represents the maximum of a sample concentration and its laboratory duplicate.
[c] Total may not equal sum of normalized values due to rounding.

5.1.8.3 Location 13

Seventeen chemicals were carried forward from the evaluation of organic and inorganic chemicals. Two of those chemicals (lead and plutonium-239/240) were detected at concentrations greater than SAL at one or more locations, as shown in Tables 5.1.8.3-1 (noncarcinogens) and 5.1.8.3-2 (radionuclides) and on Fig. 5.1.8.3-1.

TABLE 5.1.8.3-1

AGGREGATE N, LOCATION 13 NONCARCINOGENS WITH CONCENTRATIONS IN SOIL THAT EXCEED SALS

SAMPLE ID	LOCATION ID[a]	DEPTH (ft bgs)	LEAD (mg/kg)
SAL	N/A[b]	N/A	400
AAC2082	Ref 47	0-5	1050
AAC2085	Ref 50	0-5	1030

[a] A reference number is listed in lieu of a location ID.
[b] N/A = not applicable.

Values in BOLD are above SALs.

TABLE 5.1.8.3-2

AGGREGATE N, LOCATION 13 RADIONUCLIDES WITH CONCENTRATIONS IN SOIL THAT EXCEED SALS

SAMPLE ID	LOCATION ID[a]	DEPTH (ft bgs)	PLUTONIUM-239/240 (pCi/g)
SAL	N/A[b]	N/A	24
AAC2087	Ref 57	0-5	75.6[c]

[a] A reference number was used in lieu of a location ID.
[b] N/A = not applicable.
[c] Value represents the maximum of a sample concentration and its laboratory duplicate.

Values in BOLD are above SALs.

The remaining 15 chemicals (americium-241, benzo[a]anthracene, chrysene, copper, fluoranthene, mercury, plutonium-238, pyrene, silver, tritium, uranium (total), uranium-234, uranium-235, uranium-238, and zinc) are included in the following multiple chemical evaluation.

A multiple chemical evaluation is performed separately for three classes of analytes: noncarcinogens, carcinogens (nonradioactive), and radionuclides. In this case, all three classes of analytes were identified for the multiple chemical evaluation.

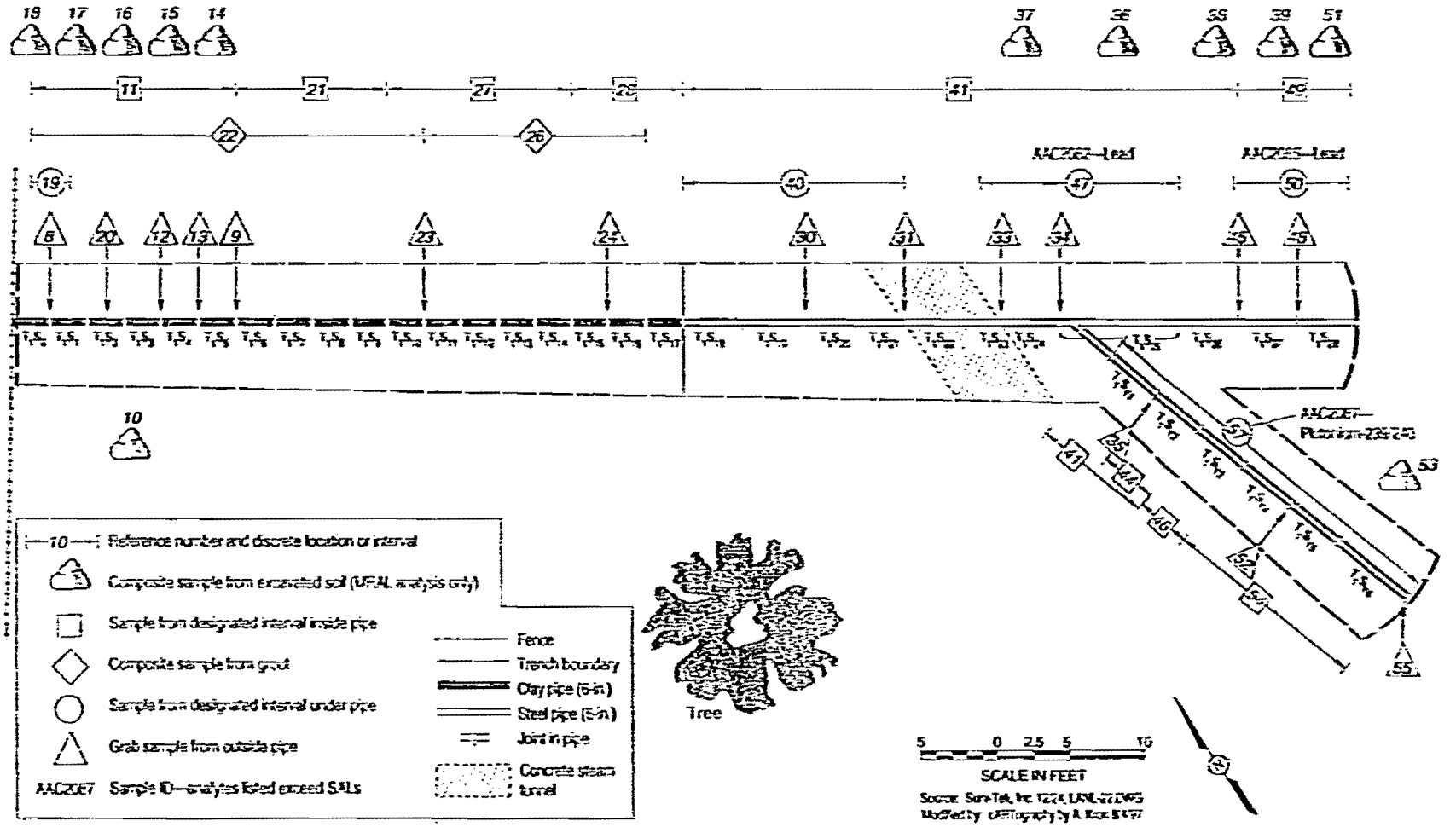


Fig. 5.1.8.3-1. Chemicals with concentrations above screening action levels at Location 13.

The data qualifiers shown in Table 5.1.8.3-3 have been assigned during baseline data validation. However, as discussed in Sections 4.1.1 and 4.1.3, the data are considered usable for site-specific decisions.

Based on the results of this risk-based screening assessment, two chemicals (lead and plutonium-239/240) were identified as COPCs for Location 13. These chemicals are further evaluated in the human health risk assessment presented in Section 5.1.9.

Table 5.1.8.3-3 presents the results of the multiple chemical evaluation for Aggregate N, Location 13. The total normalized value is 0.55 for noncarcinogens, 0.71 for carcinogens (nonradioactive), and 0.99 for radionuclides. These results suggest that noncarcinogenic and

TABLE 5.1.8.3-3

MULTIPLE CHEMICAL EVALUATION FOR SOIL SAMPLES AT AGGREGATE N, LOCATION 13

CHEMICAL	LOCATION ID[a]	SAMPLE ID	MAXIMUM SAMPLE VALUE (mg/kg) OR (pCi/g)	SOIL SAL (mg/kg) OR (pCi/g)	NORMALIZED VALUE
NONCARCINOGENIC EFFECTS					
Copper	Ref 24	AAB7438	29	2800	0.010
Fluoranthene	Ref 57	AAC2087	0.84	2600	0.00032
Mercury	Ref 23	AAB7450	0.1	23	0.40
Pyrene	Ref 57	AAC2087	0.63	1900[b]	0.00033
Silver	Ref 8	AAB7440	0.6 (J)	380	0.0016
Total Uranium	Ref 20	AAC0510	30.844	230	0.13
Zinc	Ref 23	AAB7450	144	23000	0.0063
				Total:	0.55
CARCINOGENIC EFFECTS OF CHEMICALS					
Benzo(a) anthracene	Ref 57	AAC2087	0.43	0.61	0.70
Chrysene	Ref 57	AAC2087	0.52	61[b]	0.0085
				Total:	0.71
CARCINOGENIC EFFECTS OF RADIONUCLIDES					
Americium-241	Ref 57	AAC2087	0.013	22	0.00059
Plutonium-238	Ref 57	AAC2087	0.185[c]	27	0.0069
Tritium	Ref 24	AAB7438	0.228	200	0.00088
Uranium-234	Ref 20	AAC0510	10.23 (J)	13	0.79
Uranium-235	Ref 20	AAC0510	0.428 (J)	10	0.043
Uranium-238	Ref 20	AAC0510	10.3 (J)	67	0.15
				Total:	0.99

[a] A reference number is listed in lieu of a location ID.

[b] The EPA Region 9 *preliminary remediation goal* for this chemical, which is normally the basis for LANL SALs, is based on the theoretical soil saturation concentration. This value was replaced by an alternative value also calculated by Region 9. This alternative value, which is higher than the theoretical saturation concentration, is intended to represent a "health-based" concentration, assuming that the model used to evaluate inhalation of vapors is valid at this concentration.

[c] Value represents the maximum of a sample concentration and its laboratory duplicate.

carcinogenic chemicals and radionuclides included in this multiple chemical evaluation should not pose a noncarcinogenic or carcinogenic health risk or radiation health hazard; therefore, none are identified as COPCs.

5.1.8.4 Inside the Pipe

Forty-four chemicals were carried forward from the evaluations of organic and inorganic chemicals. Nineteen of these chemicals (americium-241, benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, cadmium, cesium-137, chromium, copper, dibenzo[a,h]anthracene, 1,4-dichlorobenzene, indeno[1,2,3-cd]pyrene, lead, mercury, plutonium-239/240, uranium (total), uranium-234, uranium-235, and uranium-238) were detected at concentrations greater than SAL at one or more locations, as shown in Tables 5.1.8.4-1, 5.1.8.4-2, and 5.1.8.4-3 for noncarcinogens, chemical carcinogens, and radionuclides, respectively, and on Fig. 5.1.8.4-1.

The data qualifiers shown in Table 5.1.8.4-3 have been assigned during baseline data validation. However, as discussed in Section 4.1.3, the data are considered usable for site-specific decisions.

Two of the chemicals carried forward from the evaluation of inorganic and organic chemicals are essential nutrients (calcium and iron). SALs have not been developed for these chemicals; therefore, the potential significance of these chemicals was evaluated in terms of their recommended daily allowances (RDAs). Using the maximum detected concentrations and standard default assumptions for soil ingestion rate, the daily exposure to calcium was estimated to be 2.6 mg/day for children and 1.3 mg/day for adults. The RDA for calcium is 800 mg/day for 1- to 10-year olds and 1 200 mg/day for 11- to 24-year olds. These values are significantly higher than the estimated daily intakes; therefore, calcium is not considered further in the screening evaluation. For iron, the estimated daily exposures were 42 mg/day for children and 21 mg/day for adults. The RDAs for iron are 15 mg/day for teenage girls and adult women, 12 mg/day for teenage boys, and 10 mg/day for adult men. Given that these values are below the estimated daily exposures, iron is identified as a COPC.

Another chemical carried forward from the evaluation of inorganic and organic chemicals, i.e., arsenic, does not have a SAL. In this case, a SAL has not been developed for arsenic because the Region IX preliminary remediation goal (PRG) is significantly below background levels in the Los Alamos area. Given that arsenic was detected in samples from inside the pipe at concentrations up to 81 mg/kg, which is significantly greater than the background screening value of 7.82, arsenic is identified as a COPC.

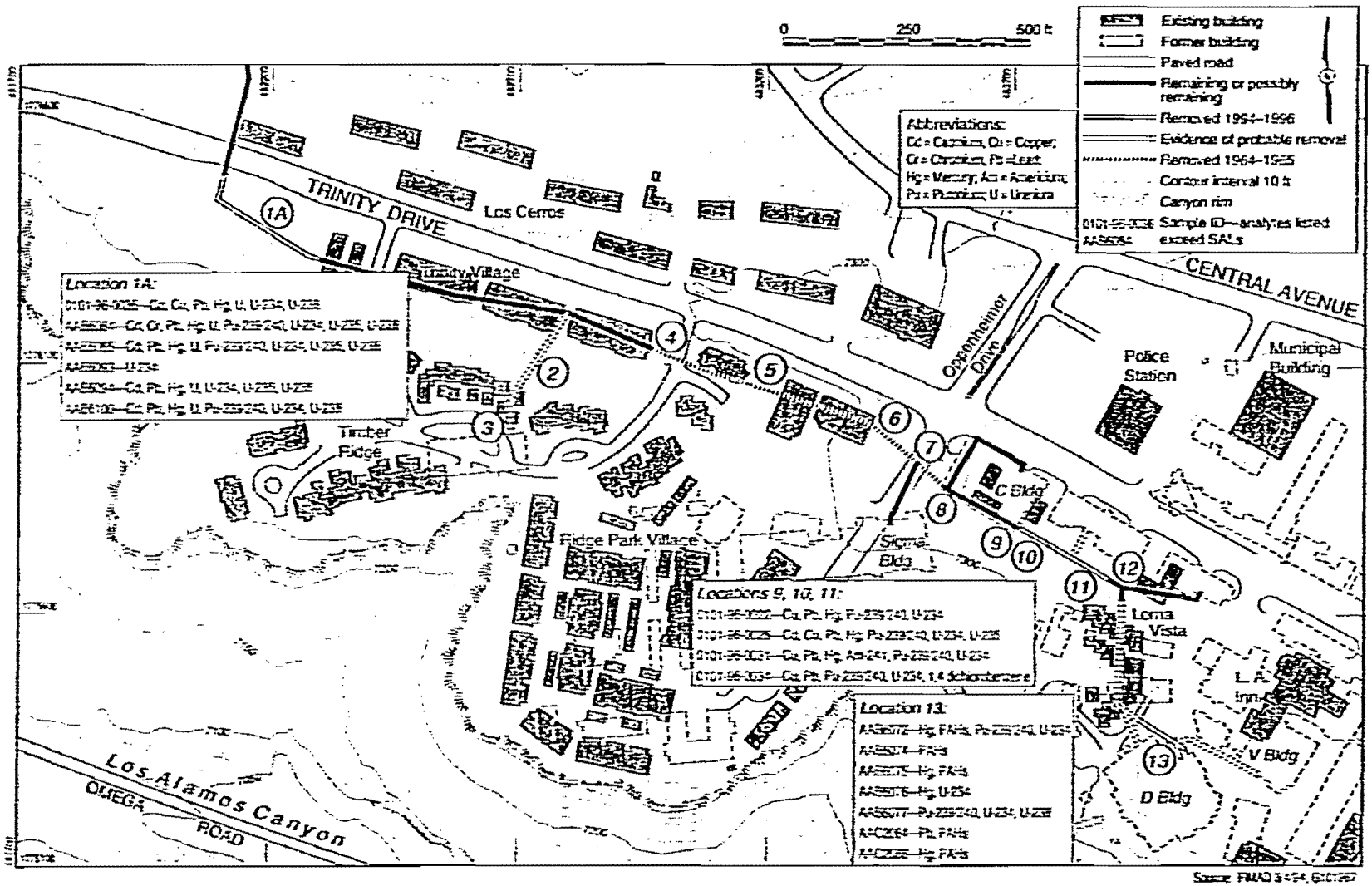


Fig. 5.1.8.4-1. Chemicals with concentrations above screening action levels inside the pipe.

TABLE 5.1.8.4-1

AGGREGATE N, INSIDE THE PIPE NONCARCINOGENS WITH CONCENTRATIONS IN SOIL THAT EXCEED SALS[a]

SAMPLE ID	LOCATION ID[b]	DEPTH (ft bgs)	CADMIUM (mg/kg)	COPPER (mg/kg)	LEAD (mg/kg)	MERCURY (mg/kg)	TOTAL URANIUM (mg/kg)
SAL	N/A[c]	N/A	38	2800	400	23	230
AAB6094	Rel 3	3-5	660	NA[d]	8070	542	1147
AAB6085	Rel 4	3-5.5	6355[e]	NA	1759[e]	46.5[e]	349
AAB6100	Rel 5	3-5.5	95.1	NA	7340	117	289
AAB6084	Rel 6	4-6	140	NA	9080	690	627
AAB6076	Rel 11	0-4	1.7	57.2	29.6	36.9	165
AAB6072	Rel 28	0-4	4	376	190	155	98
AAB6075	Rel 41	0-5	1.6	264	265	50.4	135
AAC2084	Rel 49	0-5	0.2 (U)	21.4	1750	1.5	3.9
AAC2088	Rel 54	0-5	0.2 (U)	19.6	83.2	31.5	3.3
0101-96-0022	01-10102	N/A	12	1600	2700	240	16.6
0101-96-0025	01-10105	N/A	120	5100	4000	730	112
0101-96-0031	01-10111	N/A	15	4500	830	66	42.6
0101-96-0034	01-10116	N/A	24	4300 (J-)	3800	0.64	44.7
0101-96-0036	01-10115	N/A	190	4100	1600 (J+)	26	267

[a] Qualifiers used in table are defined in Section 3.1.2. The data qualifiers in this table have been assigned during baseline data validation. However, as discussed in Section 4.1.1, the data are considered usable for site-specific decisions.
[b] A reference number was used in lieu of a location ID.
[c] N/A = not applicable.
[d] NA = not analyzed.
[e] Value represents the maximum of a sample concentration and its laboratory duplicate.

Values in BOLD are above SALs.

The data qualifiers shown in Table 5.1.8.4-1 have been assigned during baseline data validation. However, as discussed in Section 4.1.1, the data are considered usable for site-specific decisions.

The data qualifiers shown in Table 5.1.8.4-2 have been assigned during baseline data validation. However, as discussed in Sections 4.1.1 and 4.1.2, the data are considered usable for site-specific decisions.

The remaining 22 chemicals (acenaphthene, acenaphthylene, antimony, anthracene, Aroclor-1254™, Aroclor-1260™, benzo(g,h,i)perylene, bis(2-ethylhexyl)phthalate, chrysene, di-n-butyl phthalate, fluoranthene, fluorene, heptachlor epoxide, nickel, phenanthrene, phenol, plutonium-238, pyrene, silver, thallium, tritium, and zinc) are included in the following multiple chemical evaluation.

TABLE 5.1.8.4-2

AGGREGATE N, INSIDE THE PIPE CARCINOGENS WITH CONCENTRATIONS IN SOIL THAT EXCEED SALS

SAMPLE ID	LOCATION ID/REFERENCE NO.	DEPTH (ft bgs)	BENZO(A) ANTHRA-CENE (mg/kg)	BENZO(A) PYRENE (mg/kg)	BENZO(B) FLUOR-ANTHENE (mg/kg)	BENZO(K) FLUOR-ANTHENE (mg/kg)	CHROMIUM (mg/kg)	DIBENZO(A,H) ANTHRACENE (mg/kg)	1,4-DICHLORO-BENZENE (mg/kg)	INDENO (1,2,3-CD) PYRENE (mg/kg)
SAL	N/A[a]	N/A	0.61	0.061	0.61	6.1	210	0.061	3.6	0.61
AAB6084	Ref 6	0-5	NA[b]	NA	NA	NA	350	NA	0.37 (U)	NA
AAB6072	Ref 28	0-4	1.4	1.1	1.4	1.5	13.1	0.34 (U)	0.34 (U)	0.65
AAB6075	Ref 41	0-5	0.35 (U)	21	26	16	34.9	2.7	0.35 (U)	4.9
AAB6074	Ref 46	0-5	1.3	0.95	1.1	1	3[c]	0.36 (U)	0.36 (U)	0.7
AAC2084	Ref 49	0-5	2.3	3.1	2.6	2.6	4.6	0.79	0.37 (U)	2.2
AAC2088	Ref 54	0-5	1.7	1.4	1.6	1.2	3.6	0.37 (U)	0.37 (U)	0.81
0101-96-0022	01-10102	N/A	1.1 (U)	1.1 (U)	1.1 (U)	1.1 (U)	130	1.1 (U)	2.2	1.1 (U)
0101-96-0025	01-10105	N/A	1.1 (U)	1.1 (U)	1.1 (U)	1.1 (U)	120	1.1 (U)	2.7	1.1 (U)
0101-96-0031	01-10111	N/A	1.2 (U)	1.2 (U)	1.2 (U)	1.2 (U)	190 (J-)	1.2 (U)	3.1	1.2 (U)
0101-96-0034	01-10116	N/A	1.3 (U)	1.3 (U)	1.3 (U)	1.3 (U)	150 (J-)	1.3 (U)	4	1.3 (U)
0101-96-0036	01-10115	N/A	0.19 (U)	0.19 (U)	0.19 (U)	0.19 (U)	19	0.19 (U)	0.19 (U)	0.19 (U)

[a] N/A = not applicable.
[b] NA = not analyzed.
[c] Value represents the maximum of a sample concentration and its laboratory duplicate.

Values in **BOLD** are above SALs.

TABLE 5.1.8.4-3

AGGREGATE N, INSIDE THE PIPE RADIONUCLIDES WITH CONCENTRATIONS IN SOIL THAT EXCEED SALS[a]

SAMPLE ID	LOCATION ID/ REFERENCE NO.	DEPTH (ft bgs)	AMERICIUM-241 (pCi/g)	CESIUM-137 (pCi/g)	PLUTONIUM2-39/240 (pCi/g)	URANIUM-234 (pCi/g)	URANIUM-235 (pCi/g)	URANIUM-238 (pCi/g)
SAL	N/A[b]	N/A	22	5.1	24	13	10	67
AAB6093	Ref 10	4.5-6.5	NA[c]	NA	17.06[d]	31.4	1.2	15.3
AAB6094	Ref 3	3-5	NA	NA	20.455	552	23.6	382
AAB6085	Ref 4	3-5.5	NA	NA	774.72[d]	266	12	115
AAB6100	Ref 5	3-5.5	NA	NA	46.54[d]	135	6.3	96
AAB6084	Ref 6	4-6	NA	NA	27.35[d]	336	14.1	209
AAB6076	Ref 11	0-4	NA	0.011[d]	18.55[d]	56.5[d]	2.4[d]	55.2[d]
AAB6077	Ref 21	0-4	NA	-0.048 (U)	79.727	165	4.2	103
AAB6072	Ref 26	0-4	NA	0.25	74.568	40.6	1.9	32.7
0101-96-0022	01-10102	N/A	3.26	5.9	69	36	1.5	5.4
0101-96-0025	01-10105	N/A	21.5	4.67	1515	510	16.7	34.9
0101-96-0031	01-10111	N/A	87.6	5.25	228	162	6.5	13.3
0101-96-0034	01-10116	N/A	15.5	2.5	503	229	7.7	13.8
0101-96-0036	01-10115	N/A	0.272	0.471	3.28	145	5.01	89

[a] The data qualifiers in this table are defined in Section 3.1.2
[b] N/A = not applicable.
[c] NA = not analyzed.
[d] Value represents the maximum of a sample concentration and its laboratory duplicate.

Values in BOLD are above SALs.

A multiple chemical evaluation is performed separately for three classes of analytes: noncarcinogens, carcinogens (nonradioactive), and radionuclides. In this case, all three classes of analytes were identified for the multiple chemical evaluation.

Table 5.1.8.4-4 presents the results of the multiple chemical evaluation for Aggregate N, inside the pipe. The total normalized value is 1.8 for noncarcinogens, 1.4 for carcinogens (nonradioactive), and 0.43 for radionuclides. These results suggest that carcinogenic radionuclides included in this multiple chemical evaluation should not pose an unacceptable radiation health hazard; therefore, none are identified as COPCs. However, cumulative exposure to noncarcinogenic or carcinogenic chemicals included in this multiple chemical evaluation may pose an unacceptable noncarcinogenic or carcinogenic health risk. Therefore, those noncarcinogenic chemicals with individual normalized values greater than 0.1 (antimony, Aroclor-1254™, Aroclor-1260™, heptachlor epoxide, nickel, silver, thallium, and zinc) are identified as COPCs.

The data qualifiers shown in Table 5.1.8.4-4 have been assigned during baseline data validation. However, as discussed in Section 4.1.3, the data are considered usable for site-specific decisions.

Based on the results of this risk-based screening assessment, 29 chemicals (americium-241, antimony, Aroclor-1254™, Aroclor-1260™, arsenic, benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, heptachlor epoxide, cadmium, cesium-137, chromium, copper, dibenzo[a,h]anthracene, 1,4-dichlorobenzene, indeno[1,2,3-cd]pyrene, iron, lead, mercury, nickel, plutonium-239/240, silver, thallium, uranium (total), uranium-234, uranium-235, uranium-238, and zinc) were identified as COPCs. With the exception of Aroclor-1254™, Aroclor-1260™, and heptachlor epoxide, these chemicals are further evaluated in the human health risk assessment presented in Section 5.1.9.

Aroclor-1254™, Aroclor-1260™, and heptachlor epoxide were identified as COPCs based on the results of the MCE for carcinogens, which had a total normalized value of 1.4. It should be noted, however, that several other carcinogens were detected inside the pipe at concentrations up to several orders of magnitudes greater than their respective SALs. These chemicals are evaluated further in the human health risk assessment presented in Section 5.1.9. Inclusion of Aroclor-1254™, Aroclor-1260™, and heptachlor epoxide, which individually are present at concentrations less than SALs, in a human health risk assessment that includes chemicals present at orders of magnitude above SALs would not affect the results of that assessment. Therefore, further evaluation of Aroclor-1254™, Aroclor-1260™, and heptachlor epoxide inside the pipe is not warranted.

TABLE 5.1.8.4-4

MULTIPLE CHEMICAL EVALUATION FOR SOIL SAMPLES AT AGGREGATE N, INSIDE THE PIPE

CHEMICAL	LOCATION ID[a]	SAMPLE ID	MAXIMUM SAMPLE VALUE (mg/kg) OR (pCi/g)	SOIL SAL (mg/kg) OR (pCi/g)	NORMALIZED VALUE
NONCARCINOGENIC EFFECTS					
Acenaphthene	Ref 41	AAB6075	0.51	2200[b]	0.00023
Acenaphthylene	Ref 41	AAB6075	0.99	2200[b]	0.00045
Antimony	01-10102	0101-06-0022	18 (J-)	31	0.58
Anthracene	Ref 41	AAB6075	4.6	18000[b]	0.00026
Benzo(g,h,i) perylene	Ref 41	AAB6075	2.0	1900[b,c]	0.0015
Di-n-butyl phthalate	01-10102	0101-06-0022	1.5	65000	0.000023
Fluoranthene	Ref 41	AAB6075	52	2600	0.020
Fluorene	Ref 41	AAB6075	0.94	2300	0.00041
Nickel	01-10115	0101-06-0030	240	1500	0.16
Phenanthrene	Ref 41	AAB6075	19	18000[b,d]	0.0011
Phenol	Ref 41	AAB6075	0.46	39000	0.000012
Pyrene	Ref 41	AAB6075	44	1900	0.023
Silver	Ref 5	AAB6100	143	380	0.38
Thallium	01-10111	0101-06-0031	1.6	5.4	0.29
Zinc	01-10105	0101-06-0025	7500	23000	0.33
				Total[e]:	1.8
CARCINOGENIC EFFECTS OF CHEMICALS					
Aroclor 1254	Ref 28	AAB6072	0.0559	0.1	0.56
Aroclor 1260	Ref 28	AAB6072	0.0431	0.1	0.43
Bis(2-ethylhexyl) phthalate	01-10115	0101-06-0030	0.31	32	0.010
Chrysene	Ref 40	AAC2084	2.3	61[c]	0.038
Heptachlor Epoxide	Ref 41	AAB6075	0.0184	0.049	0.38
				Total[e]:	1.4
CARCINOGENIC EFFECTS OF RADIONUCLIDES					
Plutonium-239	01-10105	0101-06-0025	11.7	27	0.43
Tritium	Ref 1	AAB6000	0.139	260	0.00054
				Total[e]:	0.4

[a] A reference number is listed in lieu of a location ID.

[b] The EPA Region 9 preliminary remediation goal for this chemical, which is normally the basis for LANL BALs, is based on the theoretical soil saturation concentration. This value was replaced by an alternative value also calculated by Region 9. This alternative value, which is higher than the theoretical saturation concentration, is intended to represent a "health-based" concentration.

[c] A BAL has not been calculated for benzo(g,h,i)perylene due to a lack of toxicity criteria; therefore, the SAL for pyrene was used as a surrogate based on similarity in chemical structure.

[d] A BAL has not been calculated for phenanthrene due to a lack of toxicity criteria; therefore, the SAL for anthracene was used as a surrogate based on similarity in chemical structure.

[e] Total may not equal sum of normalized values due to rounding.

5.1.9 Human Health Risk Assessment

The human health risk assessments presented in this section follow the general procedures outlined in the policy document Risk-Based Corrective Action Process (Dorries 1996, 1297), as well as guidance provided by the EPA and other regulatory agencies (EPA 1989, 0305). The human health risk assessment process consists of the following four steps as outlined by the National Academy of Science (1983) and EPA (1989, 0305):

1. Data evaluation is the process of analyzing site characteristics and analytical data to identify COPCs to be included in the quantitative risk assessment. At LANL, COPCs are identified through the screening assessment process described previously. In cases where the data collected for the screening assessment are sufficient for completing the human health risk assessment, no further effort regarding COPC identification is required. However, in other cases, additional assessment of the adequacy of the data to identify COPCs and/or complete the risk assessment is required. This assessment could include, but not necessarily be limited to, an evaluation of data qualifiers, nondetect results, and frequency of detection. The result of the data evaluation process is a final list of COPCs to be included in the risk assessment.

2. Exposure assessment is the process of quantifying the exposure to a chemical by measuring or estimating the intensity, frequency, and duration of exposure. The principal elements of exposure assessment consist of

   - evaluating the influence of fate and transport processes for the COPCs,
   - identifying potential exposure scenarios and pathways,
   - calculating representative (source term) concentrations, and
   - estimating potential chemical uptake or dose.

   The exposure assessment is performed within the framework of a conceptual site model that identifies potential chemical sources, transport routes, current and future receptors, and exposure scenarios and routes linking sources and receptors, which are referred to as complete exposure pathways. As new information becomes available, the conceptual site model is re-evaluated to verify that all potentially complete human exposure pathways have been identified.

3. Toxicity assessment for nonradiological chemicals is a two-step process that evaluates available information regarding the potential for a contaminant to cause adverse health effects in exposed individuals (hazard identification), and estimates the relationship between the extent of exposure and the increased likelihood (probability or chance) and/or severity of adverse effects (dose-response assessment). The result of the hazard identification is a toxicity profile that summarizes the available toxicological information and its relevance to human exposure under conditions present at the site. The result of the dose-response assessment is a toxicity criterion that is used in the risk characterization to estimate the likelihood of adverse effects occurring in humans at different exposure levels. The toxicity criteria used to evaluate noncarcinogenic and carcinogenic effects of nonradiological chemicals are commonly referred to as reference doses (RfDs) and slope factors (SFs), respectively.

   Toxicity assessments have been completed by federal and/or state regulatory agencies for most nonradioactive chemicals commonly found at hazardous waste sites. If a toxicity assessment has already been completed for a COPC, then the toxicity criteria included in that assessment are used in the human health risk assessment. Otherwise, a toxicity profile is written based on information in the scientific literature, and toxicity criteria are developed, if possible, according to guidance provided by EPA (1989, 0305).

Toxicity assessment for the carcinogenic effects of radionuclides is more limited than the comparable assessment for chemicals because the mechanism of carcinogenicity for radionuclides is limited to the effects of ionizing radiation. Ionizing radiation is any radiation capable of displacing electrons from an atom or molecule. Ionizing radiation may cause adverse effects in somatic and germ cells, resulting in cancer and hereditary disorders, respectively. The energy imparted by ionizing radiation, weighted by the type of radiation and the types of tissues and organs irradiated, is referred to as the effective dose equivalent (EDE). When the internal dose is integrated over time following the intake of a radionuclide, the dose over the time period of integration is referred to as the committed effective dose equivalent (CEDE). The sum of the internal dose, integrated over time, and the external dose is referred to by DOE as the total effective dose equivalent (TEDE). The EDE and CEDE are based on an estimate of radionuclide dose or intake, respectively, and dose conversion factors (DCFs). DCFs from Federal Guidance Reports No. 11 (EPA 1988, 0297) and 12 (EPA 1993, 1122) are contained within the RESRAD computer code, which is used to estimate radiation doses at LANL PRSs.

4. Risk and dose characterization represents the final step in the risk assessment process, in which the results of the exposure and toxicity assessments are integrated into quantitative or qualitative estimates of potential carcinogenic or noncarcinogenic health risks (nonradioactive chemicals) or dose (radionuclides). The presentation of risk and dose estimates is highly dependent on the uncertainty analysis, which evaluates the possible biases and degree of confidence in the risk assessment results. This uncertainty analysis may be qualitative or quantitative in nature, depending on the scope and purpose of the risk assessment.

   At LANL, potential health impacts associated with radionuclides is characterized in terms of radiation dose. Therefore, in instances where the COPCs are radionuclides, the overall process is more accurately referred to as a dose assessment, and the last step in the process is referred to as a dose characterization.

5.1.9.1 Location 1A

Data Evaluation

At Location 1A, five radionuclides were identified as COPCs based on the results of the screening assessment presented in Section 5.1.8 (americium-241, plutonium-239/240, uranium-234, uranium-235, and uranium-238). Consistent with the screening assessment, this dose assessment is based on the results of confirmation samples collected from outside the pipe in 1994 and 1996. With the exception of americium-241, the confirmation data are believed to adequately represent current conditions at Location 1A. Americium-241 was analyzed in only one confirmation sample from Location 1A, i.e., the single confirmation sample collected as part of the 1996 investigation. The measured concentration of americium-241 in this sample was 202 pCi/g, which is well above its SAL of 22 pCi/g. It should be noted, however, that a laboratory duplicate of this sample did not contain detectable concentrations of americium-241. A re-analysis of the original sample also reported an americium-241 concentration of approximately 200 pCi/g. These results suggest that americium-241 may be present in subsurface soil at Location 1A as small particles; however, the extent of these particles is not well understood given that only one confirmation sample was collected in 1996 and the 1994 samples were not analyzed for americium-241. Field screening of trenches in 1994 (for alpha and beta radiation) and in 1996 (for alpha radiation) did not detect any radiation levels above background. This indicates that americium-241 (if present) exists as a small discrete point source and not a result of a pipeline release. The americium-241 data for

Location 1A are insufficient for a quantitative dose assessment; however, the data are adequate to provide an upper-bound estimate of potential exposure. The uncertainty associated with this estimate is discussed in subsequent sections of this dose assessment.

Exposure Assessment

The conceptual site model for Location 1A was created based on the confirmation sampling results, potential future land use, and physical and chemical characteristics of the COPCs, as shown in Fig. 5.1.9.1-1. Each of the components of the conceptual site model is discussed below.

Evaluating Influence of Fate and Transport of COPCs

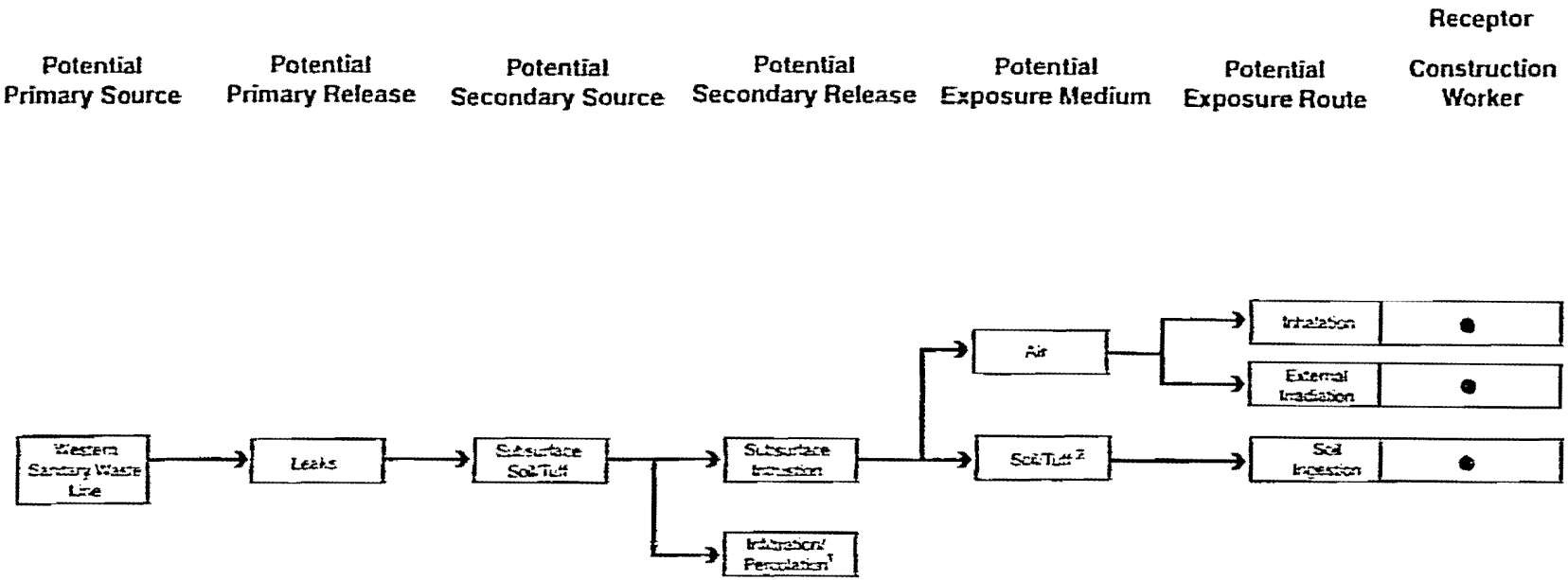
The environmental fate of the COPCs is controlled by the cumulative interaction of transport and transformation processes. Once released into the environment, a chemical may partition among various compartments (soil, water, air). The transport processes that define the movement of chemicals between compartments are highly dependent on the physiochemical properties of both the chemicals and the environmental media.

All of the COPCs identified at the site are high atomic weight radionuclides. As such, in some respects, the COPCs will behave like other high atomic weight nonradioactive metals, i.e., they are expected to be relatively immobile in soil, but may leach to a limited extent with infiltrating water or be entrained by either surface runoff or the wind. In addition, the COPCs will generate progeny over time as a result of radioactive decay. In this case, the half-lives of all of the COPCs are long; therefore, their composition will not change appreciably in the foreseeable future.

Environmental media (soil or air) that may potentially contribute to an individual's exposure to a chemical can be determined based on this general understanding of the environmental transport mechanisms of the COPCs. As shown in Fig. 5.1.9.1-1, the COPCs at Location 1A are limited to subsurface soil in the vicinity of the former WSWL, but may be exposed in a trench or resuspended in air as a result of subsurface intrusion (installation of underground utilities).

Identifying Potential Exposure Scenarios and Pathways

Location 1A is a vacant plot of land bounded by Trinity Drive to the north, Trinity Village to the east, Los Alamos Canyon to the south, and the Professional Buiding to the west. As discussed in Section 5.1.4.1, the WSWL was located approximately 4 to 6 ft below grade at Location 1A. Therefore, there are no complete exposure pathways under current conditions. The most likely future receptor to residual radionuclides in the subsurface would be construction workers at the



1 Infiltration or percolation of precipitation is expected to be limited at mesa top sites due to high rate of evaporation.

2 Soil and tuff are presumed to be exposed in a trench during construction activities.

Fig. 5.1.9.1-1. Conceptual site model for Location 1A.

time the site is developed; however, exposure may be minimal to nonexistent if intrusive activities are limited. Assuming development of the site results in significant intrusion into the subsurface in the vicinity of the former WSWL, future construction workers may be exposed to the COPCs via the following pathways:

- Incidental ingestion of soil
- Inhalation of resuspended particulates (dust)
- External irradiation

Exposure to residual radionuclides in the subsurface is not expected to occur following site development, although it is possible that subsurface soil containing COPCs could be inadvertently redistributed to the surface during construction. However, site development activities (clearing, utility installation, grading) would mix any small volume of soil containing COPCs with a substantially larger volume of "clean" soil and significantly reduce the concentrations of COPCs. Therefore, this dose assessment is limited to an evaluation of potential health impacts to a construction worker.

Calculating Representative (Source Term) Concentrations

Estimates of source term concentrations are necessary for evaluating uptake and/or dose in exposed individuals. COPC concentrations that are considered representative of the average concentration to which an individual might be exposed over an extended period were estimated as described in Appendix B. Consistent with the RBCAP, source term concentrations are based on the mean of the underlying distribution and the 95% upper confidence limit (UCL) of the mean of the underlying distribution. Calculation of source term statistics is associated with a number of decision points with regard to method. For example, an underlying distribution of a data set must be identified to calculate a mean and 95% UCL. In addition, if a COPC is not measured above its reporting limit at one or more sample points, a value must be chosen to represent the sample for the calculation of a statistic. The statistical methods employed for the calculation of source term values are discussed in more detail in Appendix B. The source term concentrations for the COPCs, rounded to 3 significant figures, are provided in Table 6.1.9.1-1.

The 95% UCL concentrations are used to estimate dose for a "reasonable maximum exposure" (RME) scenario. The EPA defines the RME scenario as "the highest exposure that is reasonably expected to occur at the Site" (EPA 1989, 0305). In addition, the U.S. EPA states that, "The intent of the RME is to estimate a conservative exposure case (well above the average) that is still within the range of possible exposures" (EPA 1989, 0305). The mean

concentrations are used to estimate dose for a "more-likely exposure" (MLE) scenario. The intent of this scenario is to provide a more realistic estimate of potential exposure.

As discussed above, americium-241 was detected at a concentration of 202 pCi/g in a single confirmation sample from Location 1A. The laboratory duplicate of the confirmation sample did not contain detectable concentrations of americium-241, whereas a re-analysis of the original sample also contained americium-241 at a concentration of approximately 200 pCi/g. Given that the sample was field screened using a Ludlum 2221™ with a 43-1 zinc sulfide scintillation probe before submittal to the analytical laboratory and the results of the field screening did not suggest the presence of americium-241 or other alpha emitters at concentrations greater than background, the highest observation among these three analyses, i.e., 202 pCi/g, is considered a conservative estimate of the average concentration of americium-241 at Location 1A for the purposes of providing an upper-bound estimate of potential dose.

Estimating Potential Contaminant Intake and Dose

Potential exposure to radionuclides was evaluated using the RESRAD computer code, Version 5.61, developed for the Department of Energy by Argonne National Laboratory. The RESRAD code provides output directly in the form of annual radiation dose as a function of the dose from the radionuclide of interest and its decay products integrated over a 50-year period. The complete list of intake parameters and exposure equations imbedded in the RESRAD code are not reproduced here. A subset of the most important intake parameters are provided in Table 5.1.9.1-2; copies of the summary output files, including all input parameters, are provided in Appendix C.

TABLE 5.1.9.1-1

SOURCE TERM CONCENTRATIONS, LOCATION 1A

COPC	MEAN[a] (pCi/g)	95% UCL (pCi/g)
Plutonium-239/240	9.20	25.6
Uranium-234	16.6	42.4
Uranium-235	1.46	4.04
Uranium-238	5.82	11.2

[a] Mean = Lognormal mean.

TABLE 5.1.9.1-2

SELECTED RESRAD CODE INPUT PARAMETERS, LOCATION 1A

PARAMETER	ASSUMPTION		RATIONALE
	RME[a]	MLE[b]	
Area of contaminated zone	40 m^2	40 m^2	Approximate length of excavation (265 ft) multiplied by 2 ft (assumes that release occurred along entire length of pipe and extended 1 foot laterally); site-specific and professional judgment, respectively.
Thickness of contaminated zone	1 m	1 m	RESRAD default.
Depth of uncontaminated cover soil	0 m	0 m	Assumes construction activities expose affected soil; professional judgment.
Evapotranspiration coefficient	0.999	0.999	RESRAD maximum.
Inhalation rate	19272 m^3/year	11388 m^3/year	Equal to 2.2 m^3/hour and 1.3 m^3/hour, respectively; Table 1 of RBCAP.
Mass loading	0.001g/m^3	0.0005 g/m^3	Cowherd, 1977.
Fraction of time outdoors (on-site)	0.023	0.008	Assumes one-tenth of 8 hours/day for 250 days/year and 90 days/year, respectively; Table 1 of RBCAP. A factor of one-tenth was applied to account for the fact that the area of contaminated zone would represent only a small fraction of a construction zone.
Soil ingestion rate	175 g/year	36.5 g/year	Equal to 480 mg/day and 100 mg/day, respectively; Table 1 of RBCAP and professional judgment, respectively.

[a]RME = Reasonable maximum exposure.
[b]MLE = More likely exposure.

Toxicity Assessment

As stated previously, the DCFs used in this dose assessment are default values provided in the RESRAD code and are listed in the RESRAD summary output files in Appendix C. The RESRAD output files contain DCFs for the radionuclides identified as COPCs as well as DCFs for important progeny of the COPCs. Additional information regarding DCFs is provided in Federal Guidance Reports Nos. 11 (EPA 1988, 0297) and 12 (EPA 1993, 1122).

Risk and Dose Characterization

All of the COPCs in this assessment are radionuclides; therefore, the results are presented in terms of dose, followed by an assessment of the overall uncertainty in the dose estimates.

Dose Estimates

As stated previously, the RESRAD computer code, Version 5.61, was used to estimate radiation doses for the COPCs, including any contribution from daughter products, in terms of a total effective dose equivalent. The dose estimates, rounded to 2 significant figures, are provided in Table 5.1.9.1-3; RESRAD summary output files are provided in Appendix C.

As shown in Table 5.1.9.1-3, the total radiation dose estimates associated with exposure to plutonium-239/240, uranium-234, uranium-235, and uranium-238 are 5.8 and 0.24 mrem/yr for the RME and MLE scenarios, respectively. These estimates are below the 15 mrem/yr annual dose limit proposed in the working draft of EPA's Radiation-site Cleanup Regulation, 40 CFR 196 (EPA 1994, 1316).

The radiation dose estimates for americium-241 based on the highest analytical observation are 28 and 2.9 mrem/yr for the RME and MLE scenarios, respectively. When combined with the dose estimates for the other COPCs, the total radiation dose estimates are 34 and 3.2 mrem/yr for the RME and MLE scenarios, respectively. The total radiation dose estimate for the RME scenario is approximately a factor of 2 higher than EPA's proposed limit of 15 mrem/yr; however, it is well below the 100 mrem/yr dose limit specified in DOE Order 5400.5. Greater than 90% of the total radiation dose is associated with americium-241. As discussed further in the following section, there is considerable uncertainty associated with the dose estimates for americium-241. Therefore, the fact that the total radiation dose estimate for the RME scenario is approximately two times above EPA's proposed limit does not necessarily mean that some corrective action needs to be taken.

Assessment of Uncertainty

Uncertainty is inherent in many aspects of the risk assessment process, and generally arises from a lack of knowledge of (1) COPC distribution at a site, (2) toxicity and dose-response of the COPCs, and (3) the extent to which an individual will be exposed to those chemicals. This lack of knowledge means that assumptions must be made based on information presented in the scientific literature or professional judgment. While some assumptions have significant scientific basis, others have much less. The assumptions that introduce the greatest amount of uncertainty and their effect on the dose estimates are discussed below. This discussion is qualitative in nature, reflecting the difficulty in quantifying the uncertainty in specific assumptions. In general, assumptions were selected in a manner that purposefully biases the process toward health conservatism.

TABLE 5.1.9.1-3

DOSE ESTIMATES FOR RADIOACTIVE COPCs, LOCATION 1A

COPC	SOIL INGESTION (mrem/yr)	DUST INHALATION (mrem/yr)	EXTERNAL GAMMA (mrem/yr)	PATHWAY SUM (mrem/yr)
MORE-LIKELY EXPOSURE (MLE) SCENARIO				
Plutonium-239/240	0.00047	0.13	0.000017	0.13
Uranium-234	0.000067	0.070	0.000042	0.070
Uranium-235	0.0000056	0.0057	0.0066	0.012
Uranium-238	0.000022	0.022	0.0046	0.027
			TOTAL (mrem/yr)	0.24
REASONABLE MAXIMUM EXPOSURE (RME) SCENARIO				
Plutonium-239/240	0.018	3.4	0.00014	3.4
Uranium-234	0.0024	1.7	0.00031	1.7
Uranium-235	0.00021	0.15	0.053	0.21
Uranium-238	0.00059	0.41	0.026	0.44
			TOTAL (mrem/yr)	5.8

Uncertainty Associated with Data Evaluation

As discussed in Section 5.1.4, confirmation samples were collected following removal of the WSWL from Location 1A and submitted for analysis of one or more suites of chemicals or radionuclides. With the exception of americium-241, these data are considered sufficient to adequately characterize the concentrations of the COPCs in subsurface soil at the site, based on the number and location of samples collected and the analyses completed. As stated previously, only one confirmation sample was collected during the 1996 investigation, and this was the only confirmation sample analyzed for americium-241. As a result, there is considerable uncertainty in the residual concentration of americium-241 at Location 1A, and inclusion of this radionuclide in the dose calculations at the highest observed concentration may result in an over- or underestimate of the total radiation dose.

Uncertainty Associated with Exposure Assessment

Source Term Concentrations

The highest observed concentration of americium-241 was used to represent the area-wide subsurface soil concentration construction workers might be exposed to throughout the construction period, although the lack of additional information means that this assumption may still underestimate the representative concentration. However, it is much more likely to be an overestimate because (1) americium-241 was not detected in the laboratory duplicate, and (2) elevated levels of alpha radiation were not recorded during field screening of the sample before being sent for analysis.

The results from the other confirmation samples collected from Location 1A may also support the conclusion that the highest observed concentration of americium-241 overestimates the representative concentration of this radionuclide. Although not analyzed for americium-241, the concentration of plutonium in these samples was low, which likely suggests that the concentration of americium was low for the following reasons. Americium-241 is a decay product of plutonium-241 and is a byproduct of the weapons-grade plutonium production process. Plutonium-241 is formed in relatively small quantities as compared to plutonium-239/240; therefore, the concentration of plutonium-239/240 is generally higher than the concentration of americium-241. Based on all of the samples collected from the WSWL that were analyzed for both plutonium-239/240 and americium-241, the ratio of plutonium to americium varied from approximately 3 to 70, with the exception of the single confirmation sample from Location 1A. In this sample, the ratio of plutonium to americium was approximately 0.05 (the concentration of americium-241 was approximately 20 times higher than the concentration of plutonium-239/240). This exception may be explained by the fact that as part of bench scale tests performed at TA-1, small amounts of americium may have been concentrated relative to plutonium as a result of purifying the plutonium. Otherwise, it is much more likely that residual concentrations of plutonium are higher than residual concentrations of americium.

Exposure Assumptions and Parameters

Location 1A is currently a part of an undeveloped property. Given that the WSWL was located between 4 and 6 ft below ground surface at this location, the most likely exposure to residual concentrations of the COPCs in subsurface soil would be limited to construction workers during site development, but only if that development requires significant intrusion into the subsurface. The circumstances under which development will occur some time in the future is unknown; therefore, this dose assessment is based on the assumption that future development of the property will result in worker exposure to subsurface soil in the vicinity of the former WSWL. This assumption will overestimate the potential doses during future development of the site if only limited or no contact with subsurface soil occurs in this part of the site.

This dose assessment included two scenarios, an RME scenario and an MLE scenario. The RME scenario is defined by the U.S. EPA as the highest exposure that could reasonably be expected to occur for a given exposure pathway at a site (EPA 1989, 0305). To achieve this goal, the RME scenario uses highly conservative exposure assumptions (soil ingestion rate nearly 10 times that recommended for workers, inhalation of dust at a level 10 times greater than ambient levels estimated for the Los Alamos area over a sustained period of time), thereby

most likely overestimating the radiation dose associated with the COPCs in subsurface soil at the site. Conversely, the MLE scenario is intended to provide a more realistic estimate of potential exposures to COPCs in subsurface soil (soil ingestion rate double that recommended for workers). Use of more likely estimates of exposure may underestimate the potential exposure for some individuals; however, it still likely represents a conservative estimate of "average" exposures.

Uncertainty Associated with Toxicity Assessment

The DCFs used in this assessment are associated with assumptions that contribute to uncertainty in dose estimates. Separate DCFs exist for internal and external exposure to radiation. DCFs do not evaluate the effects of radiation on pregnant women, infants, or children. These groups may have differing ratios of organ weights to body mass than those considered in Federal Guidance Reports 11 and 12, and may have different sensitivity to the effects of radiation. In addition, body disposition and uptake rates of certain radionuclides may also change with age. Given that the exposure scenario evaluated in this dose assessment is a construction worker scenario, this area of uncertainty in the DCFs may not be an issue for the receptor population evaluated in this dose assessment for Location 1A.

Uncertainty Associated with Dose Characterization

The uncertainties associated with dose characterization are generally the result of the combined uncertainties in the COPC distribution, exposure model and input assumptions, and toxicity criteria. As discussed above, the majority of the assumptions are believed to result in overestimates of dose; therefore, it is believed that the dose estimates in this assessment represent conservative estimates of dose associated with residual concentrations of the COPCs in subsurface soil at Location 1A.

5.1.9.2 Location 13

Data Evaluation

At Location 13, one chemical (lead) and one radionuclide (plutonium-230/240) were identified as COPCs based on the results of the screening assessment presented in Section 5.1.8. Consistent with the screening assessment, this risk and dose assessment is based on the results of confirmation samples collected from outside the pipe in 1994. The confirmation data are believed to adequately represent current conditions at Location 13.

Exposure Assessment

The conceptual site model for Location 13 was created based on the confirmation sampling results, current and potential future land use, and physical and chemical characteristics of the COPCs, as shown in Fig. 5.1.9.2-1. Each of the components of the conceptual site model is discussed below.

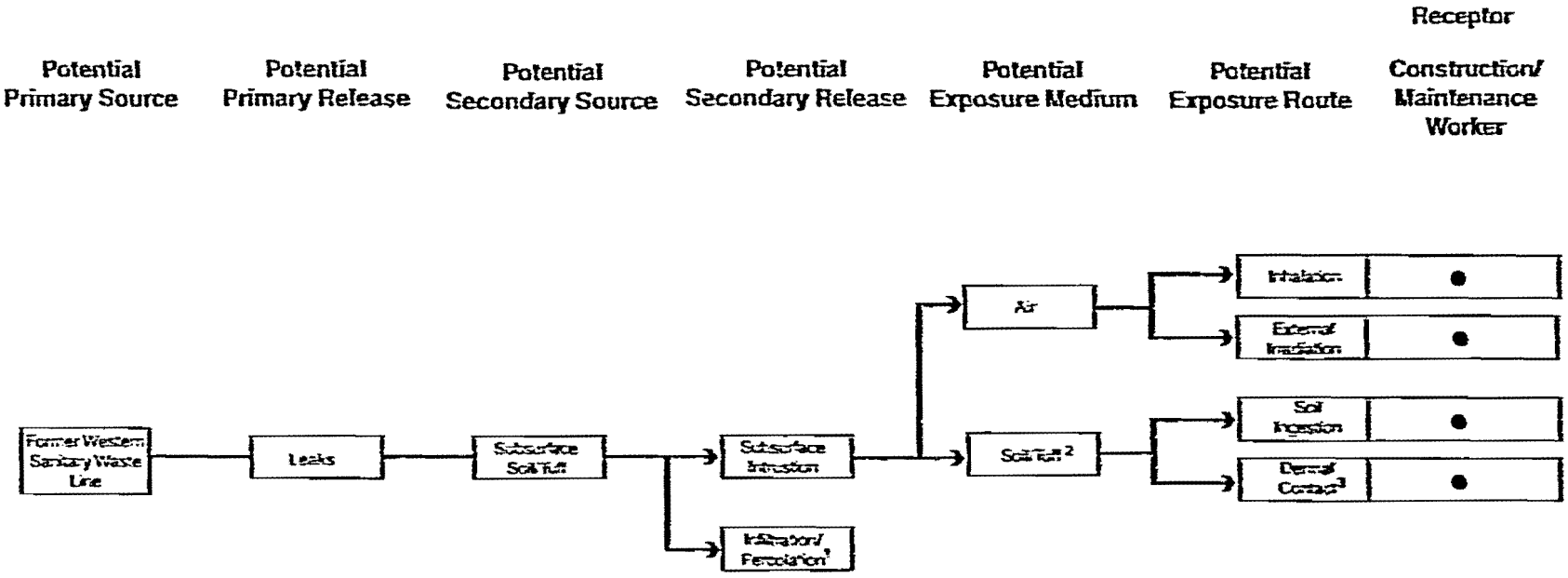
Evaluating Influence of Fate and Transport of COPCs

Both lead and plutonium-239/240 are nonvolatile and, if present on the surface, may be entrained by either surface water or the wind. Lead and plutonium-239/240 may also leach with infiltrating water; this transport pathway is more likely for lead than plutonium-239/240, especially under acidic conditions. In addition, plutonium-239/240 will generate progeny over time due to radioactive decay; however, the half-life of this radionuclide is long; therefore, its composition will not change appreciably in the foreseeable future. Based on these fate and transport characteristics, the COPCs at Location 13 are believed to be limited to subsurface soil in the vicinity of the former location of the WSWL, but may be exposed in a trench and resuspended in air as a result of subsurface intrusion (installation of subsurface utilities).

Identifying Potential Exposure Scenarios and Pathways

Location 13 is bounded by Trinity Drive to the north, the Los Alamos Inn to the east, Los Alamos Canyon to the south, and the Loma Vista apartments to the west. As discussed in Section 5.1.4.3, the WSWL was located approximately 3 to 4 ft below grade at Location 13. In addition, a three-story commercial building was constructed over the western portion of Location 13 in 1995. Therefore, there are no complete exposure pathways under current conditions. The most likely future receptor to residual concentrations of the COPCs would be construction or maintenance worker in the event that underground utilities require maintenance or new utilities are installed; however, exposure may be minimal to nonexistent if intrusive activities are limited. Assuming maintenance or construction activities do require significant intrusion into the subsurface in the vicinity of the former WSWL, future construction or maintenance workers may be exposed to the COPCs via the following pathways:

- Incidental ingestion of soil
- Dermal contact with soil (nonradiological COPCs only)
- Inhalation of resuspended particulates (dust)
- External irradiation



1 Infiltration/percolation of precipitation is expected to be limited at mesa top sites due to high rate of evaporation.

2 Soil and tuff are presumed to be exposed in trench during construction activities.

3 Applicable to non-radiological chemicals of potential concern.

Fig. 5.1.9.2-1. Conceptual site model for Location 13.

Similar to Location 1A, exposure to residual concentrations of the COPCs in subsurface soil is not expected to occur after construction/maintenance activities are completed; therefore, this risk and dose assessment is limited to an evaluation of potential impacts to a maintenance or construction worker.

Calculating Representative (Source Term) Concentrations

Similar to Location 1A, COPC concentrations that are considered representative of the average concentration to which an individual could be exposed over an extended period of time were estimated as described in Appendix B. These concentrations, rounded to 3 significant figures, are provided in Table 5.1.9.2-1.

As stated previously, the 95% UCL concentrations are used for the RME scenario and the mean concentrations are used for the MLE scenario.

Estimating Contaminant Intake and Dose

For the majority of nonradiological chemicals, intake is calculated in a deterministic manner as described in the Risk Assessment Guidance for Superfund, Part A (EPA 1989, 0305), and is expressed in units of milligrams per kilogram per day (mg/kg-day). However, for Location 13, the only nonradiological COPC is lead. Unlike other nonradiological chemicals, the potential health effects associated with exposure to lead are evaluated based on estimates of blood lead levels, which is expressed in units of micrograms per deciliter (µg/dl) rather than on estimates of intake because sufficient toxicology data exist to correlate the body burden of lead measured by blood lead level with a particular adverse effect. Therefore, intakes were not calculated for lead in this assessment.

As stated previously, exposure to radionuclides was evaluated using the RESRAD computer code. A subset of the most important intake parameters are provided in Table 5.1.9.2-2; copies of the summary output files, including all input parameters, are provided in Appendix C.

TABLE 5.1.9.2-1

SOURCE TERM CONCENTRATIONS, LOCATION 13

COPC	MEAN[a] (mg/kg) OR (pCi/g)	95% UCL (mg/kg) OR (pCi/g)
Lead	113	259
Plutonium-239/240	5.1	11.7

[a] Mean = Lognormal mean.

TABLE 5.1.9.2-2

SELECTED RESRAD CODE INPUT PARAMETERS, LOCATION 13

PARAMETER	ASSUMPTION		RATIONALE
	RME[a]	MLE[b]	
Area of contaminated zone	14 m^2	14 m^2	Approximate length of excavation (75 ft) multiplied by 2 ft (assumes that release occurred along entire length of pipe and extended 1 foot laterally); site-specific and professional judgment, respectively.
Thickness of contaminated zone	1 m	1 m	RESRAD default.
Depth of uncontaminated cover soil	0 m	0 m	Assumes construction activities expose affected soil; professional judgment.
Evapotranspiration coefficient	0.999	0.999	RESRAD maximum.
Inhalation rate	10272 m^3/year	11388 m^3/year	Equal to 2.2 m^3/hour and 1.3 m^3/hour, respectively; Table 1 of RBCAP.
Mass loading	0.001g/m^3	0.0005 g/m^3	Cowherd, 1977.
Fraction of time outdoors (on-site)	0.023	0.008	Assumes one-tenth of 8 hours/day for 250 days/year and 90 days/year, respectively; Table 1 of RBCAP. A factor of one-tenth was applied to account for the fact that the area of contaminated zone would represent only a small fraction of a construction zone.
Soil ingestion rate	176 g/year	36.5 g/year	Equal to 480 mg/day and 100 mg/day, respectively; Table 1 of RBCAP and professional judgment, respectively.

[a]RME = Reasonable maximum exposure.
[b]MLE = More likely exposure.

Toxicity Assessment

As stated previously, potential health effects associated with exposure to lead are evaluated in terms of blood lead level rather than in terms of intake. The Centers for Disease Control (CDC) have established a blood lead level of concern at 10 µg/dl for children. The U.S. EPA has developed a lead exposure model for estimating blood lead levels associated with intake of lead from food, water, air, and soil (EPA 1994, 1178). This model, which is referred to as the Integrated Exposure Uptake Biokinetic (IEUBK) model, is calibrated for use only for children ages 7 and younger. Given that the most likely receptor at Location 13 is a construction worker,

the IEUBK model cannot be used to evaluate potential health risks associated with lead at Location 13. Instead, a qualitative evaluation based on other factors is presented in the risk characterization.

As stated previously, the DCFs used in this assessment are default values provided in the RESRAD code; those values are listed in the RESRAD summary output files in Appendix C.

Risk and Dose Characterization

The risk characterization for the nonradionuclides and the dose characterization for the radionuclides are presented in the following sections, followed by an assessment of the overall uncertainty in the risk and dose estimates.

Nonradionuclides

Lead is the only nonradiological COPC. As stated previously, a quantitative assessment of the potential health risks associated with exposure to lead by a construction worker cannot be completed because the EPA's model for estimating blood lead levels cannot be used for adults. It should be noted, however, that EPA has established a PRG of 1000 mg/kg based on an industrial scenario (EPA 1996, 1351). Similar to SALs, EPA's PRG for lead is intended to represent a concentration in soil at which adverse health effects would not be expected to occur. As shown in Table 5.1.9.2-1, the mean and 95% UCL concentrations of lead at Location 13 are 113 and 259 mg/kg, respectively. These values are well below EPA's PRG of 1000 mg/kg, suggesting that potential exposures to residual concentrations of lead in subsurface soil should not pose a noncarcinogenic health risk to future construction workers.

Radionuclides

Plutonium-239/240 is the only radionuclide COPC. As stated previously, the RESRAD computer code was used to estimate radiation doses for this compound, including any contribution from daughter products, in terms of a total effective dose equivalent. The dose estimates, rounded to two significant figures, are provided in Table 5.1.9.2-3; RESRAD summary output files are provided in Appendix C.

As shown in Table 5.1.9.2-3, the total radiation dose estimates associated with exposure to plutonium-239/240 are 1.2 and 0.055 mrem/yr for the RME and MLE scenarios, respectively. These estimates are well below the 15 mrem/yr annual dose limit proposed in the working draft of EPA's Radiation-site Cleanup Regulation, 40 CFR 196 (EPA 1994, 1316) and the 100 mrem/yr dose limit specified in DOE Order 5400.5.

TABLE 5.1.9.2-3

DOSE ESTIMATES FOR RADIOACTIVE COPCs, LOCATION 13

COPC	SOIL INGESTION (mrem/yr)	DUST INHALATION (mrem/yr)	EXTERNAL GAMMA (mrem/yr)	TOTAL (mrem/yr)
MORE-LIKELY EXPOSURE (MLE) SCENARIO				
Plutonium-239/240	0.000074	0.055	0.0000070	0.055
REASONABLE MAXIMUM EXPOSURE (RME) SCENARIO				
Plutonium-239/240	0.0023	1.2	0.000046	1.2

Assessment of Uncertainty

As stated previously, uncertainty is inherent in many aspects of the risk assessment process, primarily due to the myriad of assumptions that must be made. The assumptions that introduce the greatest amount of uncertainty and their effect on the results of this assessment are discussed below. Similar to Location 1A, this discussion is qualitative in nature, reflecting the difficulty in quantifying the uncertainty in specific assumptions. In general, assumptions were selected in a manner that purposefully biases the process toward health conservatism.

Uncertainty Associated with Exposure Assessment

Location 13 is underneath or immediately adjacent to a newly constructed, multi-story office building. Given that the WSWL was located between 3 and 4 ft below ground surface at this location, the most likely exposure to residual concentrations of the COPCs in subsurface soil would be limited to a construction or maintenance worker in the event that underground utilities require maintenance or new utilities are installed. The need for and extent of maintenance or construction activities beneath or in the immediate vicinity of this new building is unknown; therefore, this assessment is based on the assumption that future maintenance or construction activities will result in worker exposure to subsurface soil in the vicinity of the former WSWL. This assumption will overestimate the potential health risks during future maintenance or construction at the site if only limited or no contact with subsurface soil occurs in this part of the site.

Similar to Location 1A, this assessment included two scenarios, an RME scenario and an MLE scenario. The RME scenario is intended to represent the highest exposure that could reasonably be expected to occur for a given exposure pathway at a site (EPA 1989, 0305). To achieve this goal, the RME scenario uses highly conservative exposure assumptions, thereby most likely overestimating the potential health risks associated with the COPCs in subsurface soil at the

site. Conversely, the MLE scenario is intended to provide a more realistic estimate of potential exposures to COPCs in subsurface soil. Use of more likely estimates of exposure may underestimate the potential exposure for some individuals; however, it still likely represents a conservative estimate of "average" exposures.

Uncertainty Associated with Toxicity Assessment

The methodology used to evaluate potential health risks associated with exposure to lead is different from that used for other nonradiological chemicals, and is currently focused on evaluating potential health effects in young children. Given that the most likely receptor at Location 13 is a maintenance or construction worker, this methodology could not be used to perform a quantitative evaluation in this assessment. However, based on a comparison of the source term concentrations to EPA's Industrial PRG, it does not appear that residual lead concentrations pose a significant health risk to future maintenance or construction workers. With regard to radionuclide COPCs, the uncertainty associated with the toxicity assessment for Location 13 is the same as that discussed previously for Location 1A.

Uncertainty Associated with Risk or Dose Characterization

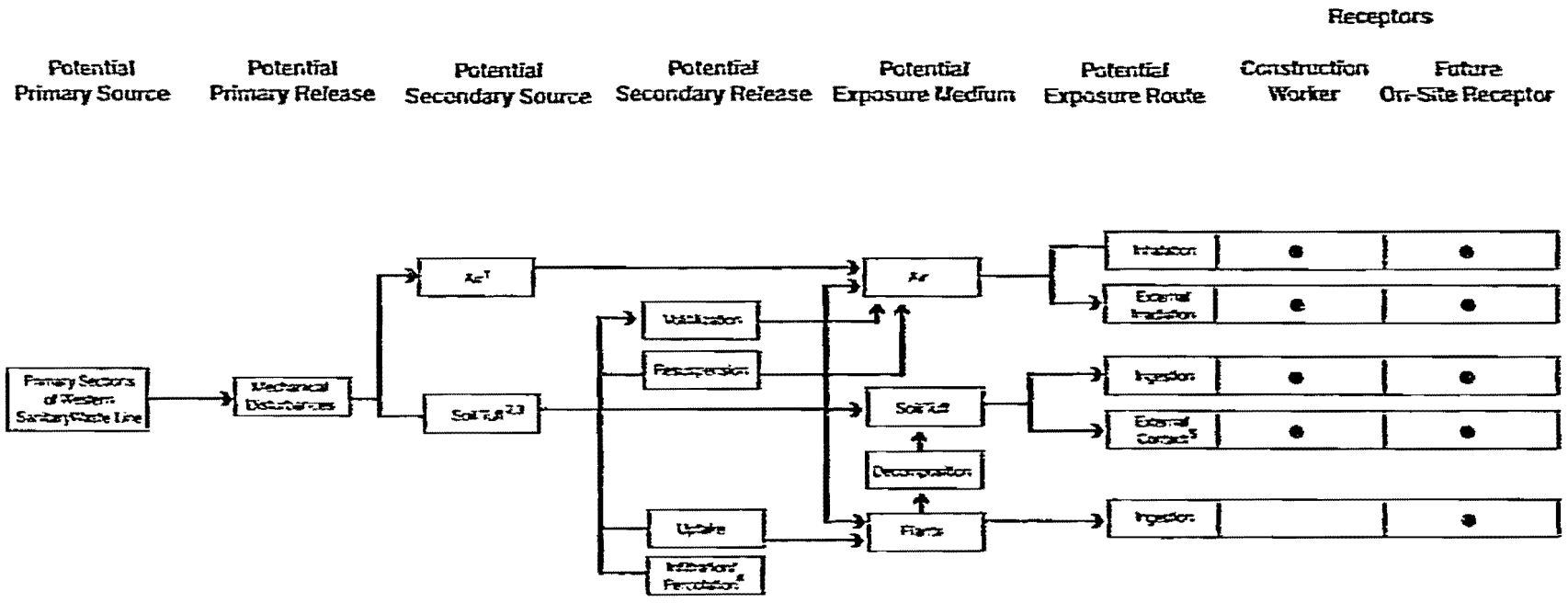
The uncertainties associated with dose characterization are generally the result of the combined uncertainties in the site conditions, exposure assumptions, and toxicity criteria. As discussed above, the majority of the assumptions are believed to result in overestimates of dose; therefore, it is believed that the dose estimates in this assessment represent conservative estimates of dose associated with residual concentrations of the COPCs in subsurface soil at Location 13.

5.1.9.3 Inside the Pipe

Data Evaluation

Twenty-five chemicals were identified as COPCs based on the results of the screening assessment presented in Section 5.1.8, as shown in Table 5.1.9.3-1.

Consistent with the screening assessment, this risk and dose assessment is based on the results from samples collected from inside the pipe at Locations 1A; 10 and 11; and 13. These data are believed to adequately represent the concentrations of COPCs that may be present inside the remaining sections of the WSWL.



1 Immediate exposure.

2 Immediate and long-term exposure.

3 Soil and tuff are presumed to be exposed, either in a trench during construction activities or on the surface following construction activities.

4 Infiltration or percolation of precipitation expected to be limited at mesa top sites due to high rate of evaporation.

5 Applicable to non-radiological chemicals of potential concern.

Fig. 5.1.9.3-1. Conceptual site model for inside the pipe.

Split • 05/05/97 • 4:34

Exposure Assessment

The conceptual site model for inside the pipe was created based on the aforementioned sampling results, current and potential future land use of properties where the WSWL may still remain, and physical and chemical characteristics of the COPCs, as shown in Fig. 5.1.9.3. Each of the components of the conceptual site model is discussed below.

Evaluating Influence of Fate and Transport of COPCs

The COPCS can be divided into three general categories: semivolatile organic compounds (SVOCs), primarily polycyclic aromatic hydrocarbons (PAHs); high atomic weight nonradioactive metals; and high atomic weight radionuclides. The COPCs that are SVOCs are essentially non-volatile, although 1,4-dichlorobenzene does have some potential to volatilize. Therefore, it is most likely that the SVOC COPCs, if present on the surface, may be entrained by either surface water or the wind or may leach with infiltrating water. These pathways are also applicable to the metals and radionuclides. With the exception of cesium-137, the radionuclide COPCs will generate progeny over time due to radioactive decay; however, the half-lives of these radionuclides is long; therefore, their composition will not change appreciably in the foreseeable future. Cesium-137 decays to nonradioactive cesium; the half-life of this decay is approximately 30 years. Based on these general fate and transport characteristics, it would be expected that, in the event the material from within the remaining sections of the pipe is released (breakage during removal) the COPCs would initially be limited to the soil in the immediate vicinity of the release (either in a trench or on the surface), but may subsequently be entrained in air or water.

TABLE 5.1.9.3-1

CHEMICALS OF POTENTIAL CONCERN, INSIDE THE PIPE

NONCARCINOGENS	CARCINOGENS (NONRADIOACTIVE)	RADIONUCLIDES
Antimony	Benzo(a)anthracene	Americium-241
Cadmium	Benzo(a)pyrene	Cesium-137
Copper	Benzo(b)fluoranthene	Plutonium-239/240
Iron	Benzo(k)fluoranthene	Uranium-234
Lead	Chromium	Uranium-235
Mercury	Dibenzo(a,h)anthracene	Uranium-238
Nickel	1,4-Dichlorobenzene	
Silver	Indeno(1,2,3-cd)pyrene	
Thallium		
Uranium (total)		
Zinc		

Identifying Potential Exposure Scenarios and Pathways

As shown on Fig. 1.2.1-2, sections of the WSWL may be present at several locations along Trinity Drive. These locations are believed to be underneath existing buildings, sidewalks, and roads, or in the immediate vicinity of active underground utilities (gas or electrical lines) such that removal of the pipe under current conditions is impractical. Therefore, there are no complete exposure pathways under current conditions. The most likely future receptor to COPCs inside the pipe some time in the future would initially be a construction worker in the event that the pipe is encountered as part of a future construction or utility repair project. It also is possible that the pipe would be removed as part of the construction/repair project, and material inside the pipe could be inadvertently deposited on the surface. In that event, other future receptors would depend on land use, but could include workers or residents. The pathways through which these receptors could be exposed to COPCs from inside the pipe also will depend on land use, but could include the following:

- Incidental ingestion of soil
- Dermal contact with soil (nonradiological COPCs only)
- Inhalation of resuspended particulates (dust)
- External irradiation
- Ingestion of homegrown produce

Calculating Representative (Source Term) Concentrations

For Locations 1A and 13, estimates of COPC concentrations that could be considered representative of the average concentration to which an individual could be exposed over an extended period of time were based on soil samples collected at each location. For inside the pipe, estimation of representative (or source term) concentrations is complicated by the fact that there is very little material remaining inside the pipe and the fact that the pipe must be disturbed in order for an individual to come into contact with this material. While it is possible that a receptor could be exposed to the material from inside the pipe at the time the pipe is disturbed, longer term exposure would be associated with lower concentrations of the COPCs following mixing with surrounding soil. As a starting point, estimates of the COPC concentrations in the material remaining inside the pipe were calculated as described in Appendix B. These concentrations, rounded to 3 significant figures, are provided in Table 5.1.9.3-2.

TABLE 5.1.9.3-2

SOURCE TERM CONCENTRATIONS, INSIDE THE PIPE

COPC	MEAN[a] (mg/kg)OR (pCi/g)	95% UCL (mg/kg)OR (pCi/g)
Americium-241	41.3	94.0
Antimony[b]	0.245	18.0
Arsenic	17.1	25.9
Benzo(a)anthracene[b]	0.550	2.3
Benzo(a)pyrene[b]	0.600	21
Benzo(b)fluoranthene[b]	0.600	20
Benzo(k)fluoranthene[b]	0.600	18
Cadmium	333	911
Cesium-137	1.50	1.76
Chromium	57.6	95.6
Copper	1480	2560
Dibenzo(a,h)anthracene[b]	0.205	2.7
1,4-Dichlorobenzene[b]	0.185	4
Indeno(1,2,3-cd)pyrene[b]	0.600	4.9
Iron	50800	87500
Lead	1840	3030
Mercury	145	261
Nickel	57.2	89.7
Plutonium-239/240	157	325
Silver	26.2	45.2
Thallium[b]	0.45	1.6
Uranium (total)	183	283
Uranium-234	121	193
Uranium-235	4.78	7.57
Uranium-238	54.5	86.4
Zinc	991	2150

[a] Mean = Lognormal mean.
[b] Data were insufficient to calculate a mean and 95% UCL; therefore, the median and maximum values are used (see Appendix B).

Estimating Contaminant Intake and Dose

As discussed previously, intake for nonradiological chemicals is calculated in a deterministic manner as described in the Risk Assessment Guidance for Superfund, Part A (EPA 1989, 0305) and radiation dose for radionuclides is calculated using the RESRAD computer code developed for the Department of Energy by the Argonne National Laboratory. However, these calculations are complicated for the COPCs inside the pipe due to the uncertainty in the manner in which a receptor could be exposed and the COPC concentrations that would be representative of that exposure. As discussed above, it is possible that a construction worker could be exposed to the material inside the pipe at the time the pipe is disturbed. The duration of this exposure is expected to be very short, on the order of minutes, before the material is mixed with the surrounding soil. Chemical toxicity criteria and radionuclide DCFs are not well suited to evaluating this type of acute exposure; therefore, this exposure scenario will be evaluated qualitatively in the dose and risk characterization.

Chemical intakes and radiation doses associated with longer term exposure to the COPCs inside the pipe once they have mixed with surrounding soil also are not directly calculated using the estimated source term concentrations because it is impossible to predict the volume of soil the material from inside the pipe would be mixed with after the pipe is disturbed. Instead, potential health risks associated with this scenario are qualitatively evaluated based on (1) an estimate of the volume of soil that would be required such that the concentrations of the COPCs would be reduced to insignificant levels and (2) assessment of the likelihood of that level of mixing would occur. This was accomplished by using a method similar to the multiple chemical evaluation described in the screening assessment, as described below.

Step 1 • Estimate Total Normalized Values

The COPCs were divided into three groups: noncarcinogens, carcinogens (nonradioactive), and radionuclides. Using the mean or 95% UCL concentration presented in Table 5.1.9.3-2 and the SALs, a total normalized value was calculated for each class of chemicals. The results of these calculations using the 95% UCL concentrations for the noncarcinogenic COPCs is shown in Table 5.1.9.3-3; the calculations for all three classes of chemicals are included in Appendix C.

Two COPCs, arsenic and iron, do not have SALs; therefore, they are not included in this part of the evaluation. The mean and UCL concentrations of arsenic and iron are approximately two to four times higher than their respective background screening values. It is expected that the concentrations of these chemicals could be reduced to background levels during any kind of construction or maintenance activities that disturbed the pipe. Therefore, the omission of arsenic and iron from this evaluation should not have a significant effect on the overall results.

TABLE 5.1.9.3-3

TOTAL NORMALIZED VALUE FOR NONCARCINOGENIC CHEMICALS OF POTENTIAL CONCERN, INSIDE THE PIPE

COPC	UCL (mg/kg)	SAL (mg/kg)	NORMALIZED VALUE
Antimony[a]	18	31	0.58
Cadmium	911	38	24
Copper	2500	2800	0.92
Lead	3030	400	7.6
Mercury	201	23	11
Nickel	89.7	1500	0.060
Silver	45.2	380	0.12
Thallium	1.6	5.4	0.30
Uranium (total)	283	230	1.2
Zinc	2150	23000	0.093
		Total[b]:	46

[a] Data were insufficient to calculate a 95% UCL; therefore, the maximum value is used (see Appendix B).
[b] Total may not equal sum of normalized values due to rounding.

Therefore, a uniform volume of material containing these concentrations of noncarcinogenic COPCs must be reduced by approximately a factor of 46 so that, based on residential exposure assumptions, the total normalized value would be equal to 1, thereby suggesting that exposure to the mixed material should not pose a noncarcinogenic health risk. As shown in Appendix C, the reduction factors for carcinogens (nonradioactive) and radionuclides based on the 95% UCL concentrations in Table 5.1.9.3-2 are approximately 450 and 35, respectively. Using the mean concentrations in Table 5.1.9.3-2, the reduction factors are approximately 21, 10, and 10 for the noncarcinogens, carcinogens (nonradioactive), and radionuclides, respectively.

Step 2 - Calculate the Volume of Soil Necessary to Achieve Estimated Reduction

The volume of soil necessary to reduce the COPC concentrations such that the total normalized value would be equal to 1 for each class of COPCs is dependent on the reduction factor calculated above, the volume of material inside the pipe, and the length of pipe disturbed. The volume of material inside the pipe was estimated based on field observations during removal of approximately 300 ft of pipe from Locations 10 and 11 and some assumptions regarding the distribution of this material in the pipe. Based on the field observations, it was estimated that an average of approximately one-sixteenth of an inch of material was present inside the pipe. The total volume of material in this length of pipe was estimated in two ways, first by assuming that one-sixteenth of an inch of material was present as film over one-half of the pipe and second by assuming that one-sixteenth of an inch of material was present as a small pile on the bottom of the pipe. Based on these assumptions, the total volume of material in this section

of the pipe was estimated to be approximately 1.64 or 0.123 cubic ft, respectively. Given that 300 ft of pipe were removed, the volume of material per linear foot of pipe is equal to approximately 0.005 cubic ft or 0.0004 cubic ft, respectively. For the purposes of this assessment, the more conservative estimate of 0.005 cubic ft per linear foot was used in conjunction with the UCL concentrations and the less conservative estimate of 0.0004 cubic ft per linear foot was used in conjunction with the mean concentrations. The detailed calculations are shown in Appendix C.

The length of pipe that would be disturbed is dependent on a number of factors, including the type of construction project and the size of the construction area. For the purposes of this assessment, a soil volume was estimated assuming 10, 50, or 100 ft of pipe was disturbed.

This step in the process is illustrated below using the UCL concentrations for the noncarcinogenic COPCs; the calculations for all three classes of chemicals are included in Appendix C.

Volume of Soil = Reduction Factor x Volume of Material

Assuming 0.005 cubic ft per linear foot and that 10 ft of pipe are disturbed, the total volume of material is 0.05 cubic ft. Therefore, if the reduction factor is 46, then the volume of soil required to reduce the COPC concentrations such that the total normalized value would be equal to 1 is equal to

Volume of Soil = 46 X 0.05 cubic ft = 2.3 cubic ft

To put this volume of soil into some perspective, the area that this volume of soil would cover assuming it was spread evenly to a depth of six inches was estimated. A depth of six inches was chosen because it is commonly used to define the layer of surface soil to which an individual would be exposed. Given a soil volume of 2.3 cubic ft, the soil would cover an area of approximately 7.6 square ft, which is equivalent to a circle approximately 2.4 ft in diameter. In the event that 50 or 100 ft of pipe are disturbed, the diameters of the resulting circles would be approximately 5.4 and 7.7 ft, respectively.

The estimates of the diameters of the circles for each class of chemicals are summarized in Table 5.1.6.3-4; the complete calculations are presented in Appendix C. Circles were used in this assessment because they optimize the geometry for external irradiation as well as being convenient for purposes of placing the results in some perspective.

TABLE 5.1.9.3-4

ESTIMATES OF CIRCLE DIAMETERS SUCH THAT TOTAL NORMALIZED VALUE IS EQUAL TO ONE

LENGTH OF PIPE DISTURBED	CIRCLE DIAMETER (ft)	
	UCL OR MAXIMUM	MEAN[a] OR MEDIAN
NONCARCINOGENIC EFFECTS		
10	2.4	0.46
50	5.4	1.0
100	7.7	1.5
CARCINOGENIC EFFECTS OF CHEMICALS		
10	7.6	0.41
50	17	0.92
100	24	1.3
CARCINOGENIC EFFECTS OF RADIONUCLIDES		
10	2.1	0.44
50	4.7	0.99
100	6.7	1.4

[a] Mean = Lognormal mean.

Toxicity Assessment

As described above, this risk and dose assessment utilizes SALs to evaluate potential health risks associated with exposure to the COPCs inside the pipe. For nonradiological chemicals, the toxicity criteria used to calculate SALs are RfDs and SFs for noncarcinogens and carcinogens, respectively. The bases for these criteria are briefly discussed below.

RfDs are developed based on the concept that a threshold dose exists below which adverse effects are not likely to be observed. For the purposes of establishing RfDs, this threshold dose is usually estimated from the no-observed adverse effect level (NOAEL) or the lowest-observed adverse effect level (LOAEL) determined in chronic animal exposure studies. Uncertainty factors are applied to these threshold doses in an attempt to account for limitations in the quality or quantity of available data. Most RfDs include a 100-fold uncertainty factor: a factor of 10 to account for the potential uncertainties in extrapolating animal data to human health effects, and another factor of 10 to account for the possible differences in sensitivity within the human population. Additional safety factors may be applied if the database is incomplete, a LOAEL is used to establish the RfD, or the chemical is considered persistent or bioaccumulative. Once developed, the RfDs are intended to represent the dose of a chemical that is not expected to cause adverse health effects over a lifetime of daily exposure, even in sensitive individuals, with a substantial margin of safety.

Conversely, SFs are developed based on the concept that there is no threshold of exposure below which a carcinogenic response may not occur (for all doses, some risk is assumed to be

present). To estimate theoretically plausible responses at very low doses, various mathematical models are used. The accuracy of the projected risk depends on how well the model predicts the true relationship between dose and risk at levels where this relationship cannot be actually measured. The accuracy of these models is currently unknown, but they are believed not to underestimate the true risk. SFs are developed by EPA using the linearized multi-stage model, and are defined as the 95% UCL of the probability of a carcinogenic response per unit daily intake of a chemical over a lifetime of exposure. By using the 95% UCL, the estimate of carcinogenic response will be conservative and will purposefully overestimate the actual risk posed by the chemical.

EPA's Integrated Risk Information System (IRIS) and Health Effects Assessment Summary Tables (HEAST) are the primary sources of RfDs and SFs used to calculate SALs. For radionuclides, DCFs provided in the RESRAD code are used to calculate SALs. As stated previously, additional information regarding the development of DCFs can be found in Federal Guidance Reports Nos. 11 (EPA, 1988, 0297) and 12 (EPA 1993, 1122).

Risk and Dose Characterization

The risk and dose characterizations for very short-term exposure to material inside the pipe and longer-term exposure to material inside the pipe after it has mixed with the surrounding soil are presented in the following sections, followed by an assessment of the overall uncertainty in these characterizations.

Short-Term Exposure to Material Inside the Pipe

Very short-term exposure to the material inside the pipe is not expected to pose a significant health risk for several reasons. First, based on field observations, there appears to be very little material remaining inside the pipe, on the order of only one-sixteenth of an inch. Therefore, the potential to be exposed to a significant volume of this material is low. Second, the concentrations of most COPCs are near (within a factor of 10) their respective SALs (based on the more conservative scenario of long-term exposure by a resident) and suggest that short-term exposure to material inside the pipe should not pose a health risk. The COPCs with the largest difference between measured concentrations and SALs are the PAHs, i.e., benzo(a)pyrene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene. These chemicals were detected in only a few samples such that a UCL could not be calculated. Therefore, the maximum detected concentrations used in this analysis would not be representative of what an individual would be exposed to, even if that exposure was short term. In addition, adverse health effects associated with exposure to these chemicals are generally seen only after long-term exposure; they are not considered to be acutely toxic (Clement International Corporation 1993, 1404).

Finally, acute radiation effects such as nausea are generally not observed until acute radiation exposure approaches approximately 5 rad (Moe 1992, 09-0517). The 5 rad value is equivalent to approximately 100 000 mrem for alpha-emitting radionuclides such as plutonium-239/240. Given that the UCL concentrations for the radioactive COPCs are at most a factor of 14 greater than the SAL, which is based on an annual dose rate of only 10 mrem, acute radiation effects should not be of concern.

Longer-Term Exposure to Material Inside the Pipe

Potentially longer-term exposure to the material inside the pipe after it has been mixed with some amount of the surrounding soil also is not expected to pose a significant health risk. Depending on the COPC concentration (UCL or maximum vs. mean or median), the volume of material inside the pipe, and the length of pipe removed, the diameter of the circle representing a volume of soil necessary to reduce the COPC concentrations such that the total normalized value would equal 1 for each class of chemicals ranged from approximately 0.5–24 ft, with the highest diameters based on the maximum concentrations of benzo(a)pyrene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene, all of which were detected in only a few samples. Even so, a 24-ft diameter circle, which represents an area of approximately 500 square ft, is relatively small compared to the standard residential exposure unit of 500 square meters or approximately 5 400 square ft. In addition, the SALs contain implicit assumptions regarding the size of the contaminated area; for nonradiological COPCs, the SALs assume that the contaminated area is approximately one-half acre (2 000 m^2), unlike the SALs for radioactive COPCs, which assume that the contaminated area is 10 000 m^2. In both cases, the assumed contaminated areas are large compared to the maximum estimated circle diameter, thereby adding another level of conservatism to this analysis. A smaller area of contamination implies that receptors would spend proportionately less time year in and year out exposed to the contaminants. It is appropriate and conservative to assume that exposure to small areas of contamination will scale in proportion to a residential exposure unit, so we assume that the health risk will be similarly decreased.

Assessment of Uncertainty

Uncertainty is inherent in many aspects of the risk assessment process, primarily due to the myriad of assumptions that must be made. The assumptions that introduce the greatest amount of uncertainty and their effect on the results of this assessment are discussed below. Similar to the discussions for Locations 1A and 13, this discussion is qualitative in nature, reflecting the difficulty in quantifying the uncertainty in specific assumptions. In general, assumptions were selected in a manner that purposefully biases the process toward health conservatism.

Uncertainty Associated with Exposure Assessment

Source Term Concentrations

A mean and 95% UCL concentration was estimated for the majority of the COPCs inside the pipe. However, the majority of the carcinogens (nonradioactive) were detected in too few samples to make meaningful estimates of these statistics; therefore, the median and maximum concentrations were used. Given that the highest reduction factor, and therefore the largest circle diameter, was estimated for this class of chemicals, it is likely that the use of the maximum concentrations overestimates the volume of soil necessary to reduce the COPC concentrations to levels that would not be associated with adverse health effects.

Exposure Assumptions and Parameters

This risk and dose assessment utilizes SALs to evaluate potential health risks associated with exposure to the COPCs inside the pipe. SALs are based on conservative estimates of exposure to a resident over a lifetime. Therefore, use of the SALs may overestimate the volume of soil necessary to reduce the COPC concentrations to levels that would not be associated with adverse health effects in non-residential areas such as current industrial properties, streets, sidewalks, and parking lots. On the other hand, the estimated soil volumes may be underestimated for residential properties where ingestion of homegrown produce is possible, because the SALs for nonradiological chemicals do not account for this exposure pathway.

Uncertainty Associated with Toxicity Assessment

One of the largest sources of uncertainty in any risk assessment of nonradiological chemicals is generally associated with the toxicity criteria used to estimate noncarcinogenic and carcinogenic health risks. The noncarcinogenic toxicity criteria (RfDs) incorporate one or more uncertainty factors to account for the limitations in the quality of available data (animal data in lieu of human data). The carcinogenic toxicity criteria (SFs) are based on a mathematical extrapolation from high to low doses. Both of these methods are conservative to ensure that the noncarcinogenic and carcinogenic health risks are far more likely to be overestimated than underestimated.

The uncertainty associated with DCFs used in this dose assessment is the same as discussed previously for Location 1A.

Uncertainty Associated with Risk or Dose Characterization

The uncertainties associated with risk and dose characterization are generally the result of the combined uncertainties in the site conditions, exposure assumptions, and toxicity criteria discussed above. An additional uncertainty associated with this assessment is related to the qualitative nature of the evaluation of potential short-term exposure to the material inside the pipe. For nonradiological chemicals, there are relatively few criteria available from which to evaluate very short-term exposures. Therefore, this qualitative evaluation was based on comparisons of the source term concentrations to SALs. Although SALs are based on long-term exposure, the fact that the majority of COPCs were measured at concentrations within a factor of 10 of their respective SALs strongly suggests that the potential for acute adverse health effects is low. For radionuclides, the source term concentrations are orders of magnitudes below the levels that would be associated with acute radiation effects.

5.1.10 Preliminary 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 ecological risk assessment at Aggregate N will be deferred until the site can be assessed as part of the ecological exposure unit methodology currently being developed.

5.1.11 Conclusions and Recommendations

The objectives of the Phase I site investigation at Aggregate N were to determine the presence or absence of radiological and/or hazardous contaminants, and if COPCs are identified, to determine whether the PRSs associated with these aggregates posed a risk to human health and/or the environment and whether NFA status could be recommended for all PRSs within the aggregates.

Based on the investigation results, no chemical constituents were found in quantities sufficient to indicate adverse human health effects. Although radioisotopes are likely to remain in the remaining pipe that is inaccessible, quantities are insufficient to pose a future unacceptable human health risk, and therefore, PRS 1-001(s,u) is recommended for NFA. Because the process for ecological risk assessment is not established, the only recommendation given is for human health risk. The entire line could not be investigated because some portions were inaccessible. However, the hundreds of feet of pipe removed provided evidence that was appropriately extrapolated to the short remaining portions.

5.2 Aggregate P, Trinity Drive

Aggregate P, also referred to as Trinity Drive, consists of two PRSs. PRS 1-006(a) is a storm drain and outfall for Building P, and PRS 1-007(l) is an area of suspected subsurface soil contamination associated with Building D (Fig. 1.2.2-1).

5.2.1 History

Aggregate P is discussed in detail in Section 6.18 of the RFI Work Plan for OU 1078 (LANL 1992, 0782).

PRS 1-006(a) served as the drainage for an area on the northwest side of Building P. Records indicate that Building P was used for personnel offices, and that no radioactive or hazardous materials other than toluene were used in this building. The open storm drain originated near the southwest corner of Building P and extended northwest along the north side of Trinity Drive for approximately 150 ft. Since Building P was an enclosed office building, there is no reason to believe that any constituents from Building P would have made their way into this storm drain and outfall (Ahlquist et al. 1977, 0016). Therefore, no potential constituents of concern were identified for PRS 1-006(a), and this PRS was listed as a nominee for NFA in the RFI Work Plan for OU 1078 (LANL 1992, 0782). As a result, PRS 1-006(a) was not sampled during the Phase I site investigation activities conducted for Aggregate P.

PRS 1-007(l) is an area of suspected subsurface soil contamination in the fill material under Trinity Drive. During the 1966 Trinity Drive widening and repaving project, fill material and other debris were reportedly transported from the former location of Building D for use as fill material. Between 1 310 and 2 760 cubic yds of fill material were reportedly removed from the Building D area for this project. The fill material contained soil, concrete fragments, pipe insulation, and other potentially contaminated debris from areas around Building D. Building D housed a facility for plutonium chemistry, metallurgy, and processing; therefore, the fill materials from the Building D area may have been potentially contaminated with uranium, plutonium, fission products, and various metals. Additional fill material for the road project was brought from areas outside LANL property.

5.2.2 Description

Aggregate P is currently owned by Los Alamos County (Weston 1989, 09-0036). This mesa top aggregate is located along present-day Trinity Drive and is bounded by 24th Street to the east and the access road into the Timber Ridge Condominiums complex to the west. All former TA-1 buildings in this aggregate have been removed, and the area adjacent to Trinity Drive is

currently occupied by Los Alamos County offices, commercial establishments, and two office buildings at Oppenheimer Drive and Trinity Drive.

5.2.3 Previous Investigations

Minimal sampling was performed in Aggregate P during the 1974-1976 Ahlquist survey (DOE 1988, 09-0006). At PRS 1-007(l), the 1977 Ahlquist summary report concluded that any remaining pockets of potentially contaminated soil used as fill material for the Trinity Drive project would have been greatly diluted by the mixing of the fill material from the Building D area with the fill material brought in from off-site sources (Ahlquist et al. 1977, 0016).

5.2.4 Field Investigation at Aggregate P

As discussed previously, the generic conceptual site model presented in the RFI Work Plan for OU 1078 was intended to encompass a wide variety of PRSs within TA-1 and contains components that are not applicable to Aggregate P. Residual contamination associated with the use of fill material beneath Trinity Drive would be present in subsurface soil or tuff, if at all. The primary receptors to this residual contamination would be construction or maintenance workers as a result of intrusion into subsurface soil or tuff in the vicinity of the fill material. The primary exposure routes associated with this type of construction or maintenance activity would be inhalation, ingestion, dermal contact, and/or external irradiation.

Aggregate P, September 1993 Field Activities

The September 1993 Phase I RFI sampling activities at Aggregate P were conducted as the opportunity became available during construction activities along the south side of Trinity Drive. Construction activities near the Giant service station and the Oppenheimer business complex involved excavating two trenches (east trench and west trench, respectively) to an approximate depth of 10 ft bgs (Fig. 5.2.4-1). Three subsurface grab samples were collected using a dedicated hand auger to bore horizontally underneath the sidewalk into the north side of the west trench; two samples were from the west trench and one sample was from the east trench. Each sample was field screened using a Ludlum 139™ alpha meter with an air proportional meter, an Eberline ESP-1™ beta/gamma meter with GM260 pancake probe, and an organic vapor analyzer (OVA). No elevated levels of radiological activity or organic vapors were detected during field screening. A summary of the samples collected from Aggregate P in September 1993 and the subsequent analyses requested is presented in Table 5.2.4-1.

Sampling activities conducted at Aggregate P were consistent with LANL QAPjP and QAPP requirements; however, no field replicate samples or rinsate samples were collected.

Aggregate P, July 1996 Field Activities

Additional Phase I RFI sampling activities were conducted at Aggregate P in July 1996. Four subsurface grab samples were collected at three locations (A, B, and C) from depth intervals associated with fill material. After asphalt and base course were removed at each location, hand augering was conducted to collect core/cuttings in continuous one-foot intervals. Each interval was field screened for radioactivity using a Ludlum 44-9™ GM probe to detect beta/gamma radiation and a Ludlum 2221™ with a Ludlum 43-44™ air proportional probe to detect alpha radiation. No elevated levels of radiological activity were detected during field screening. At each location, soil samples were collected and homogenized from core/cuttings intervals associated with fill materials and submitted to a MRAL for screening and to a fixed laboratory for analysis. After sample collection, each location was backfilled with unused core/cuttings and patched with asphalt. A summary of the samples collected from Aggregate P in July 1996 and the subsequent analyses requested is presented in Table 5.2.4-2.

TABLE 5.2.4-1

SUMMARY OF SAMPLES COLLECTED IN SEPTEMBER 1993 AT AGGREGATE P

SAMPLE INFORMATION				ANALYSES PERFORMED					
LOCATION ID	SAMPLE ID	DEPTH (ft bgs)	MATRIX	TAL METALS	VOCs	SVOCs	CESIUM-137	ISOTOPIC PLUTONIUM	ISOTOPIC URANIUM
01-41190	AAA41812	2-5	Soil	15799	15800	15800	15802	15802	15802
01-41191	AAA41813	5	Soil	15799	15800	15800	15802	15802	15802
01-41192	AAA41814	3.5	Soil	15932	15927	15927	15928	15928	15928

TABLE 5.2.4-2

SUMMARY OF SAMPLES COLLECTED IN JULY 1996 AT AGGREGATE P

SAMPLE INFORMATION				ANALYSES PERFORMED			
LOCATION ID	SAMPLE ID	DEPTH (ft bgs)	MATRIX	TAL METALS	ISOTOPIC PLUTONIUM	ISOTOPIC URANIUM	AMERICIUM-241
01-10131	0101-96-0051	.5-3.0	Soil	2371	2372	2372	2372
01-10132	0101-96-0052	.5-4.0	Soil	2371	2372	2372	2372
01-10133	0101-96-0053	0.5-1.3	Soil	2371	2372	2372	2372
01-10133	0101-96-0054	0.5-1.3	Soil	2371	2372	2372	2372

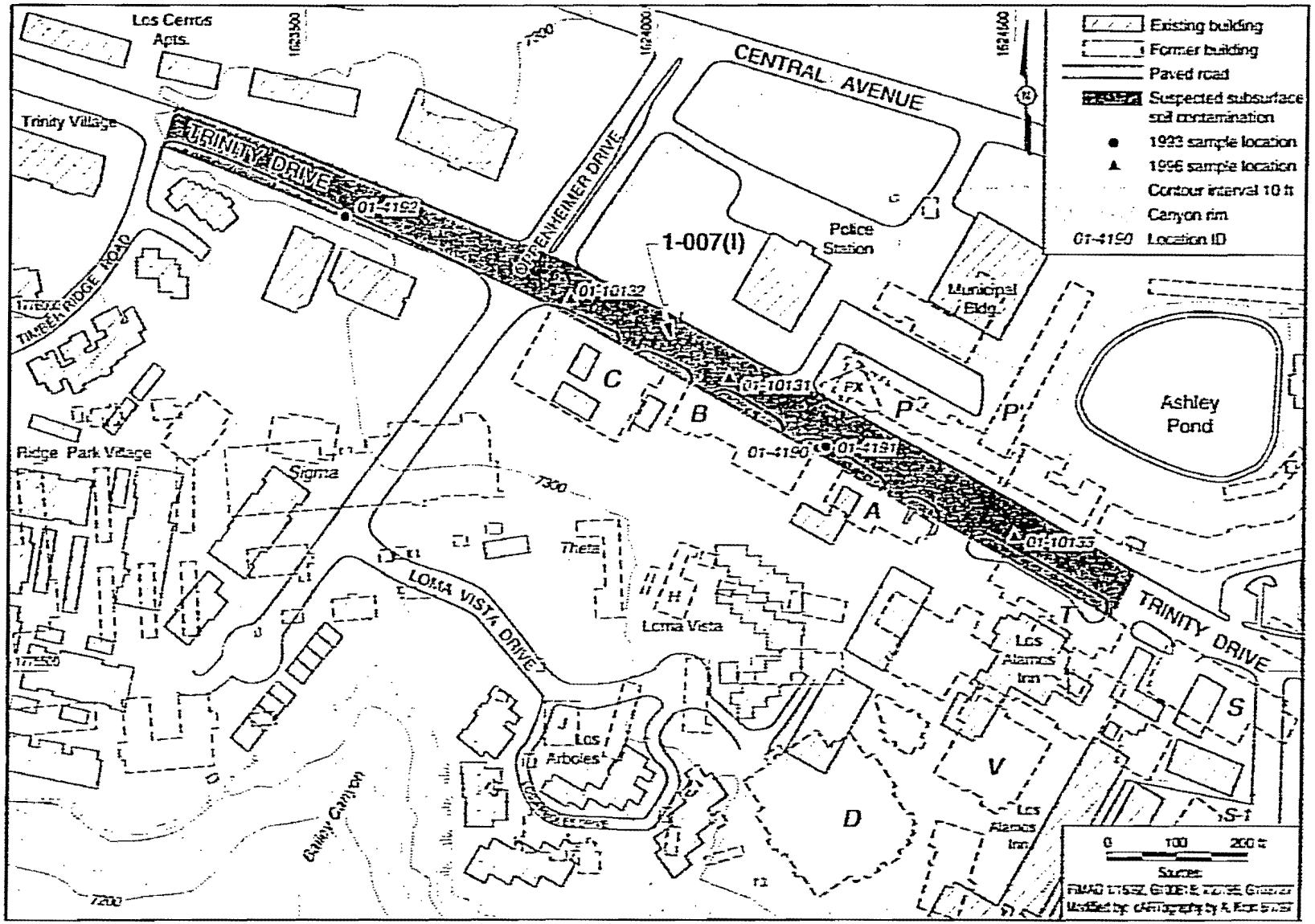


Fig. 5.2.4-1. Chemicals above background screening values at Aggregate P.

5.2.5 Evaluation of Inorganics

Three soil samples collected in 1993 at Aggregate P were analyzed for twelve metals (antimony, arsenic, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, silver, and thallium). Four soil samples collected in 1996 at Aggregate P were analyzed for the same twelve metals and an additional eleven metals (aluminum, calcium, cobalt, copper, iron, magnesium, manganese, potassium, sodium, vanadium, and zinc). Six inorganics (calcium, chromium, copper, lead, mercury, and nickel) were detected above their respective background screening values. Because there is not sufficient data to perform further statistical tests, all six of these inorganics are carried forward to the screening assessment. The data for these six inorganics are shown in Fig. 5.2.5-1 and Table 5.2.5-1.

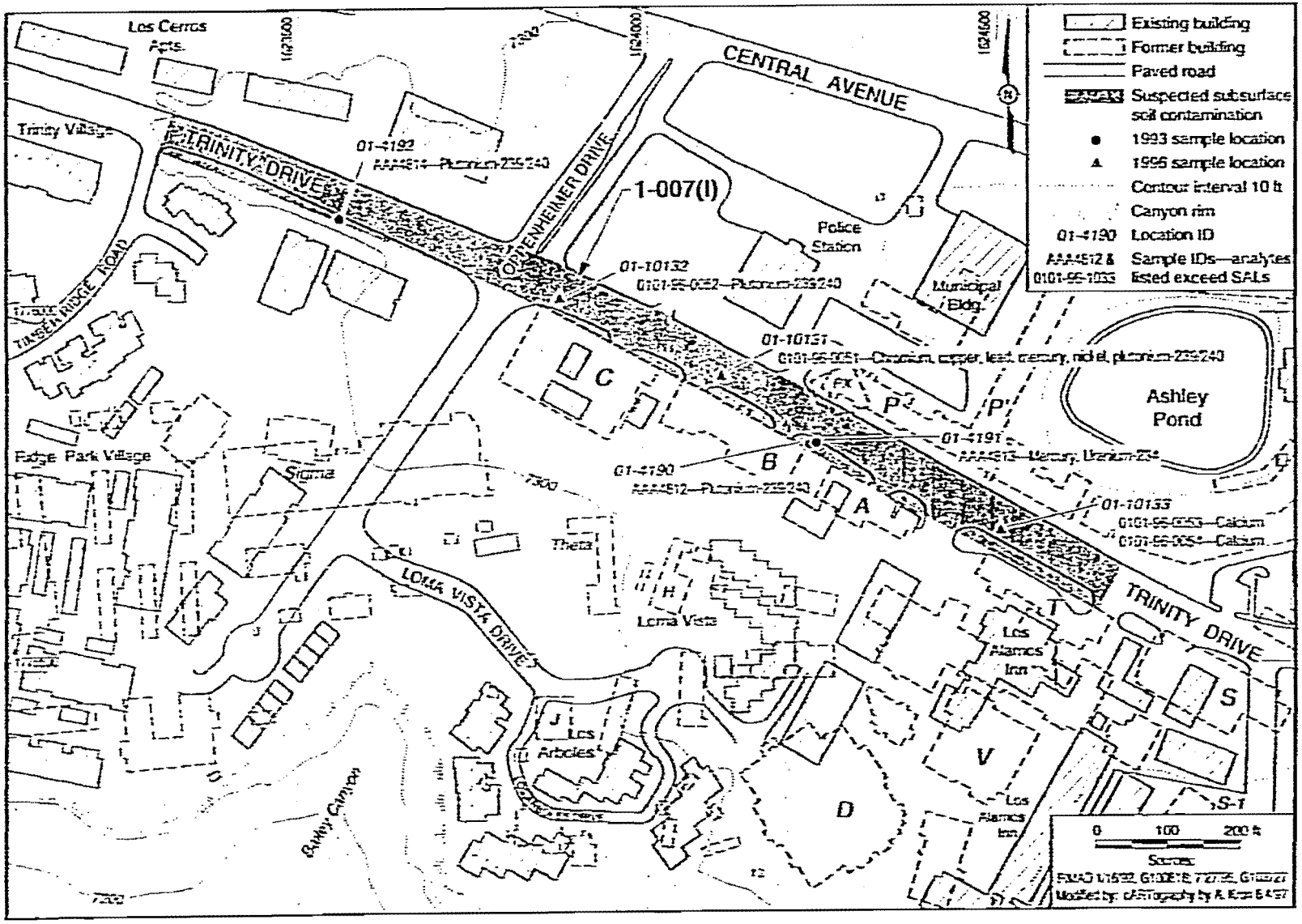


Fig. 5.2.5-1. Chemicals above background screening values at Aggregate P.

TABLE 5.2.5-1

INORGANICS WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT AGGREGATE P

LOCATION ID	SAMPLE ID	CALCIUM (mg/kg)	CHROMIUM (mg/kg)	COPPER (mg/kg)	LEAD (mg/kg)	MERCURY (mg/kg)	NICKEL (mg/kg)
UTL	N/A[a]	6120	19.3	15.5	23.3	0.1[b]	15.2
BAL	N/A	n/a[c]	210	2800	400	23	1500
01-4190	AAA4812	NA[d]	5.2	NA	3.5	0.1[b]	3
01-4191	AAA4813	NA	12	NA	13	0.2[e,f]	8
01-4192	AAA4814	NA	7	NA	63 (U)[g]	0.1 (U)[g]	5
01-10131	0101-95-0051	2100	110	17	68	0.78	53
01-10132	0101-95-0052	4200	13	6.6	12	0.11 (U)	7.8
01-10133	0101-95-0053	7100	4.8	3.8	5.4	0.11 (U)	4
01-10133	0101-95-0054	7000	5	5.4	6.2	0.11 (U)	4.9

[a] N/A = Not applicable.
[b] Value represents the maximum reported background concentration in soil.
[c] n/a = Not available.
[d] NA = Not analyzed.
[e] Value represents the maximum of a sample concentration and its laboratory duplicate.
[f] Values in bold are greater than the UTL.
[g] (U) = Not detected.

5.2.6 Evaluation of Radionuclides

Three soil samples collected in 1993 at Aggregate P were analyzed for cesium-137, isotopic plutonium, and isotopic uranium. Four additional soil samples collected in 1996 at Aggregate P were also analyzed for cesium-137, isotopic plutonium, and isotopic uranium. In addition, these four samples were also analyzed by gamma spectroscopy.

Analyses of radionuclides by gamma spectroscopy 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 of naturally occurring radionuclides. These three classes of radionuclides are generally not considered site contaminants for the reasons discussed below.

- Sixteen short-lived activation/fission products reported at Aggregate P (barium-140, cadmium-109, cerium-139, cesium-134, cobalt-57, europium-152, lanthanium-140, manganese-54, mercury-203, ruthenium-106, selenium-75, sodium-22, strontium-85, tin-113, yttrium-88, and zinc-65) have half-lives ranging from a few days to 2.6 years. Several of these radionuclides are used as internal standards to measure equipment

performance, laboratory background (or contamination), etc. 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 this PRS, these short-lived activation/fission products are eliminated as potential radionuclide contaminants.

- Potassium-40 is a naturally-occurring radionuclide that is also routinely reported by the analyst because it is used as an internal standard to measure such things as equipment performance, laboratory background (or contamination), etc. There is no process knowledge of the use of potassium-40 at this aggregate, and reported concentrations are generally within known background ranges for potassium-40 (Longmire et al. 1995,1142; Longmire et al. 1995,1266). Therefore, potassium-40 will not be considered a potential radionuclide contaminant at this site.

- Daughters of naturally occurring radionuclides (uranium and thorium) are also reported by gamma-spectroscopy analyses. These daughters (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. QA/QC activities review daughter radionuclides for consistency with parent activities, and any that can not be attributed to background concentrations of the parent are retained as potential contaminants.

EQLs and minimum detectable activities (MDAs) are often not available for radionuclides by gamma spectroscopy. A value of three times the measurement uncertainty (3 sigma or three standard deviations) is used to calculate a sample-specific MDA, which is then employed in the same manner as a detection limit. This methodology is similar to Currie's method of determining radionuclide maximum detectable activity (Currie 1968, 0792). This 3 sigma screening value takes into account variability due to counting statistics, but does not account for spectral peak identification problems. Thus, this 3 sigma screening is conservative, and may include radionuclides whose presence is spuriously reported due to spectral interferences or misidentifications. Cesium-137, cobalt-60, neptunium-237, and uranium-235 were eliminated from further consideration based on this criterion.

Of the remaining five radionuclides reported for Aggregate P, americium-241, plutonium-238, and uranium-238 were eliminated from further consideration based on background screening value criteria. Plutonium-239/240 and uranium-234 were detected above their background

screening values. The data for these two radionuclides are presented in Table 5.2.6-1. Plutonium-239/240 and uranium-234 are carried forward to the screening assessment.

TABLE 5.2.6-1

RADIONUCLIDES WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT AGGREGATE P

LOCATION ID	SAMPLE ID	PLUTONIUM-239/240 (pCi/g)	URANIUM-234 (pCi/g)
UTL	N/A[a]	0.092[b]	1.84
SAL	N/A	24	13
01-41190	AAA41812	**0.131**[c]	0.718
01-41191	AAA41813	0.025	2.30
01-41192	AAA41814	0.388	1.37
01-10131	0101-96-0051	**2.56**	**1.19**
01-10132	0101-96-0052	**0.74**	**0.8**
01-10133	0101-96-0053	0.011(U)	0.406
01-10133	0101-96-0054	0.009(U)	0.473

[a] N/A = Not applicable.
[b] Maximum reported background concentration from the Environmental Surveillance reports.
[c] Values in BOLD are greater than the UTL.

5.2.7 Evaluation of Organic Chemicals

Three soil samples collected in 1993 at Aggregate P were analyzed for VOCs and SVOCs. No organic chemicals were detected. Therefore, no organics are carried forward to the screening assessment.

5.2.8 Risk-Based Screening Assessment

Seven chemicals were carried forward from the evaluations of inorganic and organic chemicals. One of those chemicals, calcium, is an essential nutrient. A SAL has not been developed for this chemical; therefore, the potential significance of calcium was evaluated in terms of its RDA. Using the one maximum detected concentration and standard default assumptions for soil ingestion rate, the daily exposure to calcium was estimated to be 1.42 mg/day for children and 0.71 mg/day for adults. The RDA for calcium is 800 mg/day for 1–10 year olds and 1 200 mg/day for 11–24 year olds. These values are significantly higher than the estimated daily intakes; therefore, calcium is not considered further in this screening assessment.

None of the remaining six chemicals were detected at concentrations greater than SAL; therefore, these chemicals (chromium, copper, lead, mercury, nickel, and plutonium-239/240) are included in the following multiple chemical evaluation.

A multiple chemical evaluation is performed separately for three classes of analytes: noncarcinogens, carcinogens (nonradioactive), and radionuclides. In this case, all three classes of analytes were identified for the multiple chemical evaluation. However, lead is evaluated as a noncarcinogen because, even though it has been identified as a probable human carcinogen, a toxicity value has not been identified for this health endpoint. Given that chromium is the only other chemical considered to be a carcinogen (nonradioactive), a multiple chemical evaluation was not conducted for these health endpoints.

Table 5.2.8-1 presents the results of the multiple chemical evaluation for Aggregate P. The total normalized value is 0.2 for noncarcinogens. These results suggest that noncarcinogenic chemicals included in this multiple chemical evaluation should not pose a noncarcinogenic health risk. Therefore, none are identified as COPCs.

5.2.9 Human Health Risk Assessment

No human health risk assessment was conducted for Aggregate P PRSs because no COPCs were identified in the risk-based screening assessment.

TABLE 5.2.8-1

MULTIPLE CHEMICAL EVALUATION FOR SOIL SAMPLES FROM AGGREGATE P

CHEMICAL	LOCATION ID	SAMPLE ID	MAXIMUM SAMPLE VALUE (mg/kg)	SOIL SAL (mg/kg)	NORMALIZED VALUE
NONCARCINOGENIC HEALTH EFFECTS					
Copper	01-10131	0101-95-0051	17	2800	0.006
Lead	01-10131	0101-95-0051	68	400	0.2
Mercury	01-10131	0101-95-0051	0.78	23	0.03
Nickel	01-10131	0101-95-0051	53	1500	0.04
				Total[a]:	0.2

[a] Total may not equal sum of normalized values due to rounding.

5.2.10 Preliminary 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 ecological risk assessment will be deferred until the site can be assessed as part of the ecological exposure unit methodology currently being developed.

5.2.11 Conclusions and Recommendations

The objectives of the Phase I site investigation at Aggregate P were to determine the presence or absence of radiological and/or hazardous contaminants, and if COPCs are identified, to determine whether the PRSs associated with these aggregates posed a risk to human health and/or the environment and whether NFA status could be recommended for all PRSs within the aggregates. Because the process for ecological risk assessment is not established, the only recommendation given is for human health risk.

Based on the investigation results, no chemical constituents were found in quantities sufficient to indicate adverse human health effects. Although radioisotopes are likely to remain in the remaining pipe that is inaccessible, quantities are insufficient to pose a future unacceptable human health risk, and therefore, PRSs 1-006(e) and 1-007(l) are recommended for NFA.

6.0 REFERENCES

Ahlquist, A. J., A. K. Stoker, and L. K. Trocki, December 1977. "Radiological Survey and Decontamination of the Former Main Technical Area (TA-1) at Los Alamos, New Mexico," Los Alamos Scientific Laboratory Report LA-6887, Los Alamos, New Mexico. (Ahlquist et al. 1977, 0016)

Broxton, D. E., and P. G. Eller (Eds.), June 1995. "Earth Science Investigations for Environmental Restoration—Los Alamos National Laboratory Technical Area 21," Los Alamos National Laboratory Report LA-12934-MS, Los Alamos, New Mexico. (Broxton and Eller 1995, 1162)

Buckland, C., February 16, 1973. "Summary of Records Search for Radioactivity Remaining in TA-1, Acid Waste Lines, TA-10, TA-45, and Acid Canyon Below TA-45," Los Alamos Scientific Laboratory memorandum from C. Buckland to D. D. Meyer, Los Alamos, New Mexico. (Buckland 1973, 09-0008)

Clement International Corporation, October 1993. "Toxicological Profile for Polycyclic Aromatic Hydrocarbons," prepared under Contract No. 205-88-0608 for Agency for Toxic Substances and Disease Registry, US Department of Health and Human Services, Public Health Service, Washington, DC. (Clement International Corporation 1993, 1404)

Corps of Engineers, October 1943, "Los Alamos Project, Los Alamos, New Mexico, Record Drawing Area 'L' US Engineer Office, Albuquerque, New Mexico." (COE 1943, 09-0051)

Currie, L. A. (Ed.), 1988. "Detection in Analytical Chemistry: Importance, Theory, and Practice," 191st Meeting of the American Chemical Society, New York, New York, April 13-18, 1986, American Chemical Society, Washington, DC. (Currie 1988, 0792)

Dorries, A. M. (Ed.), June 1,1996. "Risk-Based Corrective Action Process," Revision 1, Los Alamos National Laboratory Report LA-UR-96-2811, Los Alamos, New Mexico. (Dorries 1996, 1297)

Drager, H. W., June 11, 1946. "Preliminary Survey of Sewer System," Los Alamos Scientific Laboratory memorandum from H. W. Drager to E. R. Jette, Los Alamos, New Mexico. (Drager 1946, 09-0038)

Environmental Protection Group, December 1990. "Environmental Surveillance at Los Alamos During 1989," Los Alamos National Laboratory Report LA-12000-ENV, Los Alamos, New Mexico. (Environmental Protection Group 1990, 0497)

Environmental Protection Group, March 1992. "Environmental Surveillance at Los Alamos During 1990," Los Alamos National Laboratory Report LA-12271-MS, Los Alamos, New Mexico. (Environmental Protection Group 1992, 0740)

ESG, June 1989. Environmental Surveillance at Los Alamos During 1988, Los Alamos National Laboratory Report LA-11628-ENV, Los Alamos, New Mexico. (ESG 1989, 0308)

ESG, May 1988. Environmental Surveillance at Los Alamos During 1987, Los Alamos National Laboratory Report LA-11306-ENV, Los Alamos, New Mexico. (ESG 1988, 0408)

Ferenbaugh, R. W., T. E. Buhl, A. K. Stoker, and W. R. Hansen, August 1982. "Environmental Analysis of Acid/Middle Pueblo Canyon, Los Alamos, New Mexico," Los Alamos National Laboratory Report LA-9409, Los Alamos, New Mexico. (Ferenbaugh et al. 1982, 0668)

H-Division, February 1952. "H-Division Progress Report, January 20-February 20, 1952," Los Alamos Scientific Laboratory, Los Alamos, New Mexico. (H-Division 1952, 0756)

International Technology Corporation, February 1991. "Solid Waste Management Unit Descriptions for the TA-1 Work Plan," Project No. 3012.15.08.01, prepared for Los Alamos National Laboratory, Los Alamos, New Mexico. (International Technology Corporation 1991, 09-0003)

Kennedy, W. R., January 26, 1987. "Summary of Environmental Data, 1943–1969," Los Alamos National Laboratory memorandum from W. R. Kennedy to R. W. Vocke, Los Alamos, New Mexico. (Kennedy 1987, 09-0007)

Longmire, P. A., D. E. Broxton, and S. L. Reneau (Eds.), October 1995. "Natural Background Geochemistry and Statistical Analysis of Selected Soil Profiles, Sediments, and Bandelier Tuff, Los Alamos, New Mexico," Los Alamos National Laboratory Report LA-UR-95-3486, Los Alamos, New Mexico. (Longmire et al. 1995, 1200)

Longmire, P., S. Reneau, P. Watt, L. McFadden, J. Gardner, C. Duffy, and R. Ryti, January 1995. "Natural Background Geochemistry, Geomorphology, and Pedogenesis of Selected Soil Profiles and Bandelier Tuff, Los Alamos, New Mexico," (draft) Los Alamos National Laboratory Report LA-12913-MS, Los Alamos, New Mexico. (Longmire et al. 1995, 1142)

Los Alamos National Laboratory, August 1993. "Western Sanitary Waste Line Sampling Plan for FY93," Environmental Restoration Program, RCRA Facility Investigation Operable Unit 1078 (TA-1), Los Alamos National Laboratory Report, Los Alamos, New Mexico. (LANL 1993, 09-0531)

Los Alamos National Laboratory, February 1995. "Installation Work Plan for Environmental Restoration," Revision 4, Los Alamos National Laboratory Report LA-UR-95-740, ER ID No. 49822, Los Alamos, New Mexico. (LANL 1995, 1164)

Los Alamos National Laboratory, July 1995. "Statement of Work–Analytical Support," Revision 2, RFP No. 9-XS1-Q4257, ER ID No. 49738, Los Alamos, New Mexico. (LANL 1995, 1278)

Los Alamos National Laboratory, June 1996. "Interim Action Plan for Potential Release Site 1-001(a), Western Sanitary Waste Line Locations 9, 10, 11, and 1A," Environmental Restoration Project, Los Alamos National Laboratory Report LA-UR-96-2273, Los Alamos, New Mexico. (LANL 1996, 09-0528)

Los Alamos National Laboratory, March 1996. "Quality Assurance Project Plan Requirements for Sampling and Analysis," Los Alamos National Laboratory Report LA-UR-96-441, Los Alamos, New Mexico. (LANL 1996, 1292)

Los Alamos National Laboratory, May 1992. "RFI Work Plan for Operable Unit 1078," Los Alamos National Laboratory Report LA-UR-92-838, Los Alamos, New Mexico. (LANL 1992, 0782)

Los Alamos National Laboratory, November 22, 1994. "Addendum to Sampling and Analysis Strategy for the Western Sanitary Waste Line Investigation, Location 13," Environmental Restoration Program, Los Alamos National Laboratory Report, Los Alamos, New Mexico. (LANL 1994, 09-0532)

Los Alamos National Laboratory. "Los Alamos National Laboratory Environmental Restoration Program Standard Operating Procedures," Los Alamos National Laboratory report, Los Alamos, New Mexico. (LANL 1997, 0875)

Los Alamos National Laboratory, September 1996. "Interim Action Report for a Potential Release Site at TA-1, 1-001(a)," Environmental Restoration Program, Los Alamos National Laboratory Report LA-UR-96-3352, Los Alamos, New Mexico. (LANL 1996, 09-0533)

Los Alamos Scientific Laboratory, November 21, 1958. "Main Technical Area Underground Utilities," Engineering Drawing ENG-R85, Los Alamos, New Mexico. (LASL 1958, 09-0048)

Moe, H. J., June 1992. "Operational Health Physics Training," Argonne National Laboratory Report ANL-88-26, Argonne, Illinois. (Moe 1992, 09-0517)

Nyhan, J. W., L. W. Hacker, T. E. Calhoun, and D. L. Young, June 1978. "Soil Survey of Los Alamos County, New Mexico," Los Alamos Scientific Laboratory Report LA-6779-MS, Los Alamos, New Mexico. (Nyhan et al. 1978, 0161)

Project Consistency Team. "Project Consistency Team (PCT) Policy Memo Notebook," (Controlled), Environmental Restoration Project, Los Alamos National Laboratory, Los Alamos, New Mexico. (Project Consistency Team, 1210)

Purtymun, W. D., January 1995. "Geologic and Hydrologic Records of Observation Wells, Test Holes, Test Wells, Supply Wells, Springs, and Surface Water Stations in the Los Alamos Area," Los Alamos National Laboratory Report LA-12883-MS, Los Alamos, New Mexico. (Purtymun 1995, 1293)

Purtymun, W. D., R. J. Peters, T. E. Buhl, M. N. Maes, and F. H. Brown, November 1987. "Background Concentrations of Radionuclides in Soils and River Sediments in Northern New Mexico, 1974-1986," Los Alamos National Laboratory Report LA-11134-MS, Los Alamos, New Mexico. (Purtymun et al. 1987, 0211)

Ryti, R., P. Longmire, and E. McDonald, March 20, 1996. "Application of LANL Background Data to ER Project Decision-Making, Part I: Inorganics," Los Alamos National Laboratory Report LA-UR-96-1634, Los Alamos, New Mexico. (Ryti et al. 1996, 1298)

Tribby, J. F., July 25, 1946. "Results of Preliminary Survey of Contamination in the Drain Line Exits of All Sanitary and Acid Sewer Lines," Los Alamos Scientific Laboratory memorandum from J. F. Tribby to E. R. Jette, Los Alamos, New Mexico. (Tribby 1946, 09-0030)

US Department of Energy, March 7, 1979. "Compliance with Floodplain/Wetlands Environmental Review Requirements," Final Rule, 10 CFR Part 1022, Vol. 44, No. 46, p. 12594. (DOE 1979, 0633)

US Department of Energy, November 9, 1988. "General Environmental Protection Program," DOE Order 5400.1, Washington, DC. (DOE 1988, 0075)

US Department of Energy, September 20, 1988. "Radioactive Waste Management," DOE Order 5820.2A, Washington, DC. (DOE 1988, 1342)

US Department of Energy, September 1988. "Remedial Investigation Plan: Task 11, Technical Area 1," Environmental Restoration Program, Albuquerque Operations Office, Albuquerque, New Mexico. (DOE 1988, 09-0006)

US Environmental Protection Agency, 1993. "External Exposure to Radionuclides in Air, Water, and Soil, Federal Guidance Report No. 12," Washington, DC. (EPA 1993, 1122)

US Environmental Protection Agency, August 1, 1996. "Region 9 Preliminary Remediation Goals (PRGs)," memorandum from S. J. Smucker, Regional Toxicologist (H-9-3), Technical Support Team, San Francisco, California. (EPA 1996, 1361)

US Environmental Protection Agency, December 1989. "Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A)," Interim Final, EPA 540/1-89/002, Office of Emergency and Remedial Response, Washington, DC. (EPA 1989, 0305)

US Environmental Protection Agency, July 1992. "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, Third Edition, Final Update 1, Office of Solid Waste and Emergency Response, Washington, DC. (EPA 1992, 1207)

US Environmental Protection Agency, March 8, 1990. "National Oil and Hazardous Substances Pollution Contingency Plan," Final Rule, 40 CFR Part 300, Federal Register, Vol. 55, No. 46, p. 8666. (EPA 1990, 0559)

US Environmental Protection Agency, May 11, 1994. "Environmental Protection Agency Radiation-site Cleanup Regulation," (preliminary working draft),Title 40, Part 196. (EPA 1994, 1316)

US Environmental Protection Agency, September 1, 1995. "Region IX Preliminary Remediation Goals (PRGs) Second Half 1995," San Francisco, California. (EPA 1995, 1307)

US Environmental Protection Agency, September 1988. "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion, Federal Guidance Report 11," EPA-520/1-88-020, Washington, DC. (EPA 1988, 0297)

Weston, R. F., September 26, 1989. "Site Database Task 11 TA-1." R. F. Weston Incorporated Report W. R. N. 89-0049-LA-9, Albuquerque, New Mexico. (Weston 1989, 09-0036)

THIS PAGE LEFT INTENTIONALLY BLANK

APPENDIX A ANALYTICAL DATA

All analytical data are available on Facility for Information Management, Analysis, and Display (FIMAD). If FIMAD is not accessible, data will be provided upon request. A hard copy of the data is available from the Records Processing Facility under the title, "Analytical Data for the 1997 RFI Report for TA-1, Aggregates N and P."

THIS PAGE LEFT INTENTIONALLY BLANK

APPENDIX B DATA QUALITY EVALUATION TABLES

TABLE B-1

1995 SUMMARY TABLE OF QUALITY CONTROL RESULTS FOR AGGREGATE N

REQUEST NUMBER	SAMPLE ID	SAMPLE MATRIX	ANALYTE SUITE	QUALITY CONTROL (QC) COMMENTS
16775	AAA8267	SOIL	VOC	Acetone found in blanks (27, 32 and 46 ug/kg). All acetone hits are changed to non-detects because they are <10 times the blank levels.
16775	AAA8269	SOIL	VOC	Acetone found in blanks (27, 32 and 46 ug/kg). All acetone hits are changed to non-detects because they are <10 times the blank levels.
16775	AAA8279	WATER	VOC	Acetone found in blanks (27, 32 and 46 ug/kg). All acetone hits are changed to non-detects because they are <10 times the blank levels.
16775	AAA8297	WATER	VOC	Acetone found in blanks (27, 32 and 46 ug/kg). All acetone hits are changed to non-detects because they are <10 times the blank levels.
16781	AAA8272	SOIL	RAD1	All U data qualified 'J' for extremely high QC recoveries. These high recoveries were evidently caused by contamination in the QC sample.
16830	AAA8281	WATER	RAD1	Pu and U isotopes were found in the method blanks at the same levels as those found in the samples. Therefore, all data should be considered non detects.
16831	AAA8308	SOIL	METALS	Se qualified 'UJ' for post digestion spike out of control.
16834	AAA8274	SOIL	PEST	All analytes are qualified 'UJ' for lack of QC documentation, poor initial calibrations and low surrogate recoveries.
16834	AAA8274	SOIL	VOC	Acetone found in sample at < 10 times concentration found in method blank. The EQL was raised and acetone is considered not detected.
16838	AAA8274	SOIL	METALS	As, Tl and Ag are qualified 'UJ' for low recoveries (45-75%) in the QC sample.
16841	AAA8274	SOIL	RAD1	All U isotopes are qualified 'J' for failure to add tracers to the LCS and method blanks necessary for quantification.
16845	AAA8311	SOIL	METALS	As, Tl and Ag are qualified 'UJ' for low recoveries (45-75%) in the QC sample.
16856	AAA8311	SOIL	RAD1	All U isotopes are qualified 'J' for failure to add tracers to the LCS and method blanks necessary for quantification.
16873	AAA8273	SOIL	PEST	All pesticide detects are qualified 'J' because of possible false positives caused by the presence of Aroclor 1254
16873	AAA8285	SOIL	VOC	The last internal standard was below allowed limits. The 15 associated analytes are qualified 'UJ'.
16873	AAA8270	SOIL	VOC	The last internal standard was below allowed limits. The 15 associated analytes are qualified 'UJ'.
16876	AAA8285	SOIL	METALS	Pb, Se and Tl all had low recoveries in the post digestion spikes and are qualified 'UJ'. Ag had a low recovery in the QC sample (63%) and is qualified 'UJ'.
16876	AAA8270	SOIL	METALS	Pb, Sb and Tl all had low recoveries in the post digestion spikes and are qualified 'UJ'. Ag had a low recovery in the QC sample (63%) and is qualified 'UJ'.

TABLE B-1 (continued)

1995 SUMMARY TABLE OF QUALITY CONTROL RESULTS FOR AGGREGATE N

REQUEST NUMBER	SAMPLE ID	SAMPLE MATRIX	ANALYTE SUITE	QUALITY CONTROL (QC) COMMENTS
16775	AAA8267	SOIL	VOC	Acetone found in blanks (27, 32 and 46 ug/kg). All acetone hits are changed to non-detects because they are <10 times the blank levels.
16775	AAA8269	SOIL	VOC	Acetone found in blanks (27, 32 and 46 ug/kg). All acetone hits are changed to non-detects because they are <10 times the blank levels.
16775	AAA8279	WATER	VOC	Acetone found in blanks (27, 32 and 46 ug/kg). All acetone hits are changed to non-detects because they are <10 times the blank levels.
16775	AAA8297	WATER	VOC	Acetone found in blanks (27, 32 and 46 ug/kg). All acetone hits are changed to non-detects because they are <10 times the blank levels.
16781	AAA8272	SOIL	RAD1	All U data qualified 'J' for extremely high QC recoveries. These high recoveries were evidently caused by contamination in the QC sample.
16830	AAA8281	WATER	RAD1	Pu and U isotopes were found in the method blanks at the same levels as those found in the samples. Therefore, all data should be considered non detects.
16831	AAA8308	SOIL	METALS	Se qualified 'UJ' for post digestion spike out of control.
16834	AAA8274	SOIL	PEST	All analytes are qualified 'UJ' for lack of QC documentation, poor initial calibrations and low surrogate recoveries.
16834	AAA8274	SOIL	VOC	Acetone found in sample at < 10 times concentration found in method blank. The EQL was raised and acetone is considered not detected.
16836	AAA8274	SOIL	METALS	As, Tl and Ag are qualified 'UJ' for low recoveries (45-75%) in the QC sample.
16841	AAA8274	SOIL	RAD1	All U isotopes are qualified 'J' for failure to add tracers to the LCS and method blanks necessary for quantification.
16845	AAA8311	SOIL	METALS	As, Tl and Ag are qualified 'UJ' for low recoveries (45-75%) in the QC sample.
16850	AAA8311	SOIL	RAD1	All U isotopes are qualified 'J' for failure to add tracers to the LCS and method blanks necessary for quantification.
16873	AAA8273	SOIL	PEST	All pesticide detects are qualified 'J' because of possible false positives caused by the presence of Aroclor 1254
16873	AAA8265	SOIL	VOC	The last internal standard was below allowed limits. The 15 associated analytes are qualified 'UJ'.
16873	AAA8270	SOIL	VOC	The last internal standard was below allowed limits. The 15 associated analytes are qualified 'UJ'.
16876	AAA8265	SOIL	METALS	Pb, Se and Tl all had low recoveries in the post digestion spikes and are qualified 'UJ'. Ag had a low recovery in the QC sample (63%) and is qualified 'UJ'.
16876	AAA8270	SOIL	METALS	Pb, Sb and Tl all had low recoveries in the post digestion spikes and are qualified 'UJ'. Ag had a low recovery in the QC sample (63%) and is qualified 'UJ'.

TABLE B-1 (continued)

1995 SUMMARY TABLE OF QUALITY CONTROL RESULTS FOR AGGREGATE N

REQUEST NUMBER	SAMPLE ID	SAMPLE MATRIX	ANALYTE SUITE	QUALITY CONTROL (QC) COMMENTS
20365	AAB6076	SOIL	SVOC	Low recovery for 14 analytes in QC sample. All are qualified 'J' or 'UJ'.
20365	AAB6077	SOIL	SVOC	Low recovery for 14 analytes in QC sample. All are qualified 'J' or 'UJ'.
20365	AAB6078	SOIL	SVOC	Low recovery for 14 analytes in QC sample. All are qualified 'J' or 'UJ'.
20365	AAB7438	SOIL	SVOC	Low recovery for 14 analytes in QC sample. All are qualified 'J' or 'UJ'.
20365	AAB7440	SOIL	SVOC	Low recovery for 14 analytes in QC sample. All are qualified 'J' or 'UJ'.
20365	AAB7450	SOIL	SVOC	Low recovery for 14 analytes in QC sample. All are qualified 'J' or 'UJ'.
20365	AAC0351	WATER	SVOC	All base/neutral analytes are qualified 'J' or 'UJ' due to low surrogate recoveries.
20365	AAC0514	SOIL	SVOC	Low recovery for 14 analytes in QC sample. All are qualified 'J' or 'UJ'.
20365	AAC0516	SOIL	SVOC	Low recovery for 14 analytes in QC sample. All are qualified 'J' or 'UJ'.
20365	AAC0517	SOIL	SVOC	Low recovery for 14 analytes in QC sample. All are qualified 'J' or 'UJ'.
20368	AAB6072	SOIL	METALS	As, Ag, Cd, Cr, K, Na, Ni had high recoveries in the QC sample. All detects are qualified 'J' for possible high bias.
20368	AAB6076	SOIL	METALS	As, Ag, Cd, Cr, K, Na, Ni had high recoveries in the QC sample. All detects are qualified 'J' for possible high bias.
20368	AAB6077	SOIL	METALS	As, Ag, Cd, Cr, K, Na, Ni had high recoveries in the QC sample. All detects are qualified 'J' for possible high bias.
20368	AAB6078	SOIL	METALS	As, Ag, Cd, Cr, K, Na, Ni had high recoveries in the QC sample. All detects are qualified 'J' for possible high bias.
20368	AAB7438	SOIL	METALS	As, Ag, Cd, Cr, K, Na, Ni had high recoveries in the QC sample. All detects are qualified 'J' for possible high bias.
20368	AAB7439	SOIL	METALS	As, Ag, Cd, Cr, K, Na, Ni had high recoveries in the QC sample. All detects are qualified 'J' for possible high bias.
20368	AAB7440	SOIL	METALS	As, Ag, Cd, Cr, K, Na, Ni had high recoveries in the QC sample. All detects are qualified 'J' for possible high bias.
20368	AAB7450	SOIL	METALS	As, Ag, Cd, Cr, K, Na, Ni had high recoveries in the QC sample. All detects are qualified 'J' for possible high bias.
20368	AAC0351	WATER	METALS	As, Ag, Cd, Cr, K, Na, Ni had high recoveries in the QC sample. All detects are qualified 'J' for possible high bias.
20368	AAC0514	SOIL	METALS	As, Ag, Cd, Cr, K, Na, Ni had high recoveries in the QC sample. All detects are qualified 'J' for possible high bias.
20368	AAC0516	SOIL	METALS	As, Ag, Cd, Cr, K, Na, Ni had high recoveries in the QC sample. All detects are qualified 'J' for possible high bias.
20368	AAC0517	SOIL	METALS	As, Ag, Cd, Cr, K, Na, Ni had high recoveries in the QC sample. All detects are qualified 'J' for possible high bias.

TABLE B-1 (continued)

1995 SUMMARY TABLE OF QUALITY CONTROL RESULTS FOR AGGREGATE N

REQUEST NUMBER	SAMPLE ID	SAMPLE MATRIX	ANALYTE SUITE	QUALITY CONTROL (QC) COMMENTS
20366	AAC2061	SOIL	METALS	As, Ag, Cd, Cr, K, Na, Ni had high recoveries in the QC sample. All detects are qualified 'J' for possible high bias.
20375	AAB6072	SOIL	RAD2	U is qualified 'J' or 'UJ' for low tracer recovery or poor duplicates caused by sample heterogeneity.
20375	AAB6076	SOIL	RAD2	U is qualified 'J' or 'UJ' for low tracer recovery or poor duplicates caused by sample heterogeneity.
20375	AAB6077	SOIL	RAD2	U is qualified 'J' or 'UJ' for low tracer recovery or poor duplicates caused by sample heterogeneity.
20375	AAB6078	SOIL	RAD2	U is qualified 'J' or 'UJ' for low tracer recovery or poor duplicates caused by sample heterogeneity.
20375	AAB7439	SOIL	RAD2	U is qualified 'J' or 'UJ' for low tracer recovery or poor duplicates caused by sample heterogeneity.
20375	AAC2061	SOIL	RAD2	U is qualified 'J' or 'UJ' for low tracer recovery or poor duplicates caused by sample heterogeneity.
20375	AAB7438	SOIL	RAD3	U is qualified 'J' or 'UJ' for low tracer recovery or poor duplicates caused by sample heterogeneity.
20375	AAB7440	SOIL	RAD3	U is qualified 'J' or 'UJ' for low tracer recovery or poor duplicates caused by sample heterogeneity.
20375	AAB7449	SOIL	RAD3	U is qualified 'J' or 'UJ' for low tracer recovery or poor duplicates caused by sample heterogeneity.
20375	AAB7450	SOIL	RAD3	U is qualified 'J' or 'UJ' for low tracer recovery or poor duplicates caused by sample heterogeneity.
20375	AAC0614	SOIL	RAD3	U is qualified 'J' or 'UJ' for low tracer recovery or poor duplicates caused by sample heterogeneity.
20375	AAC0616	SOIL	RAD3	U is qualified 'J' or 'UJ' for low tracer recovery or poor duplicates caused by sample heterogeneity.
20375	AAC0617	SOIL	RAD3	U is qualified 'J' or 'UJ' for low tracer recovery or poor duplicates caused by sample heterogeneity.
20479	AAB6060	SOIL	SVOC	There was low recovery (10-50%) of all analytes in the QC sample and high internal standards. All analytes are qualified 'J' or 'UJ'.
20479	AAB6070	SOIL	SVOC	There was low recovery (10-50%) of all analytes in the QC sample and high internal standards. All analytes are qualified 'J' or 'UJ'.
20479	AAB6071	SOIL	SVOC	There was low recovery (10-50%) of all analytes in the QC sample and high internal standards. All analytes are qualified 'J' or 'UJ'.
20479	AAB6075	SOIL	SVOC	There was low recovery (10-50%) of all analytes in the QC sample and high internal standards. All analytes are qualified 'J' or 'UJ'.
20482	AAB6069	SOIL	METALS	Na is qualified 'J' or 'UJ' for low recovery in the QC sample. Cr detects are qualified 'J' for high recoveries in the QC sample.
20482	AAB6070	SOIL	METALS	Na is qualified 'J' or 'UJ' for low recovery in the QC sample. Cr detects are qualified 'J' for high recoveries in the QC sample.
20482	AAB6071	SOIL	METALS	Na is qualified 'J' or 'UJ' for low recovery in the QC sample. Cr detects are qualified 'J' for high recoveries in the QC sample.
20482	AAB6075	SOIL	METALS	Na is qualified 'J' or 'UJ' for low recovery in the QC sample. Cr detects are qualified 'J' for high recoveries in the QC sample.

TABLE B-1 (continued)

1995 SUMMARY TABLE OF QUALITY CONTROL RESULTS FOR AGGREGATE N

REQUEST NUMBER	SAMPLE ID	SAMPLE MATRIX	ANALYTE SUITE	QUALITY CONTROL (QC) COMMENTS
20482	AAC2077	SOIL	METALS	Na is qualified 'J' or 'UJ' for low recovery in the QC sample. Cr detects are qualified 'J' for high recoveries in the QC sample.
20484	AAC0352	WATER	SVOC	The 2nd acid surrogate had a recovery of <10%. All associated analytes are qualified 'R' rejected.
20538	AAB6074	SOIL	METALS	Hg and Sb are qualified 'J' for low recoveries in the QC sample. Zn and Mg detects are qualified 'J' for high recoveries in the QC sample.
20538	AAC2078	SOIL	METALS	Hg and Sb are qualified 'J' for low recoveries in the QC sample. Zn and Mg detects are qualified 'J' for high recoveries in the QC sample.
20538	AAC2080	SOIL	METALS	Hg and Sb are qualified 'J' for low recoveries in the QC sample. Zn and Mg detects are qualified 'J' for high recoveries in the QC sample.
20538	AAC2081	SOIL	METALS	Hg and Sb are qualified 'J' for low recoveries in the QC sample. Zn and Mg detects are qualified 'J' for high recoveries in the QC sample.
20538	AAC2082	SOIL	METALS	Hg and Sb are qualified 'J' for low recoveries in the QC sample. Zn and Mg detects are qualified 'J' for high recoveries in the QC sample.
20538	AAC2084	SOIL	METALS	Hg and Sb are qualified 'J' for low recoveries in the QC sample. Zn and Mg detects are qualified 'J' for high recoveries in the QC sample.
20538	AAC2085	SOIL	METALS	Hg and Sb are qualified 'J' for low recoveries in the QC sample. Zn and Mg detects are qualified 'J' for high recoveries in the QC sample.
20557	AAC2079	SOIL	METALS	Cr qualified 'J' or 'UJ' for low recovery in the QC sample.
20557	AAC2083	SOIL	METALS	Cr qualified 'J' or 'UJ' for low recovery in the QC sample.
20557	AAC2087	SOIL	METALS	Cr qualified 'J' or 'UJ' for low recovery in the QC sample.
20557	AAC2088	SOIL	METALS	Cr qualified 'J' or 'UJ' for low recovery in the QC sample.
20557	AAC2090	SOIL	METALS	Cr qualified 'J' or 'UJ' for low recovery in the QC sample.
20804	AAC0999	WATER	PEST	All data are qualified 'R' for grossly exceeding extraction holding times for waters..
20804	AAC0999	WATER	SVOC	All data are qualified 'R' for grossly exceeding extraction holding times for waters..
20805	AAC0999	WATER	METALS	Hg qualified 'J' for exceeding extraction holding times for waters.
20800	AAC0999	WATER	RAD4	U isotopes are qualified 'J' for low tracer recoveries.

METALS = TAL metals
PEST = Pesticides
SVOC = Semi volatile organic compounds
VOC = Volatile organic compounds
RAD1 = Iso U and Pu
RAD2 = Cs-137, Iso U and Pu
RAD3 = Cs-137, Iso U, Pu, H-3, %H20
RAD4 = Iso U, Pu, H-3

TABLE B-2

1996 SUMMARY TABLE OF QUALITY CONTROL RESULTS FOR AGGREGATE N

REQUEST NUMBER	SAMPLE ID	Matrix	ANALYTE SUITE	QUALITY CONTROL (QC) COMMENTS
2258	0101-96-0022	Soil	SVOC	Di-n-butylphthalate found in method blank. Data for this analyte qualified 'U' if <10 times method blank.
2258	0101-96-0023	Soil	SVOC	Di-n-butylphthalate found in method blank. Data for this analyte qualified 'U' if <10 times method blank.
2319	0101-96-0036	Soil	SVOC	Bis(2-ethylhexyl)phthalate found in method blank. Data for this analyte qualified 'U' if <10 times method blank.
2319	0101-96-0032	Soil	SVOC	Bis(2-ethylhexyl)phthalate found in method blank. Data for this analyte qualified 'U' if <10 times method blank.
2258	0101-96-0021	Soil	TALMETALS	Sb, Tl and Se are qualified 'UJ' for low recoveries in the matrix spike sample.
2259	0101-96-0022	Soil	TALMETALS	Sb, Tl and Se are qualified 'J-' or 'UJ' for low recoveries in the matrix spike sample.
2259	0101-96-0023	Soil	TALMETALS	Sb, Tl and Se are qualified 'J-' or 'UJ' for low recoveries in the matrix spike sample.
2258	0101-96-0024	Soil	TALMETALS	Sb, Tl and Se are qualified 'J-' or 'UJ' for low recoveries in the matrix spike sample.
2288	0101-96-0025	Soil	TALMETALS	Sb, Tl and Se are qualified 'J-' or 'UJ' for low recoveries in the matrix spike sample.
2288	0101-96-0026	Soil	TALMETALS	Sb, Tl and Se are qualified 'J-' or 'UJ' for low recoveries in the matrix spike sample.
2288	0101-96-0027	Soil	TALMETALS	Sb qualified 'R' for matrix spike recovery <30%.
2288	0101-96-0028	Soil	TALMETALS	Sb qualified 'R' for matrix spike recovery <30%.
2288	0101-96-0029	Soil	TALMETALS	Sb qualified 'R' for matrix spike recovery <30%.
2288	0101-96-0221	Soil	TALMETALS	Sb qualified 'R' for matrix spike recovery <30%.
2305	0101-96-0030	Soil	TALMETALS	Sb, Ba, Be, Cd, Cr, Co, Cu, Ni, Ag, V and Zn are qualified 'J-' or 'UJ' for low recoveries in the matrix spike sample.
2305	0101-96-0031	Soil	TALMETALS	Sb, Ba, Be, Cd, Cr, Co, Cu, Ni, Ag, V and Zn are qualified 'J-' or 'UJ' for low recoveries in the matrix spike sample.
2305	0101-96-0033	Soil	TALMETALS	Sb, Ba, Be, Cd, Cr, Co, Cu, Ni, Ag, V and Zn are qualified 'J-' or 'UJ' for low recoveries in the matrix spike sample.
2305	0101-96-0034	Soil	TALMETALS	Sb, Ba, Be, Cd, Cr, Co, Cu, Ni, Ag, V and Zn are qualified 'J-' or 'UJ' for low recoveries in the matrix spike sample.
2305	0101-96-0035	Soil	TALMETALS	Sb, Ba, Be, Cd, Cr, Co, Cu, Ni, Ag, V and Zn are qualified 'J-' or 'UJ' for low recoveries in the matrix spike sample.
2320	0101-96-0032	Soil	TALMETALS	Sb, Tl and Se are qualified 'J-' or 'UJ' for low recoveries in the matrix spike sample. Cd, Pb and Zn detects qualified 'J+' for high matrix spike recoveries.

TABLE B-2 (continued)

1996 SUMMARY TABLE OF QUALITY CONTROL RESULTS FOR AGGREGATE N

REQUEST NUMBER	SAMPLE ID	Matrix	ANALYTE SUITE	QUALITY CONTROL (QC) COMMENTS
2320	0101-96-0036	Soil	TALMETALS	Sb, Tl and Se are qualified 'J-' or 'UJ' for low recoveries in the matrix spike sample. Cd, Pb and Zn detects qualified "J+' for high matrix spike recoveries.
2283	0101-96-0027	Soil	Radiological	Pu-239 qualified 'J' for large difference between original and duplicate.
2283	0101-96-0028	Soil	Radiological	Pu-239 qualified 'J' for large difference between original and duplicate.
2283	0101-96-0029	Soil	Radiological	Pu-239 qualified 'J' for large difference between original and duplicate.
2283	0101-96-0221	Soil	Radiological	Pu-239 qualified 'J' for large difference between original and duplicate.
2323	0101-96-0036	Soil	Radiological	Am241 qualified 'J' for large difference between original and duplicate.
2323	0101-96-0032	Soil	Radiological	Am241 qualified 'J' for large difference between original and duplicate.

Radiological = Gamma spec, Isotopic Pu and U
SVOCs = Semi volatile organic compounds
TALMETALS = Target analyte list for metals

TABLE B-3

1996 SUMMARY TABLE OF QUALITY CONTROL RESULTS FOR AGGREGATE P

REQUEST NUMBER	SAMPLE ID	SAMPLE MATRIX	ANALYTE SUITE	QUALITY CONTROL (QC) COMMENTS
2371	0101-95-0051	SOIL	METALS	Se and Sb qualified 'J' or 'UJ' for a low recovery in the matrix spike sample.
2371	0101-95-0052	SOIL	METALS	Se and Sb qualified 'J' or 'UJ' for a low recovery in the matrix spike sample.
2371	0101-95-0053	SOIL	METALS	Se and Sb qualified 'J' or 'UJ' for a low recovery in the matrix spike sample.
2371	0101-95-0054	SOIL	METALS	Se and Sb qualified 'J' or 'UJ' for a low recovery in the matrix spike sample.

METALS = TAL metals
RAD = Cs-137, Isotopic U and Pu and %H2O
RAD = Gamma Spectroscopy, Isotopic U and Pu
SVOC = Semivolatile organic compounds

THIS PAGE LEFT INTENTIONALLY BLANK

APPENDIX C RISK ASSESSMENT CALCULATIONS

THIS PAGE LEFT INTENTIONALLY BLANK

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary ... 2
Site-Specific Parameter Summary ... 3
Summary of Pathway Selections ... 7
Contaminated Zone and Total Dose Summary ... 8
Total Dose Components
Time = 0.000E+00 ... 9
Time = 1.000E+00 ... 10
Time = 3.000E+00 ... 11
Time = 1.000E+01 ... 12
Time = 3.000E+01 ... 13
Time = 1.000E+02 ... 14
Time = 3.000E+02 ... 15
Time = 1.000E+03 ... 16
Dose/Source Ratios Summed Over All Pathways ... 17
Single Radionuclide Soil Guidelines ... 17
Dose Per Nuclide Summed Over All Pathways ... 18
Soil Concentration Per Nuclide ... 18

Dose Conversion Factor (and Related) Parameter Summary
File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(2)
B-1	Pu-239	4.390E-01	4.390E-01	DCF2(3)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(4)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(2)
D-1	Pu-239	3.540E-03	3.540E-03	DCF3(3)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(4)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(2,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(2,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(2,3)
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(3,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(3,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(3,3)
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(4,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.400E-04	1.400E-04	RTF(4,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(4,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(2,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(2,2)
D-5	Pu-239 , fish	1.000E+01	1.000E+01	BIOFAC(3,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(4,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(4,2)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from User Input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.400E+01	1.000E+04	...	AREA
R011	Thickness of contaminated zone (m)	1.000E+00	2.000E+00	...	THICK0
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	...	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	1.500E+01	3.000E+01	...	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	...	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	...	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	...	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	...	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	...	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	...	T(6)
R011	Times for calculations (yr)	3.000E+02	1.000E+02	...	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	...	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	...	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	...	T(10)
R012	Initial principal radionuclide (pCi/g): Pu-239	1.170E+01	0.000E+00	...	S1(3)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	...	W1(3)
R013	Cover depth (m)	0.000E+00	0.000E+00	...	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	...	DENCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	...	VCV
R013	Density of contaminated zone (g/cm**3)	1.600E+00	1.500E+00	...	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	...	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	...	TPCZ
R013	Contaminated zone effective porosity	2.000E-01	2.000E-01	...	EPCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	4.400E+03	1.000E+01	...	HCCZ
R013	Contaminated zone b parameter	4.050E+00	5.300E+00	...	BCZ
R013	Humidity in air (g/cm**3)	not used	8.000E+00	...	HUMID
R013	Evapotranspiration coefficient	9.990E-01	5.000E-01	...	EVAPTR
R013	Precipitation (m/yr)	4.800E-01	1.000E+00	...	PRECIP
R013	Irrigation (m/yr)	0.000E+00	2.000E-01	...	RI
R013	Irrigation mode	overhead	overhead	...	IDITCH
R013	Runoff coefficient	5.200E-01	2.000E-01	...	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	...	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	Zero shows Simpson's rule.	EPS
R014	Density of saturated zone (g/cm**3)	1.600E+00	1.500E+00	...	DENSAQ
R014	Saturated zone total porosity	3.000E-01	4.000E-01	...	TPSZ
R014	Saturated zone effective porosity	1.000E-01	2.000E-01	...	EPSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	...	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	...	HGWT
R014	Saturated zone b parameter	4.050E+00	5.300E+00	...	BSZ
R014	Water table drop rate (m/yr)	3.000E-01	1.000E-01	...	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	...	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	...	MODEL
R014	Well pumping rate (m**3/yr)	1.000E+01	2.500E+02	...	UW
R015	Number of unsaturated zone strata	not used	1	...	NS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from User Input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSU2(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPU2(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPU2(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	HU2(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCU2(1)
R015	Unsat. zone 2, thickness (m)	not used	0.000E+00	---	H(2)
R015	Unsat. zone 2, soil density (g/cm**3)	not used	1.900E+00	---	DENSU2(2)
R015	Unsat. zone 2, total porosity	not used	4.000E-01	---	TPU2(2)
R015	Unsat. zone 2, effective porosity	not used	2.000E-01	---	EPU2(2)
R015	Unsat. zone 2, soil-specific b parameter	not used	5.300E+00	---	HU2(2)
R015	Unsat. zone 2, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCU2(2)
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	4.818E+01	2.000E+03	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(3,1)
R016	Unsaturated zone 2 (cm**3/g)	not used	2.000E+03	---	DCNUCU(3,2)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.972E-06	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	1.300E+02	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	---	DCNUCU(1,1)
R016	Unsaturated zone 2 (cm**3/g)	not used	2.000E+01	---	DCNUCU(1,2)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.107E-06	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	1.000E+02	5.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(2,1)
R016	Unsaturated zone 2 (cm**3/g)	not used	5.000E+01	---	DCNUCU(2,2)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.439E-06	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for daughter U-235				
R016	Contaminated zone (cm**3/g)	7.290E+00	5.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(4,1)
R016	Unsaturated zone 2 (cm**3/g)	not used	5.000E+01	---	DCNUCU(4,2)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.957E-05	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R017	Inhalation rate (m**3/yr)	1.927E+04	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-03	2.000E-04	---	MLINH
R017	Dilution length for airborne dust, inhalation (m)	1.000E+00	1.000E+00	---	LM
R017	Exposure duration	1.000E+00	1.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (if different from user input)	Parameter Name
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	...	SHF1
R017	Fraction of time spent indoors	0.000E+00	5.000E-01	...	FIND
R017	Fraction of time spent outdoors (on site)	2.300E-02	2.500E-01	...	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	1 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	...	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	...	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	...	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	...	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	...	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	...	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	...	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	...	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	...	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	...	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	...	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	...	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	...	FRACA(1)
R017	Ring 2	not used	2.732E-01	...	FRACA(2)
R017	Ring 3	not used	0.000E+00	...	FRACA(3)
R017	Ring 4	not used	0.000E+00	...	FRACA(4)
R017	Ring 5	not used	0.000E+00	...	FRACA(5)
R017	Ring 6	not used	0.000E+00	...	FRACA(6)
R017	Ring 7	not used	0.000E+00	...	FRACA(7)
R017	Ring 8	not used	0.000E+00	...	FRACA(8)
R017	Ring 9	not used	0.000E+00	...	FRACA(9)
R017	Ring 10	not used	0.000E+00	...	FRACA(10)
R017	Ring 11	not used	0.000E+00	...	FRACA(11)
R017	Ring 12	not used	0.000E+00	...	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	...	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	...	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	...	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	...	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	...	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	...	DIET(6)
R018	Soil ingestion rate (g/yr)	1.750E+02	3.650E+01	...	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	...	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	...	FDW
R018	Contamination fraction of household water	not used	1.000E+00	...	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	...	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	...	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	...	FR9
R018	Contamination fraction of plant food	not used	-1	...	FPLANT
R018	Contamination fraction of meat	not used	-1	...	FMEAT
R018	Contamination fraction of milk	not used	-1	...	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	...	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	...	LFI6

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	0.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-03	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	not used	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	not used	1.000E+00	---	STOR_T(2)
STOR	Milk	not used	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	not used	2.000E+01	---	STOR_T(4)
STOR	Fish	not used	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	not used	7.000E+00	---	STOR_T(6)
STOR	Well water	not used	1.000E+00	---	STOR_T(7)
STOR	Surface water	not used	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	not used	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average annual wind speed (m/sec)	not used	2.000E+00	---	WIND
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	14.00 square meters	Pu-239	1.170E+01
Thickness:	1.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 15 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	1.000E+03	1.000E+03
TDOSE(t):	1.237E+00	1.237E+00	1.237E+00	1.237E+00	1.233E+00	1.233E+00	1.225E+00	0.000E+00
M(t):	8.248E-02	8.248E-02	8.247E-02	8.245E-02	8.220E-02	8.222E-02	8.170E-02	0.000E+00

Maximum TDOSE(t): 1.237E+00 mrem/yr at t = 0.000E+00 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	4.644E-05	0.0000	1.335E+00	0.9981	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.334E-03	0.0019
Total	4.644E-05	0.0000	1.335E+00	0.9981	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.334E-03	0.0019

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.337E+00	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.337E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	4.644E-05	0.0000	1.335E+00	0.9981	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.334E-03	0.0019
Total	4.644E-05	0.0000	1.335E+00	0.9981	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.334E-03	0.0019

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.337E+00	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.337E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	4.644E-05	0.0000	1.235E+00	0.9981	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.334E-03	0.0019
Total	4.644E-05	0.0000	1.235E+00	0.9981	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.334E-03	0.0019

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.237E+00	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.237E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	4.643E-05	0.0000	1.334E+00	0.9981	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.333E-03	0.0019
Total	4.643E-05	0.0000	1.334E+00	0.9981	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.333E-03	0.0019

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.337E+00	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.337E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	4.640E+05	0.0000	1.234E+00	0.9981	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.332E-01	0.0019
Total	4.640E+05	0.0000	1.234E+00	0.9981	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.332E-01	0.0019

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.236E+00	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.236E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	4.630E-05	0.0000	1.231E+00	0.9981	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.326E-03	0.0019
Total	4.630E-05	0.0000	1.231E+00	0.9981	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.326E-03	0.0019

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.233E+00	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.233E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excluden radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	4.603E-05	0.0000	1.233E+00	0.9981	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.313E-03	0.0019
Total	4.603E-05	0.0000	1.233E+00	0.9981	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.313E-03	0.0019

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.235E+00	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.235E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(l,p,t) for Individual Radionuclides (l) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excluding radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(l,p,t) for Individual Radionuclides (l) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

*Sum of all water independent and dependent pathways

Dose/Source Ration Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Branch Fraction	DSR(j,t) (mrem/yr)/(pCi/g) t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Pu-239	Pu-239	1.000E+00	1.057E-01	1.057E-01	1.057E-01	1.057E-01	1.056E-01	1.054E-01	1.047E-01	0.000E+00
Pu-239	U-235	1.000E+00	0.000E+00	3.927E-11	1.178E-10	3.926E-10	1.177E-09	1.917E-09	1.169E-08	0.000E+00
Pu-239	Pa-231	1.000E+00	0.000E+00	3.312E-15	2.981E-14	3.311E-13	2.979E-12	1.304E-11	2.959E-10	0.000E+00
Pu-239	Ac-227	1.000E+00	0.000E+00	1.842E-16	4.895E-15	1.717E-13	4.010E-12	9.793E-11	1.271E-09	0.000E+00
Pu-239	DOSR(j)		1.057E-01	1.057E-01	1.057E-01	1.057E-01	1.056E-01	1.054E-01	1.047E-01	0.000E+00

Branch Fraction is the cumulative factor for the j'th principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life < 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 15 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Pu-239	1.419E+02	1.419E+02	1.419E+02	1.419E+02	1.420E+02	1.421E+02	1.432E+02	*6.312E+10

*At specific activity limit

Summed Dose/Source Ratio DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) pCi/g	DSR(i,tmax)	G(i,tmax) pCi/g
Pu-239	1.170E+01	0.000E+00	1.057E-01	1.419E+02	1.057E-01	1.419E+02

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide	Parent	BRF(i)	DOSE(j,t), mrem/yr							
(j)	(i)		t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Pu-239	Pu-239	1.000E+00	1.237E+00	1.237E+00	1.237E+00	1.237E+00	1.236E+00	1.233E+00	1.225E+00	0.000E+00
U-235	Pu-239	1.000E+00	0.000E+00	4.594E-10	1.378E-09	4.593E-09	1.377E-08	4.583E-08	1.368E-07	0.000E+00
Pa-231	Pu-239	1.000E+00	0.000E+00	1.875E-14	3.487E-13	1.874E-12	3.485E-11	3.866E-10	1.462E-09	0.000E+00
Ac-227	Pu-239	1.000E+00	0.000E+00	2.155E-15	5.737E-14	2.009E-12	4.691E-11	1.140E-09	1.487E-08	0.000E+00

BRF(i) is the branch fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide	Parent	BRF(i)	S(j,t), pCi/g							
(j)	(i)		t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Pu-239	Pu-239	1.000E+00	1.170E+01	1.170E+01	1.170E+01	1.170E+01	1.169E+01	1.166E+01	1.159E+01	1.133E+01
U-235	Pu-239	1.000E+00	0.000E+00	1.152E-08	1.457E-08	1.152E-07	1.454E-07	1.149E-06	1.430E-06	1.133E-05
Pa-231	Pu-239	1.000E+00	0.000E+00	1.219E-13	1.097E-12	1.219E-11	1.096E-10	1.216E-09	1.089E-08	1.189E-07
Ac-227	Pu-239	1.000E+00	0.000E+00	1.284E-15	3.411E-14	1.197E-12	2.794E-11	6.824E-10	8.854E-09	1.118E-07

BRF(i) is the branch fraction of the parent nuclide.

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary ... 2
Site-Specific Parameter Summary ... 3
Summary of Pathway Selections ... 7
Contaminated Zone and Total Dose Summary ... 8
Total Dose Components
Time = 0.000E+00 ... 9
Time = 1.000E+00 ... 10
Time = 3.000E+00 ... 11
Time = 1.000E+01 ... 12
Time = 3.000E+01 ... 13
Time = 1.000E+02 ... 14
Time = 3.000E+02 ... 15
Time = 1.000E+03 ... 16
Dose/Source Ratios Summed Over All Pathways ... 17
Single Radionuclide Soil Guidelines ... 17
Dose Per Nuclide Summed Over All Pathways ... 18
Soil Concentration Per Nuclide ... 18

Dose Conversion Factor (and Related) Parameter Summary
File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Pa-231	1.380E+00	1.380E+00	DCF2(2)
B-1	Pu-239	4.290E+01	4.290E+01	DCF2(3)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(4)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(2)
D-1	Pu-239	3.540E-03	3.540E-03	DCF3(3)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(4)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(2,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(2,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(2,3)
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(3,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(3,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(3,3)
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(4,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(4,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(4,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(2,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(2,2)
D-5	Pu-239 , fish	3.000E+01	3.000E+01	BIOFAC(3,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(4,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(4,2)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from User Input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.400E+01	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.000E+00	2.000E+00	---	THICK0
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	1.500E+01	1.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+01	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Pu-239	5.100E+00	0.000E+00	---	S1(3)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	---	W1(3)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.600E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone effective porosity	2.000E-01	2.000E-01	---	EPCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	4.400E+02	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.050E+00	5.300E+00	---	BCZ
R013	Humidity in air (g/cm**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	9.990E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	4.800E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	0.000E+00	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	5.200E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	Zero shows Simpson's rule.	EPS
R014	Density of saturated zone (g/cm**3)	1.600E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	3.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	1.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	4.050E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-01	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	1.000E+01	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (if different from user input)	Parameter Name
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSU2(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPU2(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPU2(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BU2(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCU2(1)
R015	Unsat. zone 2, thickness (m)	not used	0.000E+00	---	H(2)
R015	Unsat. zone 2, soil density (g/cm**3)	not used	1.500E+00	---	DENSU2(2)
R015	Unsat. zone 2, total porosity	not used	4.000E-01	---	TPU2(2)
R015	Unsat. zone 2, effective porosity	not used	2.000E-01	---	EPU2(2)
R015	Unsat. zone 2, soil-specific b parameter	not used	5.300E+00	---	BU2(2)
R015	Unsat. zone 2, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCU2(2)
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	4.830E+01	2.000E+03	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+03	---	DCNUCU(3,1)
R016	Unsaturated zone 2 (cm**3/g)	not used	2.000E+03	---	DCNUCU(3,2)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.972E-06	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	1.300E+03	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	---	DCNUCU(1,1)
R016	Unsaturated zone 2 (cm**3/g)	not used	2.000E+01	---	DCNUCU(1,2)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.107E-06	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	1.000E+02	5.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(2,1)
R016	Unsaturated zone 2 (cm**3/g)	not used	5.000E+01	---	DCNUCU(2,2)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.439E-06	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for daughter U-235				
R016	Contaminated zone (cm**3/g)	7.299E+00	5.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(4,1)
R016	Unsaturated zone 2 (cm**3/g)	not used	5.000E+01	---	DCNUCU(4,2)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.957E-05	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R017	Inhalation rate (m**3/yr)	1.139E+04	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	5.000E-04	2.000E-04	---	MLINH
R017	Dilution length for airborne dust, inhalation (m)	1.000E+00	1.000E+00	---	LH
R017	Exposure duration	1.000E+00	1.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHIF3

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (if different from user input)	Parameter Name
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	...	SHF1
R017	Fraction of time spent indoors	0.000E+00	5.000E-01	...	FIND
R017	Fraction of time spent outdoors (on site)	8.000E-01	2.500E-01	...	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	1 known circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	...	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	...	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	...	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	...	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	...	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	...	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	...	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	...	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	...	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	...	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	...	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	...	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	...	FRACA(1)
R017	Ring 2	not used	2.732E-01	...	FRACA(2)
R017	Ring 3	not used	0.000E+00	...	FRACA(3)
R017	Ring 4	not used	0.000E+00	...	FRACA(4)
R017	Ring 5	not used	0.000E+00	...	FRACA(5)
R017	Ring 6	not used	0.000E+00	...	FRACA(6)
R017	Ring 7	not used	0.000E+00	...	FRACA(7)
R017	Ring 8	not used	0.000E+00	...	FRACA(8)
R017	Ring 9	not used	0.000E+00	...	FRACA(9)
R017	Ring 10	not used	0.000E+00	...	FRACA(10)
R017	Ring 11	not used	0.000E+00	...	FRACA(11)
R017	Ring 12	not used	0.000E+00	...	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	...	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	...	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	...	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	...	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	...	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	...	DIET(6)
R018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	...	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	...	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	...	FDW
R018	Contamination fraction of household water	not used	1.000E+00	...	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	...	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	...	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	...	FR9
R018	Contamination fraction of plant food	not used	-1	...	FPLANT
R018	Contamination fraction of meat	not used	-1	...	FMEAT
R018	Contamination fraction of milk	not used	-1	...	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	...	LF15
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	...	LF16

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (if different from user input)	Parameter Name
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	...	LWI9
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	...	LWI0
R019	Livestock soil intake (kg/day)	not used	5.000E-01	...	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	...	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	...	DM
R019	Depth of roots (m)	not used	9.000E-01	...	DROOT
R019	Drinking water fraction from ground water	0.000E+00	1.000E+00	...	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	...	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	...	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	...	FGWIR
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	...	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	...	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	...	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	...	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	...	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	...	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	...	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	...	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	...	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	not used	1.400E+01	...	STOR_T(1)
STOR	Leafy vegetables	not used	1.000E+00	...	STOR_T(2)
STOR	Milk	not used	1.000E+00	...	STOR_T(3)
STOR	Meat and poultry	not used	2.000E+01	...	STOR_T(4)
STOR	Fish	not used	7.000E+00	...	STOR_T(5)
STOR	Crustacea and mollusks	not used	7.000E+00	...	STOR_T(6)
STOR	Well water	not used	1.000E+00	...	STOR_T(7)
STOR	Surface water	not used	1.000E+00	...	STOR_T(8)
STOR	Livestock fodder	not used	4.500E+01	...	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	...	FLOOR
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	...	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	...	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	...	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	...	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	...	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	...	DIFCV
R021	in foundation material	not used	3.000E-07	...	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	...	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	...	HMIX
R021	Average annual wind speed (m/sec)	not used	2.000E+00	...	WIND
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	...	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	...	HRM
R021	Building interior area factor	not used	0.000E+00	...	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	...	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	...	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	...	EMANA(2)

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	14.00 square meters	Pu-239	5.100E+00
Thickness:	1.00 meters		
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 15 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years)	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	5.539E-02	5.539E-02	5.539E-02	5.538E-02	5.534E-02	5.522E-02	5.487E-02	0.000E+00
M(t):	3.693E-03	3.693E-03	3.693E-03	3.692E-03	3.689E-03	3.681E-03	3.658E-03	0.000E+00

Maximum TDOSE(t): 5.539E-02 mrem/yr at t = 0.000E+00 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	7.041E-06	0.0001	5.531E-02	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.380E-05	0.0013
Total	7.041E-06	0.0001	5.531E-02	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.380E-05	0.0013

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.539E-02	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.539E-02	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes Radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	7.041E-06	0.0001	5.531E-02	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.380E-05	0.0013
Total	7.041E-06	0.0001	5.531E-02	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.380E-05	0.0013

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.539E-02	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.539E-02	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes Radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	7.040E-06	0.0001	5.531E-02	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.380E-05	0.0013
Total	7.040E-06	0.0001	5.531E-02	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.380E-05	0.0013

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.539E-02	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.539E-02	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	7.039E-06	0.0001	5.530E-02	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.378E-05	0.0013
Total	7.039E-06	0.0001	5.530E-02	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.378E-05	0.0013

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.538E-02	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.538E-02	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	7.039E-06	0.0001	5.526E-02	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.373E-05	0.0013
Total	7.039E-06	0.0001	5.526E-02	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.373E-05	0.0013

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.534E-02	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.534E-02	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	7.020E-06	0.0001	5.514E-02	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.357E-05	0.0013
Total	7.020E-06	0.0001	5.514E-02	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.357E-05	0.0013

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.522E-02	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.522E-02	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	6.979E-06	0.0001	5.479E-02	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.310E-05	0.0013
Total	6.979E-06	0.0001	5.479E-02	0.9985	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.310E-05	0.0013

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.487E-02	1.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.487E-02	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent	Product	Branch	DSR(j,t) (mrem/yr)/(pCi/g)						
(i)	(j)	Fraction	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Pu-239	Pu-239	1.000E+00	1.086E-02	1.086E-02	1.086E-02	1.086E-02	1.085E-02	1.083E-02	1.076E-02	0.000E+00
Pu-239	U-235	1.000E+00	0.000E+00	6.351E-12	1.905E-11	6.350E-11	1.904E-10	6.335E-10	1.891E-09	0.000E+00
Pu-239	Pa-231	1.000E+00	0.000E+00	3.463E-16	3.116E-15	3.462E-14	3.114E-13	3.454E-12	3.094E-11	0.000E+00
Pu-239	Ac-227	1.000E+00	0.000E+00	1.960E-17	5.207E-16	1.827E-14	4.306E-13	1.042E-11	1.952E-10	0.000E+00
Pu-239	ΣDSR(j)		1.086E-02	1.086E-02	1.086E-02	1.086E-02	1.085E-02	1.083E-02	1.076E-02	0.000E+00

Branch Fraction is the cumulative factor for the j'th principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life ≤ 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 15 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Pu-239	1.381E+03	1.381E+03	1.381E+03	1.381E+03	1.382E+03	1.385E+03	1.394E+03	*6.212E+10

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Pu-239	5.130E+00	0.000E+00	1.086E-02	1.381E+03	1.086E-02	1.381E+03

Individual Nuclide Dose Summed over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)		DOSE(j,t), mrem/yr						
			t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Pu-239	Pu-239	1.000E+00		5.539E-02	5.519E-02	5.519E-02	5.538E-02	5.534E-02	5.522E-02	5.487E-02	0.000E+00
U-235	Pu-239	1.000E+00		0.000E+00	3.239E-11	9.717E-11	3.238E-10	9.710E-10	3.231E-09	9.643E-09	0.000E+00
Pa-231	Pu-239	1.000E+00		0.000E+00	1.766E-15	1.589E-14	1.766E-13	1.588E-12	1.762E-11	1.578E-10	0.000E+00
Ac-227	Pu-239	1.000E+00		0.000E+00	9.994E-17	3.650E-15	9.318E-14	2.176E-12	5.313E-11	6.894E-10	0.000E+00

BRF(i) is the branch fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)		S(j,t), pCi/g							
			t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Pu-239	Pu-239	1.000E+00		5.100E+00	5.100E+00	5.100E+00	5.098E+00	5.095E+00	5.084E+00	5.052E+00	4.940E+00
U-235	Pu-239	1.000E+00		0.000E+00	5.023E-09	1.507E-08	5.022E-08	1.506E-07	5.010E-07	1.495E-06	4.896E-06
Pa-231	Pu-239	1.000E+00		0.000E+00	5.314E-14	4.782E-13	5.312E-12	4.779E-11	5.301E-10	4.747E-09	5.184E-08
Ac-227	Pu-239	1.000E+00		0.000E+00	5.595E-16	1.487E-14	5.216E-13	1.218E-11	2.974E-10	3.859E-09	4.872E-08

BRF(i) is the branch fraction of the parent nuclide.

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary ... 3
Site-Specific Parameter Summary ... 5
Summary of Pathway Selections ... 10
Contaminated Zone and Total Dose Summary ... 11
Total Dose Components
Time = 0.000E+00 ... 12
Time = 1.000E+00 ... 13
Time = 3.000E+00 ... 14
Time = 1.000E+01 ... 15
Time = 3.000E+01 ... 16
Time = 1.000E+02 ... 17
Time = 3.000E+02 ... 18
Time = 1.000E+03 ... 19
Dose/Source Ratios Summed Over All Pathways ... 20
Single Radionuclide Soil Guidelines ... 20
Dose Per Nuclide Summed Over All Pathways ... 22
Soil Concentration Per Nuclide ... 23

Dose Conversion Factor (and Related) Parameter Summary
File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Am-241	4.440E-01	4.440E-01	DCF2(2)
B-1	Np-237+D	5.400E-01	5.400E-01	DCF2(3)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(4)
B-1	Pb-210+D	2.320E-02	2.320E-02	DCF2(5)
B-1	Pu-239	4.290E-01	4.290E-01	DCF2(6)
B-1	Ra-226+D	8.600E-03	8.600E-03	DCF2(7)
B-1	Th-229+D	2.160E+00	2.160E+00	DCF2(8)
B-1	Th-230	3.260E-01	3.260E-01	DCF2(9)
B-1	U-233	1.150E-01	1.150E-01	DCF2(10)
B-1	U-234	1.320E-01	1.320E-01	DCF2(11)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(12)
B-1	U-238+D	1.180E-01	1.180E-01	DCF2(13)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Am-241	3.640E-03	3.640E-03	DCF3(2)
D-1	Np-237+D	4.440E-03	4.440E-03	DCF3(3)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(4)
D-1	Pb-210+D	7.270E-03	7.270E-03	DCF3(5)
D-1	Pu-239	3.640E-03	3.640E-03	DCF3(6)
D-1	Ra-226+D	1.330E-03	1.330E-03	DCF3(7)
D-1	Th-229+D	4.030E-03	4.030E-03	DCF3(8)
D-1	Th-230	5.480E-04	5.440E-04	DCF3(9)
D-1	U-233	2.890E-04	2.890E-04	DCF3(10)
D-1	U-234	2.830E-04	2.830E-04	DCF3(11)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(12)
D-1	U-238+D	2.690E-04	2.690E-04	DCF3(13)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34	Am-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(2,1)
D-34	Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(2,2)
D-34	Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-06	3.000E-06	RTF(2,3)
D-34	Np-237+D , plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(3,1)
D-34	Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(3,2)
D-34	Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(3,3)
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(4,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(4,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(4,3)
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(5,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(5,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-04	1.000E-04	RTF(5,3)

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(6,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(6,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(6,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(7,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(7,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(7,3)
D-34				
D-34	Th-229+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(8,1)
D-34	Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(8,2)
D-34	Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(8,3)
D-34				
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(9,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(9,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(9,3)
D-34				
D-34	U-233 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(10,1)
D-34	U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.400E-04	1.400E-04	RTF(10,2)
D-34	U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(10,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(11,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.400E-04	1.400E-04	RTF(11,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(11,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(12,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.400E-04	1.400E-04	RTF(12,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(12,3)
D-34				
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(13,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.400E-04	1.400E-04	RTF(13,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(13,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Am-241 , fish	1.000E+01	1.000E+01	BIOFAC(2,1)
D-5	Am-241 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(2,2)
D-5				
D-5	Np-237+D , fish	1.000E+01	1.000E+01	BIOFAC(3,1)
D-5	Np-237+D , crustacea and mollusks	4.000E+02	4.000E+02	BIOFAC(3,2)
D-5				
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(4,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(4,2)
D-5				
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(5,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(5,2)
D-5				
D-5	Pu-239 , fish	1.000E+01	1.000E+01	BIOFAC(6,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(6,2)
D-5				

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
D-5	Ra-226-D , fish	5.000E+01	5.000E+01	BIOFAC(7,1)
D-5	Ra-226-D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(7,2)
D-5				
D-5	Th-229-D , fish	1.000E+02	1.000E+02	BIOFAC(8,1)
D-5	Th-229-D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(8,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(9,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(9,2)
D-5				
D-5	U-233 , fish	1.000E+01	1.000E+01	BIOFAC(10,1)
D-5	U-233 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(10,2)
D-5				
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(11,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(11,2)
D-5				
D-5	U-235-D , fish	1.000E+01	1.000E+01	BIOFAC(12,1)
D-5	U-235-D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(12,2)
D-5				
D-5	U-238-D , fish	1.000E+01	1.000E+01	BIOFAC(13,1)
D-5	U-238-D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(13,2)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from User Input)	Parameter Name
R011	Area of contaminated zone (m**2)	4.900E+01	1.000E+04	...	AREA
R011	Thickness of contaminated zone (m)	1.000E+00	2.000E+00	...	THICK0
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	...	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	1.500E+01	2.500E+01	...	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	...	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	...	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	...	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	...	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	...	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	...	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	...	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	...	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	...	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	...	T(10)
R012	Initial principal radionuclide (pCi/g): Am-241	2.020E+02	0.000E+00	...	S1(2)
R012	Initial principal radionuclide (pCi/g): Pu-239	2.560E+01	0.000E+00	...	S1(6)
R012	Initial principal radionuclide (pCi/g): U-234	4.240E+01	0.000E+00	...	S1(11)
R012	Initial principal radionuclide (pCi/g): U-235	4.040E+00	0.000E+00	...	S1(12)
R012	Initial principal radionuclide (pCi/g): U-238	1.120E+01	0.000E+00	...	S1(13)
R012	Concentration in groundwater (pCi/L): Am-241	not used	0.000E+00	...	W1(2)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	...	W1(6)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	...	W1(11)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	...	W1(12)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	...	W1(13)
R013	Cover depth (m)	0.000E+00	0.000E+00	...	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	...	DENCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	...	VCV
R013	Density of contaminated zone (g/cm**3)	1.600E+00	1.500E+00	...	DENCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	...	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	...	TPCZ
R013	Contaminated zone effective porosity	2.000E-01	2.000E-01	...	EPCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	4.400E+02	1.000E+01	...	HCCZ
R013	Contaminated zone b parameter	4.050E+00	5.300E+00	...	BCZ
R013	Humidity in air (g/cm**3)	not used	8.000E+00	...	HUMID
R013	Evapotranspiration coefficient	9.990E-01	5.000E-01	...	EVAPTR
R013	Precipitation (m/yr)	4.800E-01	1.000E+00	...	PRECIP
R013	Irrigation (m/yr)	0.000E+00	2.000E-01	...	RI
R013	Irrigation mode	overhead	overhead	...	IDITCH
R013	Runoff coefficient	5.200E-01	2.000E-01	...	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	2.700E+07	1.000E+06	...	WAREA
R013	Accuracy for water/soil computations	0.000E+00	1.000E-03	Zero shown Simpson's rule.	EPS
R014	Density of saturated zone (g/cm**3)	1.600E+00	1.500E+00	...	DENSAQ
R014	Saturated zone total porosity	3.000E-01	4.000E-01	...	TPSZ
R014	Saturated zone effective porosity	3.000E-01	2.000E-01	...	EPSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	...	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	3.000E-02	...	HGWT
R014	Saturated zone b parameter	4.050E+00	5.300E+00	...	BSZ
R014	Water table drop rate (m/yr)	1.000E-01	1.000E-01	...	VWT

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (if different from user input)	Parameter Name
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	1.000E+01	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R015	Unsat. zone 2, thickness (m)	not used	0.000E+00	---	H(2)
R015	Unsat. zone 2, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(2)
R015	Unsat. zone 2, total porosity	not used	4.000E-01	---	TPUZ(2)
R015	Unsat. zone 2, effective porosity	not used	2.000E-01	---	EPUZ(2)
R015	Unsat. zone 2, soil-specific b parameter	not used	5.300E+00	---	BUZ(2)
R015	Unsat. zone 2, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(2)
R016	Distribution coefficients for Am-241				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(2,1)
R016	Unsaturated zone 2 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(2,2)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.170E-06	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	4.830E+01	2.000E+01	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	0.000E+00	2.000E+01	---	DCNUCU(6,1)
R016	Unsaturated zone 2 (cm**3/g)	0.000E+00	2.000E+01	---	DCNUCU(6,2)
R016	Saturated zone (cm**3/g)	0.000E+00	2.000E+01	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.972E-06	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(11,1)
R016	Unsaturated zone 2 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(11,2)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.876E-06	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)
R016	Distribution coefficients for U-235				
R016	Contaminated zone (cm**3/g)	7.270E+00	5.000E+01	---	DCNUCC(12)
R016	Unsaturated zone 1 (cm**3/g)	0.000E+00	5.000E+01	---	DCNUCU(12,1)
R016	Unsaturated zone 2 (cm**3/g)	0.000E+00	5.000E+01	---	DCNUCU(12,2)
R016	Saturated zone (cm**3/g)	0.000E+00	5.000E+01	---	DCNUCS(12)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.957E-09	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (if different from user input)	Parameter Name
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(13)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(13,1)
R016	Unsaturated zone 2 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(13,2)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(13)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.876E-06	ALEACH(13)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(13)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	1.300E+03	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	0.000E+00	2.000E+01	---	DCNUCU(1,1)
R016	Unsaturated zone 2 (cm**3/g)	0.000E+00	2.000E+01	---	DCNUCU(1,2)
R016	Saturated zone (cm**3/g)	0.000E+00	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.107E-06	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Np-237				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.036E+02	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	-1.000E+00	-1.000E+00	2.036E+02	DCNUCU(3,1)
R016	Unsaturated zone 2 (cm**3/g)	-1.000E+00	-1.000E+00	2.036E+02	DCNUCU(3,2)
R016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.036E+02	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.071E-07	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	1.000E+02	5.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	0.000E+00	5.000E+01	---	DCNUCU(4,1)
R016	Unsaturated zone 2 (cm**3/g)	0.000E+00	5.000E+01	---	DCNUCU(4,2)
R016	Saturated zone (cm**3/g)	0.000E+00	5.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.419E-06	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCU(5,1)
R016	Unsaturated zone 2 (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCU(5,2)
R016	Saturated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.419E-06	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(7,1)
R016	Unsaturated zone 2 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(7,2)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.055E-06	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (if different from user input)	Parameter Name
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(8,1)
R016	Unsaturated zone 2 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(8,2)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.400E-09	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(9,1)
R016	Unsaturated zone 2 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(9,2)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.400E-09	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for daughter U-233				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(10)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(10,1)
R016	Unsaturated zone 2 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(10,2)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.876E-06	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R017	Inhalation rate (m**3/yr)	1.927E+04	8.400E+07	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-03	3.000E-04	---	MLINH
R017	Dilution length for airborne dust, inhalation (m)	3.000E+00	1.000E+00	---	LM
R017	Exposure duration	1.000E+00	1.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF1
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	--	SHF1
R017	Fraction of time spent indoors	0.000E+00	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.500E-02	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	1 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (if different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	...	FRACA(1)
R017	Ring 2	not used	2.732E-01	...	FRACA(2)
R017	Ring 3	not used	0.000E+00	...	FRACA(3)
R017	Ring 4	not used	0.000E+00	...	FRACA(4)
R017	Ring 5	not used	0.000E+00	...	FRACA(5)
R017	Ring 6	not used	0.000E+00	...	FRACA(6)
R017	Ring 7	not used	0.000E+00	...	FRACA(7)
R017	Ring 8	not used	0.000E+00	...	FRACA(8)
R017	Ring 9	not used	0.000E+00	...	FRACA(9)
R017	Ring 10	not used	0.000E+00	...	FRACA(10)
R017	Ring 11	not used	0.000E+00	...	FRACA(11)
R017	Ring 12	not used	0.000E+00	...	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	...	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	...	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	...	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	...	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	...	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	...	DIET(6)
R018	Soil ingestion rate (g/yr)	1.750E+02	1.650E+01	...	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	...	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	...	FDW
R018	Contamination fraction of household water	1.000E+00	1.000E+00	...	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	...	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	...	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	...	FR9
R018	Contamination fraction of plant food	not used	-1	...	FPLANT
R018	Contamination fraction of meat	not used	-1	...	FMEAT
R018	Contamination fraction of milk	not used	-1	...	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	...	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	...	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	...	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	...	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	...	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	...	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	...	DM
R019	Depth of roots (m)	not used	9.000E-01	...	DROOT
R019	Drinking water fraction from ground water	0.000E+00	1.000E+00	...	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	...	FGWHH
R019	Livestock water fraction from ground water	0.000E+00	1.000E+00	...	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	...	FGWIR
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	...	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	...	C12C2
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	...	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	...	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	...	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	...	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	...	REVSN

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (if different from user input)	Parameter Name
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	not used	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	not used	1.000E+00	---	STOR_T(2)
STOR	Milk	not used	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	not used	2.000E+01	---	STOR_T(4)
STOR	Fish	not used	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	not used	7.000E+00	---	STOR_T(6)
STOR	Well water	not used	1.000E+00	---	STOR_T(7)
STOR	Surface water	not used	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	not used	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	2.000E-06	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	2.000E+00	2.000E+00	---	HMIX
R021	Average annual wind speed (m/sec)	3.000E+00	2.000E+00	---	WIND
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building room (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	code computed (time dependent)	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	code computed (time dependent)	DMFL
R021	Emanating power of Rn-222 gas	3.500E-01	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	active

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	49.00 square meters	Am-241	2.030E+02
Thickness:	1.00 meters	Pu-239	2.560E+01
Cover Depth:	0.00 meters	U-234	4.240E+01
		U-235	4.040E+00
		U-238	1.120E+01

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 15 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years)	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	1.194E+01	1.189E+01	1.180E+01	1.149E+01	1.061E+01	2.976E+01	3.319E+01	0.000E+00
M(t):	2.383E+00	2.379E+00	2.361E+00	2.212E+00	2.174E+00	1.984E+00	1.546E+00	0.000E+00

Maximum TDOSE(t): 1.194E+01 mrem/yr at t = 0.000E+00 years

Total *Dose* Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	1.550E-01	0.0046	2.783E+01	0.8200	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.450E-01	0.0043
Pu-239	1.351E-04	0.0000	3.408E+00	0.1004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.787E-02	0.0005
U-234	3.052E-04	0.0000	1.737E+00	0.0512	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.367E-03	0.0001
U-235	5.280E-02	0.0016	1.542E-01	0.0045	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.137E-04	0.0000
U-238	2.556E-02	0.0008	4.101E-01	0.0121	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.942E-04	0.0000
*******	**********	******	**********	******	**********	******	**********	******	**********	******	**********	******	**********	******
Total	2.338E-01	0.0069	1.354E+01	0.9882	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.661E-01	0.0049

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.813E+01	0.8288
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.426E+00	0.1009
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.719E+00	0.0512
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.072E-01	0.0061
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.362E-01	0.0129
*******	**********	******	**********	******	**********	******	**********	******	**********	******	**********	******	**********	******
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.394E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	1.548E-01	0.0046	3.778E+01	0.8198	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.448E-01	0.0043
Pu-239	1.351E-04	0.0000	3.404E+00	0.1005	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.787E-02	0.0005
U-234	1.052E-04	0.0000	1.737E+00	0.0512	2.260E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.367E-03	0.0001
U-235	9.280E-03	0.0016	1.543E-01	0.0046	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.129E-04	0.0000
U-238	2.556E-03	0.0008	4.101E-01	0.0121	5.458E-21	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.942E-04	0.0000
Total	2.316E-01	0.0069	3.349E+01	0.9882	2.260E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.658E-01	0.0049

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.808E+01	0.8280
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.426E+00	0.1011
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.739E+00	0.1511
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.072E-01	0.1161
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.362E-01	0.3123
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.149E+01	1.2000

*Sum of all water independent and dependent pathways

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excluding radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	1.543E-01	0.0046	3.269E+01	0.9193	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.443E-01	0.0041
Pu-239	1.351E-04	0.0000	1.407E+00	0.1008	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.787E-02	0.0006
U-234	3.053E-04	0.0000	1.737E+00	0.0514	2.011E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.367E-03	0.0001
U-239	5.280E-02	0.0016	1.543E-01	0.0046	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.133E-04	0.0000
U-238	2.596E-03	0.0008	4.101E-01	0.0121	1.533E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.942E-04	0.0000
Total	2.331E-01	0.0069	3.340E+01	0.9883	2.011E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.654E-01	0.0049

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.799E+01	0.8282
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.425E+00	0.1013
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.739E+00	0.0515
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.073E-01	0.0061
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.162E-01	0.0123
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.380E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	1.520E-01	0.0046	2.730E+01	0.8177	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.427E-01	0.0043
Pu-239	1.350E-04	0.0000	3.407E+00	0.1017	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.787E-03	0.0005
U-234	3.067E-04	0.0000	1.727E+00	0.0519	2.246E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.367E-03	0.0001
U-235	5.279E-02	0.0016	1.547E-01	0.0046	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.148E-04	0.0000
U-238	2.556E-02	0.0008	4.101E-01	0.0123	5.609E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.942E-04	0.0000
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total	2.313E-01	0.0069	1.309E+01	0.9883	2.246E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.637E-01	0.0049

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.768E+01	0.8266
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.439E+00	0.1027
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.740E+00	0.0519
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.078E-01	0.0062
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.102E-01	0.0122
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.349E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	1.477E-01	0.0045	2.852E+01	0.8131	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.382E-01	0.0042
Pu-239	1.150E-04	0.0000	3.404E+00	0.1044	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.786E-02	0.0005
U-234	3.191E-04	0.0000	1.737E+00	0.0531	1.991E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.367E-03	0.0001
U-235	5.281E-02	0.0016	1.570E-01	0.0048	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.206E-04	0.0000
U-238	2.596E-02	0.0008	4.101E-01	0.0126	1.494E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.942E-04	0.0000
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total	2.266E-01	0.0069	1.232E+01	0.9882	1.993E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.592E-01	0.0049

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.880E+01	0.8219
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.422E+00	0.1349
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.740E+00	0.0534
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.100E-01	0.0064
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.302E-01	0.0134
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.261E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	1.321E-01	0.0044	2.369E+01	0.7960	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.234E+01	0.0041
Pu-239	1.347E-04	0.0000	3.397E+00	0.1141	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.782E-02	0.0000
U-234	4.566E-04	0.0000	1.719E+00	0.0584	3.099E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.170E-01	0.0001
U-235	5.293E-02	0.0018	1.697E-01	0.0057	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.476E-04	0.0000
U-238	2.555E-02	0.0009	4.101E-01	0.0138	5.260E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.942E-04	0.0000
Total	2.111E-01	0.0071	2.940E+01	0.9881	3.099E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.445E+01	0.0049

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.594E+01	0.8946
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.415E+00	0.1147
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.943E+00	0.0585
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.239E-01	0.0075
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.362E-01	0.0147
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.976E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	9.590E-02	0.0041	1.717E+01	0.7401	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.945E-02	0.0039
Pu-239	1.139E-04	0.0000	3.375E+00	0.1455	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.770E-03	0.0000
U-234	1.624E-03	0.0001	1.745E+00	0.0752	1.553E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.389E-03	0.0001
U-235	5.115E-02	0.0022	2.110E-01	0.0091	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.314E-04	0.0000
U-238	2.554E-02	0.0011	4.101E-01	0.0177	1.176E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.943E-04	0.0000
-------	----------	------	----------	------	----------	------	----------	------	----------	------	----------	------	----------	------
Total	1.765E-01	0.0076	2.291E+01	0.9876	1.553E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.105E-01	0.0048

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.739E+01	0.7491
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.393E+00	0.1463
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.749E+00	0.0754
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.647E-01	0.0114
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.362E-01	0.0188
-------	----------	------	----------	------	----------	------	----------	------	----------	------	----------	------	----------	------
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.319E+01	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excluding radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent	Product	Branch		DSR(j,t) (mrem/yr)/(pCi/g)							
(i)	j[i]	Fraction	t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	Am-241	1.000E+00		1.393E-01	1.390E-01	1.386E-01	1.370E-01	1.327E-01	1.195E-01	8.588E-02	0.000E+00
Am-241	Np-237	1.000E+00		0.000E+00	6.056E-08	1.814E-07	6.012E-07	1.775E-06	5.597E-06	1.442E-05	0.000E+00
Am-241	U-233	1.000E+00		0.000E+00	2.971E-14	2.671E-13	2.950E-13	2.632E-11	2.618E-10	2.290E-09	0.000E+00
Am-241	Th-229	1.000E+00		0.000E+00	1.557E-17	4.196E-16	1.550E-14	4.144E-13	1.492E-11	3.710E-10	0.000E+00
Am-241	ΣDSR(j)			1.393E-01	1.390E-01	1.386E-01	1.370E-01	1.327E-01	1.185E-01	8.590E-02	0.000E+00
Pu-239	Pu-239	1.000E+00		1.338E-01	1.338E-01	1.338E-01	1.338E-01	1.337E-01	1.334E-01	1.325E-01	0.000E+00
Pu-239	U-235	1.000E+00		0.000E+00	5.051E-11	1.515E-10	5.050E-10	1.514E-09	5.018E-09	1.504E-08	0.000E+00
Pu-239	Pa-231	1.000E+00		0.000E+00	4.194E-15	3.774E-14	4.193E-13	3.772E-12	4.184E-11	3.747E-10	0.000E+00
Pu-239	Ac-227	1.000E+00		0.000E+00	2.328E-16	6.186E-15	2.170E-13	5.066E-12	1.238E-10	1.606E-09	0.000E+00
Pu-239	ΣDSR(j)			1.338E-01	1.338E-01	1.338E-01	1.338E-01	1.337E-01	1.334E-01	1.325E-01	0.000E+00
U-234	U-234	1.000E+00		4.102E-02	4.102E-02	4.102E-02	4.102E-02	4.101E-02	4.100E-02	4.095E-02	0.000E+00
U-234	Th-230	1.000E+00		0.000E+00	9.117E-07	2.735E-06	9.116E-06	2.735E-05	9.110E-05	2.729E-04	0.000E+00
U-234	Ra-226	1.000E+00		0.000E+00	3.666E-10	3.297E-09	3.660E-08	3.284E-07	3.611E-06	3.155E-05	0.000E+00
U-234	Pb-210	1.000E+00		0.000E+00	1.752E-13	4.657E-12	1.635E-10	3.831E-09	9.329E-08	1.190E-06	0.000E+00
U-234	ΣDSR(j)			4.102E-02	4.102E-02	4.102E-02	4.103E-02	4.104E-02	4.109E-02	4.126E-02	0.000E+00
U-235	U-235	1.000E+00		5.129E-02	5.128E-02	5.128E-02	5.128E-02	5.126E-02	5.119E-02	5.099E-02	0.000E+00
U-235	Pa-231	1.000E+00		0.000E+00	8.516E-06	2.555E-05	8.515E-05	2.553E-04	8.499E-04	2.539E-03	0.000E+00
U-235	Ac-227	1.000E+00		0.000E+00	7.072E-07	6.213E-06	6.444E-05	4.791E-04	3.133E-03	1.199E-02	0.000E+00
U-235	ΣDSR(j)			5.129E-02	5.129E-02	5.131E-02	5.143E-02	5.199E-02	5.517E-02	6.561E-02	0.000E+00
U-238	U-238	1.000E+00		3.895E-02	3.895E-02	3.895E-02	3.895E-02	3.894E-02	3.894E-02	3.891E-02	0.000E+00
U-238	U-234	1.000E+00		0.000E+00	1.163E-07	3.489E-07	1.161E-06	3.480E-06	1.162E-05	1.484E-05	0.000E+00
U-238	Th-230	1.000E+00		0.000E+00	1.292E-12	1.163E-11	1.292E-10	1.163E-09	1.292E-08	1.161E-07	0.000E+00
U-238	Ra-226	1.000E+00		0.000E+00	1.350E-16	9.158E-15	1.460E-13	9.320E-12	1.425E-10	9.043E-09	0.000E+00
U-238	Pb-210	1.000E+00		0.000E+00	0.000E+00	6.454E-18	1.174E-15	8.481E-14	7.416E-12	3.119E-10	0.000E+00
U-238	ΣDSR(j)			3.895E-02	3.895E-02	3.895E-02	3.895E-02	3.895E-02	3.895E-02	3.895E-02	0.000E+00

Branch Fraction is the cumulative factor for the i'th principal radionuclide daughters: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life < 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 15 mrem/yr

Nuclide								
(i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	1.077E+02	1.079E+02	1.082E+02	1.095E+02	1.131E+02	1.265E+02	1.746E+02	*1.430E+12
Pu-239	1.121E+02	1.121E+02	1.121E+02	1.121E+02	1.122E+02	1.125E+02	1.132E+02	*6.212E+10
U-234	3.657E+02	3.657E+02	3.657E+02	3.656E+02	3.655E+02	3.650E+02	3.636E+02	*6.345E+09
U-235	2.925E+02	2.924E+02	2.923E+02	2.917E+02	2.885E+02	2.719E+02	2.290E+02	*3.160E+08
U-238	3.851E+02	3.851E+02	3.851E+02	3.851E+02	3.851E+02	3.851E+02	3.851E+02	*3.340E+09

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Am-241	2.020E+02	0.000E+00	1.392E-01	1.077E+02	1.392E-01	1.077E+02
Pu-239	2.560E+01	0.000E+00	1.338E-01	1.121E+02	1.338E-01	1.121E+02
U-234	4.240E+01	849.8 ± 0.8	4.180E-02	3.588E+02	4.102E-02	3.657E+02
U-235	4.040E+00	849.5 ± 0.8	9.109E-02	1.611E+02	5.129E-02	2.925E+02
U-238	1.120E+01	414.2 ± 0.4	3.895E-02	3.851E+02	3.895E-02	3.851E+02

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)	DOSE(j,t), mrem/yr							
		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	Am-241	1.000E+00	2.813E+01	2.808E+01	2.799E+01	2.768E+01	2.680E+01	2.394E+01	1.739E+01	0.000E+00
Np-237	Am-241	1.000E+00	0.000E+00	1.223E-05	3.664E-05	1.214E-04	3.585E-04	1.131E-03	2.912E-03	0.000E+00
U-233	Am-241	1.000E+00	0.000E+00	6.091E-12	5.195E-11	5.972E-10	5.317E-09	5.693E-08	4.625E-07	0.000E+00
Th-229	Am-241	1.000E+00	0.000E+00	3.145E-15	8.477E-14	3.130E-12	8.179E-11	1.013E-09	7.494E-08	0.000E+00
Pu-239	Pu-239	1.000E+00	1.426E+00	1.426E+00	1.426E+00	1.425E+00	1.422E+00	1.410E+00	1.191E+00	0.000E+00
U-235	Pu-239	1.000E+00	0.000E+00	1.293E-09	3.879E-09	1.293E-08	3.876E-08	1.290E-07	3.849E-07	0.000E+00
U-235	U-235	1.000E+00	2.072E-01	2.072E-01	2.072E-01	2.072E-01	2.071E-01	2.068E-01	2.060E-01	0.000E+00
U-235	SUM DOSE(j):		2.072E-01	2.072E-01	2.072E-01	2.072E-01	2.071E-01	2.068E-01	2.060E-01	0.000E+00
Pa-231	Pu-239	1.000E+00	0.000E+00	1.074E-11	9.662E-11	1.077E-11	9.656E-11	1.071E-09	9.592E-09	0.000E+00
Pa-231	U-235	1.000E+00	0.000E+00	3.441E-05	1.033E-04	3.440E-04	1.033E-03	3.433E-03	1.026E-02	0.000E+00
Pa-231	SUM DOSE(j):		0.000E+00	3.441E-05	1.033E-04	3.440E-04	1.033E-03	3.433E-03	1.026E-02	0.000E+00
Ac-227	Pu-239	1.000E+00	0.000E+00	5.960E-15	1.984E-13	5.956E-12	1.297E-10	1.148E-09	4.111E-08	0.000E+00
Ac-227	U-235	1.000E+00	0.000E+00	2.857E-06	2.518E-05	2.604E-04	1.936E-03	1.266E-02	4.844E-02	0.000E+00
Ac-227	SUM DOSE(j):		0.000E+00	2.857E-06	2.518E-05	2.604E-04	1.936E-03	1.266E-02	4.844E-02	0.000E+00
U-234	U-234	1.000E+00	1.719E+00	1.719E+00	1.719E+00	1.719E+00	1.719E+00	1.718E+00	1.716E+00	0.000E+00
U-234	U-238	1.000E+00	0.000E+00	1.302E-04	1.907E-06	1.302E-05	1.907E-05	1.302E-04	3.902E-04	0.000E+00
U-234	SUM DOSE(j):		1.719E+00	1.719E+00	1.719E+00	1.719E+00	1.719E+00	1.718E+00	1.717E+00	0.000E+00
Th-230	U-234	1.000E+00	0.000E+00	3.866E-05	1.160E-04	3.865E-04	1.159E-03	3.861E-03	1.157E-02	0.000E+00
Th-230	U-238	1.000E+00	0.000E+00	1.447E-11	1.303E-10	1.447E-09	1.302E-08	1.447E-07	1.300E-06	0.000E+00
Th-230	SUM DOSE(j):		0.000E+00	3.866E-05	1.160E-04	3.865E-04	1.159E-03	3.861E-03	1.157E-02	0.000E+00
Ra-226	U-234	1.000E+00	0.000E+00	1.554E-06	1.398E-07	1.552E-06	1.392E-05	1.531E-04	1.338E-03	0.000E+00
Ra-226	U-238	1.000E+00	0.000E+00	3.752E-15	1.048E-13	3.875E-12	1.044E-10	1.436E-09	1.013E-07	0.000E+00
Ra-226	SUM DOSE(j):		0.000E+00	1.554E-06	1.398E-07	1.552E-06	1.392E-05	1.531E-04	1.338E-03	0.000E+00
Pb-210	U-234	1.000E+00	0.000E+00	7.428E-12	1.974E-10	6.931E-09	1.620E-07	1.755E-06	5.048E-05	0.000E+00
Pb-210	U-238	1.000E+00	0.000E+00	0.000E+00	7.229E-17	1.115E-14	9.499E-11	8.106E-11	1.491E-09	0.000E+00
Pb-210	SUM DOSE(j):		0.000E+00	7.428E-12	1.974E-10	6.931E-09	1.620E-07	1.755E-06	5.048E-05	0.000E+00
U-238	U-238	1.000E+00	4.142E-01	4.142E-01	4.142E-01	4.142E-01	4.142E-01	4.141E-01	4.139E-01	0.000E+00

BRF(i) is the branch fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
			S(j,t), pCi/g							
Am-241	Am-241	1.000E+00	2.020E+02	2.017E+02	2.010E+02	1.988E+02	1.925E+02	1.719E+02	1.246E+02	4.034E+01
Np-237	Am-241	1.000E+00	0.000E+00	6.534E-05	1.958E-04	6.490E-04	1.916E-03	6.043E-03	1.586E-02	3.248E-02
U-233	Am-241	1.000E+00	0.000E+00	1.410E-10	1.385E-09	1.423E-08	1.267E-07	1.356E-06	1.102E-05	8.910E-05
Th-229	Am-241	1.000E+00	0.000E+00	4.505E-15	1.214E-13	4.484E-12	1.200E-10	4.317E-09	1.074E-07	3.062E-06
Pu-239	Pu-239	1.000E+00	2.560E+01	2.560E+01	2.560E+01	2.559E+01	2.558E+01	2.553E+01	2.536E+01	2.480E+01
U-235	Pu-239	1.000E+00	0.000E+00	2.521E-04	7.563E-04	2.521E-03	7.558E-03	2.515E-02	7.506E-02	2.457E-01
U-235	U-235	1.000E+00	4.040E+00	4.040E+00	4.040E+00	4.039E+00	4.038E+00	4.032E+00	4.016E+00	3.962E+00
U-235	SUM(j):		4.040E+00	4.040E+00	4.040E+00	4.039E+00	4.038E+00	4.032E+00	4.016E+00	3.962E+00
Pa-231	Pu-239	1.000E+00	0.000E+00	2.667E-11	2.400E-12	2.667E-11	2.399E-10	2.661E-09	2.383E-08	2.602E-07
Pa-231	U-235	1.000E+00	0.000E+00	8.548E-05	2.564E-04	8.540E-04	2.561E-03	8.530E-03	2.548E-02	8.370E-02
Pa-231	SUM(j):		0.000E+00	8.548E-05	2.564E-04	8.540E-04	2.563E-03	8.530E-03	2.548E-02	8.370E-02
Ac-227	Pu-239	1.000E+00	0.000E+00	2.808E-15	7.463E-14	2.618E-12	6.114E-11	1.493E-09	1.917E-08	3.440E-07
Ac-227	U-235	1.000E+00	0.000E+00	1.346E-06	1.186E-05	1.327E-04	9.121E-04	5.964E-03	2.283E-02	8.113E-02
Ac-227	SUM(j):		0.000E+00	1.346E-06	1.186E-05	1.327E-04	9.121E-04	5.964E-03	2.283E-02	8.113E-02
U-234	U-234	1.000E+00	4.240E+01	4.240E+01	4.240E+01	4.240E+01	4.239E+01	4.238E+01	4.233E+01	4.216E+01
U-234	U-238	1.000E+00	0.000E+00	1.175E-05	9.525E-05	1.175E-04	9.524E-04	1.174E-03	9.513E-03	1.162E-02
U-234	SUM(j):		4.240E+01	4.240E+01	4.240E+01	4.240E+01	4.239E+01	4.238E+01	4.234E+01	4.219E+01
Th-230	U-234	1.000E+00	0.000E+00	1.817E-04	1.145E-01	1.817E-01	1.145E-02	1.814E-02	1.143E-01	1.789E-01
Th-230	U-238	1.000E+00	0.000E+00	1.429E-10	1.286E-09	1.429E-08	1.286E-07	1.428E-06	1.284E-05	1.421E-04
Th-230	SUM(j):		0.000E+00	1.817E-04	1.145E-01	1.817E-01	1.145E-02	1.814E-02	1.143E-01	1.790E-01
Ra-226	U-234	1.000E+00	0.000E+00	8.266E-08	7.437E-07	8.255E-06	7.407E-05	8.145E-04	7.117E-03	7.162E-02
Ra-226	U-238	1.000E+00	0.000E+00	1.996E-14	5.976E-13	2.061E-11	5.551E-10	2.041E-08	5.388E-07	1.849E-05
Ra-226	SUM(j):		0.000E+00	8.266E-08	7.437E-07	8.255E-06	7.407E-05	8.145E-04	7.117E-03	7.163E-02
Pb-210	U-234	1.000E+00	0.000E+00	6.499E-10	2.259E-08	7.931E-07	1.854E-05	4.526E-04	5.775E-03	6.734E-02
Pb-210	U-238	1.000E+00	0.000E+00	0.000E+00	8.271E-15	1.505E-13	1.087E-10	9.501E-09	3.996E-07	1.687E-05
Pb-210	SUM(j):		0.000E+00	6.499E-10	2.259E-08	7.931E-07	1.854E-05	4.526E-04	5.776E-03	6.736E-02
U-238	U-238	1.000E+00	1.120E+01	1.120E+01	1.120E+01	1.120E+01	1.120E+01	1.120E+01	1.119E+01	1.117E+01

BRF(i) is the branch fraction of the parent nuclide.

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary ... 2
Site-Specific Parameter Summary ... 5
Summary of Pathway Selections ... 10
Contaminated Zone and Total Dose Summary ... 11
Total Dose Components
Time = 0.000E+00 ... 12
Time = 1.000E+00 ... 13
Time = 3.000E+00 ... 14
Time = 1.000E+01 ... 15
Time = 3.000E+01 ... 16
Time = 1.000E+02 ... 17
Time = 3.000E+02 ... 18
Time = 1.000E+03 ... 19
Dose/Source Ratios Summed Over All Pathways ... 20
Single Radionuclide Soil Guidelines ... 20
Dose Per Nuclide Summed Over All Pathways ... 22
Soil Concentration Per Nuclide ... 23

CON-1A-0005-4-2

Dose Conversion Factor (and Related) Parameter Summary
File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.720E+00	6.720E+00	DCF2(1)
B-1	Am-241	4.440E+01	4.440E+01	DCF2(2)
B-1	Np-237+D	5.400E+01	5.400E+01	DCF2(3)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(4)
B-1	Pb-210+D	2.320E-02	2.320E-02	DCF2(5)
B-1	Pu-239	4.290E+01	4.290E+01	DCF2(6)
B-1	Ra-226+D	8.600E-03	8.600E-03	DCF2(7)
B-1	Th-229+D	2.160E+00	2.160E+00	DCF2(8)
B-1	Th-230	1.260E-01	1.260E-01	DCF2(9)
B-1	U-233	1.350E-01	1.350E-01	DCF2(10)
B-1	U-234	1.320E-01	1.320E-01	DCF2(11)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(12)
B-1	U-238+D	1.180E-01	1.180E-01	DCF2(13)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.480E-02	DCF3(1)
D-1	Am-241	3.640E-01	3.640E-01	DCF3(2)
D-1	Np-237+D	4.440E-01	4.440E-01	DCF3(3)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(4)
D-1	Pb-210+D	7.270E-03	7.270E-03	DCF3(5)
D-1	Pu-239	3.540E-01	3.540E-01	DCF3(6)
D-1	Ra-226+D	1.330E-01	1.330E-01	DCF3(7)
D-1	Th-229+D	4.010E-01	4.010E-01	DCF3(8)
D-1	Th-230	5.480E-04	5.480E-04	DCF3(9)
D-1	U-233	2.890E-04	2.890E-04	DCF3(10)
D-1	U-234	2.810E-04	2.810E-04	DCF3(11)
D-1	U-235+D	2.670E-04	2.670E-04	DCF3(12)
D-1	U-238+D	2.690E-04	2.690E-04	DCF3(13)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-01	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34	Am-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(2,1)
D-34	Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(2,2)
D-34	Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(2,3)
D-34	Np-237+D , plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(3,1)
D-34	Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-01	1.000E-03	RTF(3,2)
D-34	Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(3,3)
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(4,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(4,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(4,3)
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(5,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(5,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-04	1.000E-04	RTF(5,3)

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(6,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(6,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(6,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(7,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(7,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(7,3)
D-34				
D-34	Th-229+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(8,1)
D-34	Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(8,2)
D-34	Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(8,3)
D-34				
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(9,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(9,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(9,3)
D-34				
D-34	U-233 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(10,1)
D-34	U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.400E-04	1.400E-04	RTF(10,2)
D-34	U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(10,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(11,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.400E-04	1.400E-04	RTF(11,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(11,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(12,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.400E-04	1.400E-04	RTF(12,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(12,3)
D-34				
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(13,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.400E-04	1.400E-04	RTF(13,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(13,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Am-241 , fish	1.000E+01	1.000E+01	BIOFAC(2,1)
D-5	Am-241 , crustacea and mollusks	1.000E+01	1.000E+01	BIOFAC(2,2)
D-5				
D-5	Np-237+D , fish	1.000E+01	1.000E+01	BIOFAC(3,1)
D-5	Np-237+D , crustacea and mollusks	4.000E+02	4.000E+02	BIOFAC(3,2)
D-5				
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(4,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(4,2)
D-5				
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(5,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(5,2)
D-5				
D-5	Pu-239 , fish	1.000E+01	1.000E+01	BIOFAC(6,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(6,2)
D-5				

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: DOSFAC.BIN

Menu	Parameter	Current Value	Default	Parameter Name
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(7,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(7,2)
D-5				
D-5	Th-229+D , fish	1.000E+02	1.000E+02	BIOFAC(8,1)
D-5	Th-229+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(8,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(9,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(9,2)
D-5				
D-5	U-233 , fish	1.000E+01	1.000E+01	BIOFAC(10,1)
D-5	U-233 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(10,2)
D-5				
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(11,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(11,2)
D-5				
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(12,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(12,2)
D-5				
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(13,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(13,2)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (if different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	4.900E+01	1.000E+04	...	AREA
R011	Thickness of contaminated zone (m)	1.000E+00	2.000E+00	...	THICK0
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	...	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	1.500E+01	3.000E+01	...	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	...	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	...	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	...	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	...	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	...	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	...	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	...	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	...	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	...	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	...	T(10)
R012	Initial principal radionuclide (pCi/g): Am-241	2.020E+02	0.000E+00	...	S1(3)
R012	Initial principal radionuclide (pCi/g): Pu-239	9.300E+00	0.000E+00	...	S1(6)
R012	Initial principal radionuclide (pCi/g): U-234	1.660E+01	0.000E+00	...	S1(11)
R012	Initial principal radionuclide (pCi/g): U-235	1.460E+00	0.000E+00	...	S1(12)
R012	Initial principal radionuclide (pCi/g): U-238	5.820E+00	0.000E+00	...	S1(13)
R012	Concentration in groundwater (pCi/L): Am-241	not used	0.000E+00	...	W1(3)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	...	W1(6)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	...	W1(11)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	...	W1(12)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	...	W1(13)
R013	Cover depth (m)	0.000E+00	0.000E+00	...	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	...	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	...	VCV
R013	Density of contaminated zone (g/cm**3)	1.600E+00	1.500E+00	...	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	...	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	...	TPCZ
R013	Contaminated zone effective porosity	2.000E-01	2.000E-01	...	EPCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	4.400E+03	1.000E+01	...	HCCZ
R013	Contaminated zone b parameter	4.050E+00	5.300E+00	...	BCZ
R013	Humidity in air (g/cm**3)	not used	8.000E+00	...	HUMID
R013	Evapotranspiration coefficient	9.990E-01	5.000E-01	...	EVAPTR
R013	Precipitation (m/yr)	4.800E-01	1.000E+00	...	PRECIP
R013	Irrigation (m/yr)	0.000E+00	2.000E-01	...	RI
R013	Irrigation mode	overhead	overhead	...	IDITCH
R013	Runoff coefficient	5.200E-01	2.000E-01	...	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	2.700E+07	1.000E+06	...	WAREA
R013	Accuracy for water/soil computations	0.000E+00	1.000E-03	Zero shows Simpson's rule.	EPS
R014	Density of saturated zone (g/cm**3)	1.600E+00	1.500E+00	...	DENSAQ
R014	Saturated zone total porosity	1.000E-01	4.000E-01	...	TPSZ
R014	Saturated zone effective porosity	1.000E-01	2.000E-01	...	EPSZ
R014	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	...	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	...	HGWT
R014	Saturated zone b parameter	4.050E+00	5.300E+00	...	BSZ
R014	Water table drop rate (m/yr)	1.000E-01	1.000E-03	...	VWT

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (if different from user input)	Parameter Name
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	...	DWIINT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	...	MODEL
R014	Well pumping rate (m**3/yr)	1.000E+01	2.500E+02	...	UW
R015	Number of unsaturated zone strata	not used	1	...	NS
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	...	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	...	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	...	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	...	EPUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	...	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	...	HCUZ(1)
R015	Unsat. zone 2, thickness (m)	not used	0.000E+00	...	H(2)
R015	Unsat. zone 2, soil density (g/cm**3)	not used	1.500E+00	...	DENSUZ(2)
R015	Unsat. zone 2, total porosity	not used	4.000E-01	...	TPUZ(2)
R015	Unsat. zone 2, effective porosity	not used	2.000E-01	...	EPUZ(2)
R015	Unsat. zone 2, soil-specific b parameter	not used	5.300E+00	...	BUZ(2)
R015	Unsat. zone 2, hydraulic conductivity (m/yr)	not used	1.000E+01	...	HCUZ(2)
R016	Distribution coefficients for Am-241				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	...	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	...	DCNUCU(2,1)
R016	Unsaturated zone 2 (cm**3/g)	2.000E+01	2.000E+01	...	DCNUCU(2,2)
R016	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	...	DCNUCS(2)
R016	Leach rate (1/yr)	0.000E+00	0.000E+00	7.176E-06	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	4.838E+01	2.000E+03	...	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	0.000E+00	2.000E+03	...	DCNUCU(6,1)
R016	Unsaturated zone 2 (cm**3/g)	0.000E+00	2.000E+03	...	DCNUCU(6,2)
R016	Saturated zone (cm**3/g)	0.000E+00	2.000E+03	...	DCNUCS(6)
R016	Leach rate (1/yr)	0.000E+00	0.000E+00	2.972E-06	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	...	DCNUCC(11)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	...	DCNUCU(11,1)
R016	Unsaturated zone 2 (cm**3/g)	5.000E+01	5.000E+01	...	DCNUCU(11,2)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	...	DCNUCS(11)
R016	Leach rate (1/yr)	0.000E+00	0.000E+00	2.876E-06	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)
R016	Distribution coefficients for U-235				
R016	Contaminated zone (cm**3/g)	7.290E+00	5.000E+01	...	DCNUCC(12)
R016	Unsaturated zone 1 (cm**3/g)	0.000E+00	5.000E+01	...	DCNUCU(12,1)
R016	Unsaturated zone 2 (cm**3/g)	0.000E+00	5.000E+01	...	DCNUCU(12,2)
R016	Saturated zone (cm**3/g)	0.000E+00	5.000E+01	...	DCNUCS(12)
R016	Leach rate (1/yr)	0.000E+00	0.000E+00	1.957E-06	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from User Input)	Parameter Name
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(13)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(13,1)
R016	Unsaturated zone 2 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(13,2)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(13)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.876E-06	ALEACH(13)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(13)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	1.300E+03	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	0.000E+00	2.000E+01	---	DCNUCU(1,1)
R016	Unsaturated zone 2 (cm**3/g)	0.000E+00	2.000E+01	---	DCNUCU(1,2)
R016	Saturated zone (cm**3/g)	0.000E+00	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.107E-06	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Np-237				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.036E+02	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	-1.000E+00	-1.000E+00	2.036E+02	DCNUCU(3,1)
R016	Unsaturated zone 2 (cm**3/g)	-1.000E+00	-1.000E+00	2.036E+02	DCNUCU(3,2)
R016	Saturated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.036E+02	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.071E-07	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	1.000E+02	5.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	0.000E+00	5.000E+01	---	DCNUCU(4,1)
R016	Unsaturated zone 2 (cm**3/g)	0.000E+00	5.000E+01	---	DCNUCU(4,2)
R016	Saturated zone (cm**3/g)	0.000E+00	5.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.439E-06	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCU(5,1)
R016	Unsaturated zone 2 (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCU(5,2)
R016	Saturated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.439E-06	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(7,1)
R016	Unsaturated zone 2 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(7,2)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.055E-06	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (if different from user input)	Parameter Name
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	...	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	...	DCNUCU(8,1)
R016	Unsaturated zone 2 (cm**3/g)	6.000E+04	6.000E+04	...	DCNUCU(8,2)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	...	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.400E-09	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	...	DCNUCC(9)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	...	DCNUCU(9,1)
R016	Unsaturated zone 2 (cm**3/g)	6.000E+04	6.000E+04	...	DCNUCU(9,2)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	...	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.400E-09	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)
R016	Distribution coefficients for daughter U-233				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	...	DCNUCC(10)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	...	DCNUCU(10,1)
R016	Unsaturated zone 2 (cm**3/g)	5.000E+01	5.000E+01	...	DCNUCU(10,2)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	...	DCNUCS(10)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.476E-06	ALEACH(10)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(10)
R017	Inhalation rate (m**3/yr)	1.139E+04	8.400E+03	...	INHALR
R017	Mass loading for inhalation (g/m**3)	5.000E-04	2.000E-04	...	MLINH
R017	Dilution length for airborne dust, inhalation (m)	3.000E+00	1.000E+00	...	LM
R017	Exposure duration	1.000E+00	1.000E+01	...	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	...	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	...	SHF1
R017	Fraction of time spent indoors	0.000E+00	5.000E-01	...	FIND
R017	Fraction of time spent outdoors (on site)	8.000E-03	2.500E-01	...	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	1 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	...	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	...	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	...	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	...	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	...	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	...	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	...	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	...	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	...	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	...	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	...	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	...	RAD_SHAPE(12)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (if different from user input)	Parameter Name
3017	Fractions of annular areas within AREA:				
3017	Ring 1	not used	1.000E+00	...	FRACA(1)
3017	Ring 2	not used	3.733E-01	...	FRACA(2)
3017	Ring 3	not used	0.000E+00	...	FRACA(3)
3017	Ring 4	not used	0.000E+00	...	FRACA(4)
3017	Ring 5	not used	0.000E+00	...	FRACA(5)
3017	Ring 6	not used	0.000E+00	...	FRACA(6)
3017	Ring 7	not used	0.000E+00	...	FRACA(7)
3017	Ring 8	not used	0.000E+00	...	FRACA(8)
3017	Ring 9	not used	0.000E+00	...	FRACA(9)
3017	Ring 10	not used	0.000E+00	...	FRACA(10)
3017	Ring 11	not used	0.000E+00	...	FRACA(11)
3017	Ring 12	not used	0.000E+00	...	FRACA(12)
3018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	...	DIET(1)
3018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	...	DIET(2)
3018	Milk consumption (L/yr)	not used	9.300E+01	...	DIET(3)
3018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	...	DIET(4)
3018	Fish consumption (kg/yr)	not used	5.400E+00	...	DIET(5)
3018	Other seafood consumption (kg/yr)	not used	9.000E-01	...	DIET(6)
3018	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	...	SOIL
3018	Drinking water intake (L/yr)	not used	5.100E+02	...	DWI
3018	Contamination fraction of drinking water	not used	1.000E+00	...	FDW
3018	Contamination fraction of household water	0.000E+00	1.000E+00	...	FHHW
3018	Contamination fraction of livestock water	not used	1.000E+00	...	FLW
3018	Contamination fraction of irrigation water	not used	1.000E+00	...	FIRW
3018	Contamination fraction of aquatic food	not used	5.000E-01	...	FR9
3018	Contamination fraction of plant food	not used	-1	...	FPLANT
3018	Contamination fraction of meat	not used	-1	...	FMEAT
3018	Contamination fraction of milk	not used	-1	...	FMILK
3019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	...	LF15
3019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	...	LF16
3019	Livestock water intake for meat (L/day)	not used	5.000E+01	...	LW15
3019	Livestock water intake for milk (L/day)	not used	1.600E+02	...	LW16
3019	Livestock soil intake (kg/day)	not used	5.000E-01	...	LSI
3019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	...	MLFD
3019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	...	DM
3019	Depth of roots (m)	not used	9.000E-01	...	DROOT
3019	Drinking water fraction from ground water	0.000E+00	1.000E+00	...	FGWDW
3019	Household water fraction from ground water	not used	1.000E+00	...	FGWHH
3019	Livestock water fraction from ground water	0.000E+00	1.000E+00	...	FGWLW
3019	Irrigation fraction from ground water	not used	1.000E+00	...	FGWIR
3114	C-12 concentration in water (g/cm**3)	not used	2.000E-05	...	C12WTR
3114	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	...	C12CZ
3114	Fraction of vegetation carbon from soil	not used	2.000E-02	...	CSOIL
3114	Fraction of vegetation carbon from air	not used	9.800E-01	...	CAIR
3114	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	...	DMC
3114	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	...	EVSN
3114	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	...	REVSN

DOE-0035-5 Rev

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (if different from user input)	Parameter Name
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	...	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	...	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	not used	1.400E+01	...	STOR_T(1)
STOR	Leafy vegetables	not used	1.000E+00	...	STOR_T(2)
STOR	Milk	not used	1.000E+00	...	STOR_T(3)
STOR	Meat and poultry	not used	2.000E+01	...	STOR_T(4)
STOR	Fish	not used	7.000E+00	...	STOR_T(5)
STOR	Crustacea and mollusks	not used	7.000E+00	...	STOR_T(6)
STOR	Well water	not used	1.000E+00	...	STOR_T(7)
STOR	Surface water	not used	1.000E+00	...	STOR_T(8)
STOR	Livestock fodder	not used	4.500E+01	...	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	...	FLOOR
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	...	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	...	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	...	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	...	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	...	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	...	DIFCV
R021	in foundation material	not used	3.000E-07	...	DIFFL
R021	in contaminated zone soil	2.000E-06	2.000E-06	...	DIFCZ
R021	Radon vertical dimension of mixing (m)	2.000E+00	2.000E+00	...	HMIX
R021	Average annual wind speed (m/sec)	1.000E+00	2.000E+00	...	WIND
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	...	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	...	HRM
R021	Building interior area factor	not used	0.000E+00	code computed (time dependent)	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	code computed (time dependent)	DMFL
R021	Emanating power of Rn-222 gas	2.500E-01	2.500E-01	...	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	...	EMANA(2)

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	suppressed
meat ingestion	suppressed
ilk ingestion	suppressed
tic foods	suppressed
ng water	suppressed
ation	active
	active

4455055.4

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	49.00 square meters	Am-241	2.020E+03
Thickness:	1.00 meters	Pu-239	9.200E+00
Cover Depth:	0.00 meters	U-234	1.660E+01
		U-235	1.460E+00
		U-238	5.820E+00

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 15 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	1.000E+02	1.000E+03
TDOSE(t):	3.160E+00	3.155E+00	3.146E+00	3.113E+00	3.022E+00	2.725E+00	2.041E+00	0.000E+00
M(t):	2.107E-01	2.104E-01	2.097E-01	2.076E-01	2.015E-01	1.817E-01	1.361E-01	0.000E+00

Maximum TDOSE(t): 3.160E+00 mrem/yr at t = 0.000E+00 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excluding radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	5.192E-03	0.0171	2.860E+00	0.9052	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.052E-02	0.0033
Pu-239	1.689E-05	0.0000	1.259E-01	0.0398	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.660E-04	0.0001
U-234	4.156E-05	0.0000	6.988E-02	0.0221	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.722E-05	0.0000
U-235	6.637E-03	0.0021	5.727E-03	0.0018	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.578E-06	0.0000
U-238	4.620E-03	0.0015	2.190E-02	0.0069	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.240E-05	0.0000
Total	6.521E-02	0.0206	3.044E+00	0.9758	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.10BE-02	0.0035

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.925E+00	0.9256
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.264E-01	0.0400
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.999E-02	0.0221
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.237E-02	0.0039
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.654E-02	0.0084
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.160E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excluden radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	5.383E-02	0.0171	2.856E+00	0.9051	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.050E-02	0.0033
Pu-239	1.688E-05	0.0000	1.259E-01	0.0399	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.660E-04	0.0001
U-234	4.156E-05	0.0000	6.988E-02	0.0221	3.078E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.722E-05	0.0000
U-235	6.637E-03	0.0021	5.728E-03	0.0018	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.583E-06	0.0000
U-238	4.620E-03	0.0015	2.190E-02	0.0069	9.864E-22	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.140E-05	0.0000
Total	6.519E-02	0.0206	3.079E+00	0.9758	3.078E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.106E-02	0.0035

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.930E+00	0.9254
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.264E-01	0.0399
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.999E-02	0.0222
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.237E-03	0.0004
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.654E-02	0.0084
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.155E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excluding radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	5.366E-02	0.0171	2.847E+00	0.9048	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.047E-02	0.0033
Pu-239	1.648E-05	0.0000	1.359E-01	0.0400	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.699E-04	0.0001
U-234	4.158E-05	0.0000	6.989E-02	0.0222	2.766E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.722E-05	0.0000
U-235	6.616E-03	0.0021	5.733E-03	0.0018	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.593E-06	0.0000
U-238	4.620E-03	0.0015	2.140E-02	0.0070	2.751E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.340E-05	0.0000
Total	6.498E-02	0.0207	3.070E+00	0.9758	2.766E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.103E-02	0.0035

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.911E+00	0.9252
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.263E-01	0.0402
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.989E-02	0.0222
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.237E-02	0.0039
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.654E-02	0.0084
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.146E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	5.306E-02	0.0170	2.815E+00	0.9041	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.035E-02	0.0033
Pu-239	1.689E-05	0.0000	1.250E-01	0.0404	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.658E-04	0.0001
U-234	4.177E-05	0.0000	6.989E-02	0.0224	1.059E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.722E-05	0.0000
U-235	6.636E-03	0.0021	5.748E-01	0.0018	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.633E-04	0.0000
U-238	4.620E-03	0.0015	2.190E-02	0.0070	1.014E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.240E-05	0.0000
Total	6.438E-02	0.0207	3.018E+00	0.9758	1.059E-13	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.091E-02	0.0035

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.870E+00	0.9244
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.301E-01	0.0419
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.000E-02	0.0225
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.239E-02	0.0040
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.654E-02	0.0085
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.113E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	5.139E-02	0.0170	2.725E+00	0.9018	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.002E-02	0.0033
Pu-239	1.687E-05	0.0000	1.258E-01	0.0416	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.695E-04	0.0002
U-234	4.345E-05	0.0000	5.993E-02	0.0231	2.714E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.724E-05	0.0000
U-235	6.610E-01	0.0022	5.832E-03	0.0019	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.788E-06	0.0000
U-238	4.619E-01	0.0015	2.190E-02	0.0072	2.701E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.340E-05	0.0000
******	**********	******	**********	******	**********	******	**********	******	**********	******	**********	******	**********	******
Total	6.371E-02	0.0207	2.949E+00	0.9757	2.714E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.059E-02	0.0035

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.787E+00	0.9221
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.262E-01	0.0418
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.003E-02	0.0232
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.248E-02	0.0041
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.654E-02	0.0088
******	**********	******	**********	******	**********	******	**********	******	**********	******	**********	******	**********	******
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.022E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	4.594E-02	0.0109	3.435E+00	0.8934	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.955E-03	0.0033
Pu-239	1.684E-05	0.0000	1.255E-01	0.0460	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.649E-04	0.0002
U-234	6.217E-05	0.0000	7.000E-03	0.0257	2.859E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.733E-05	0.0000
U-235	6.693E-03	0.0024	6.304E-03	0.0023	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.491E-06	0.0000
U-238	4.618E-03	0.0017	2.190E-02	0.0080	9.507E-16	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.240E-05	0.0000
Total	5.729E-02	0.0210	2.659E+00	0.9755	2.859E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.516E-03	0.0035

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio- Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.490E+00	2.9126
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.260E-01	0.0462
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.013E-02	0.0257
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.296E-02	0.0048
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.654E-02	0.0097
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.725E+00	1.0000

*Sum of all water independent and dependent pathways

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excluding radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	1.136E-02	0.0161	1.764E+00	0.8645	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.489E-03	0.0032
Pu-239	1.674E-05	0.0000	1.247E-01	0.0611	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.816E-04	0.0002
U-234	3.212E-04	0.0001	7.033E-02	0.0344	2.115E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.774E-05	0.0000
U-235	6.706E-03	0.0031	7.838E-01	0.0018	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.686E-06	0.0000
U-238	4.616E-03	0.0023	2.190E-02	0.0107	2.125E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.240E-05	0.0000
Total	4.492E-02	0.0230	1.989E+00	0.9745	2.115E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.050E-03	0.0035

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
At mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.804E+00	0.8840
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.252E-01	0.0613
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.053E-02	0.0346
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.455E-02	0.0071
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.694E-02	0.0132
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.041E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excluden radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-														
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent	Product	Branch	DSR(j,t) (mrem/yr)/(pCi/g)							
(i)	(j)	Fraction	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	Am-241	1.000E+00	1.448E-02	1.446E-02	1.441E-02	1.425E-02	1.380E-02	1.232E-02	8.930E-03	0.000E+00
Am-241	Np-237	1.000E+00	0.000E+00	7.694E-09	2.306E-08	7.642E-08	2.256E-07	7.119E-07	1.833E-06	0.000E+00
Am-241	U-233	1.000E+00	0.000E+00	3.057E-15	2.748E-14	3.042E-13	2.708E-12	2.900E-11	2.356E-10	0.000E+00
Am-241	Th-229	1.000E+00	0.000E+00	1.747E-18	4.710E-17	1.739E-15	4.656E-14	1.674E-12	4.164E-11	0.000E+00
Am-241	ΣDSR(j)		1.448E-02	1.446E-02	1.441E-02	1.425E-02	1.380E-02	1.233E-02	8.932E-03	0.000E+00
Pu-239	Pu-239	1.000E+00	1.373E-02	1.373E-02	1.373E-02	1.373E-02	1.372E-02	1.369E-02	1.360E-02	0.000E+00
Pu-239	U-235	1.000E+00	0.000E+00	8.344E-12	2.503E-11	8.342E-11	2.501E-10	8.323E-10	2.484E-09	0.000E+00
Pu-239	Pa-231	1.000E+00	0.000E+00	4.347E-16	3.949E-15	4.387E-14	3.946E-13	4.377E-12	3.920E-11	0.000E+00
Pu-239	Ac-227	1.000E+00	0.000E+00	2.484E-17	6.600E-16	2.315E-14	5.407E-13	1.320E-11	1.713E-10	0.000E+00
Pu-239	ΣDSR(j)		1.373E-02	1.373E-02	1.373E-02	1.373E-02	1.372E-02	1.369E-02	1.360E-02	0.000E+00
U-234	U-234	1.000E+00	4.216E-03	4.216E-03	4.216E-03	4.216E-03	4.216E-03	4.214E-03	4.209E-03	0.000E+00
U-234	Th-230	1.000E+00	0.000E+00	9.372E-08	2.812E-07	9.372E-07	2.811E-06	9.366E-06	2.806E-05	0.000E+00
U-234	Ra-226	1.000E+00	0.000E+00	1.261E-10	1.134E-09	1.259E-08	1.130E-07	1.242E-06	1.085E-05	0.000E+00
U-234	Pb-210	1.000E+00	0.000E+00	1.767E-14	4.696E-13	1.649E-11	3.854E-10	9.408E-09	1.201E-07	0.000E+00
U-234	ΣDSR(j)		4.216E-03	4.216E-03	4.217E-03	4.217E-03	4.218E-03	4.225E-03	4.248E-03	0.000E+00
U-235	U-235	1.000E+00	8.472E-03	8.472E-03	8.472E-03	8.470E-03	8.467E-03	8.456E-03	8.423E-03	0.000E+00
U-235	Pa-231	1.000E+00	0.000E+00	8.910E-07	2.673E-06	8.908E-06	2.671E-05	8.891E-05	2.656E-04	0.000E+00
U-235	Ac-227	1.000E+00	0.000E+00	7.544E-08	6.649E-07	6.879E-06	5.111E-05	3.342E-04	1.279E-03	0.000E+00
U-235	ΣDSR(j)		8.472E-03	8.473E-03	8.475E-03	8.486E-03	8.545E-03	8.879E-03	9.967E-03	0.000E+00
U-238	U-238	1.000E+00	4.561E-03	4.561E-03	4.561E-03	4.561E-03	4.560E-03	4.560E-03	4.557E-03	0.000E+00
U-238	U-234	1.000E+00	0.000E+00	1.195E-08	3.584E-08	1.195E-07	3.580E-07	1.195E-06	3.581E-06	0.000E+00
U-238	Th-230	1.000E+00	0.000E+00	1.329E-13	1.196E-12	1.328E-11	1.196E-10	1.328E-09	1.194E-08	0.000E+00
U-238	Ra-226	1.000E+00	0.000E+00	1.152E-16	3.219E-15	1.190E-13	3.206E-12	1.178E-10	3.110E-09	0.000E+00
U-238	Pb-210	1.000E+00	0.000E+00	0.000E+00	6.509E-19	1.184E-16	8.553E-15	7.478E-13	3.145E-11	0.000E+00
U-238	ΣDSR(j)		4.561E-03	4.561E-03	4.561E-03	4.561E-03	4.561E-03	4.561E-03	4.561E-03	0.000E+00

Branch Fraction is the cumulative factor for the j'th principal radionuclide daughter: CUMBRF(j) = BRF(1)*BRF(2)* ... BRF(j).
The DSR includes contributions from associated (half-life < 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 15 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	1.036E+03	1.038E+03	1.041E+03	1.053E+03	1.087E+03	1.217E+03	1.679E+03	*3.430E+12
Pu-239	1.093E+03	1.093E+03	1.093E+03	1.093E+03	1.093E+03	1.094E+03	1.103E+03	*6.212E+10
U-234	1.559E+03	1.559E+03	1.559E+03	1.559E+03	1.559E+03	1.561E+03	1.571E+03	*6.248E+09
U-235	1.771E+03	1.770E+03	1.770E+03	1.768E+03	1.755E+03	1.689E+03	1.505E+03	*2.160E+06
U-238	1.289E+03	1.289E+03	1.289E+03	1.289E+03	1.289E+03	1.289E+03	1.289E+03	*1.360E+05

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Am-241	2.030E+02	0.000E+00	1.448E-02	1.036E+03	1.448E-02	1.036E+03
Pu-239	9.300E+00	0.000E+00	1.373E-02	1.092E+01	1.373E-02	1.092E+03
U-234	1.660E+01	849.8 to 0.8	4.345E-03	3.452E+03	4.216E-01	3.556E+01
U-235	1.460E+00	849.8 to 0.8	1.273E-02	1.178E+03	8.472E-03	1.771E+03
U-238	5.820E+00	0.000E+00	4.561E-03	3.289E+03	4.561E-01	3.289E+01

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)	DOSE(j,t), mrem/yr						
		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	Am-241	1.000E+00	3.929E+00	3.920E+00	2.911E+00	2.878E+00	2.787E+00	2.490E+00	1.804E+00	0.000E+00
Np-237	Am-241	1.000E+00	0.000E+00	1.559E-06	4.657E-06	1.544E-05	4.598E-05	1.437E-04	1.703E-04	0.000E+00
U-233	Am-241	1.000E+00	0.000E+00	6.174E-13	5.551E-12	6.144E-11	5.471E-10	5.057E-09	4.759E-08	0.000E+00
Th-229	Am-241	1.000E+00	0.000E+00	3.530E-16	9.514E-15	3.513E-13	9.405E-12	3.382E-10	8.413E-09	0.000E+00
Pu-239	Pu-239	1.000E+00	1.264E-01	1.264E-01	1.263E-01	1.263E-01	1.262E-01	1.260E-01	1.252E-01	0.000E+00
U-235	Pu-239	1.000E+00	0.000E+00	7.676E-11	2.303E-10	7.674E-10	2.301E-09	7.667E-09	2.289E-08	0.000E+00
U-235	U-235	1.000E+00	1.237E-02	1.237E-02	1.237E-02	1.237E-02	1.236E-02	1.235E-02	1.230E-02	0.000E+00
U-235	ΣDOSE(j):		1.237E-02	1.237E-02	1.237E-02	1.237E-02	1.236E-02	1.235E-02	1.230E-02	0.000E+00
Pa-231	Pu-239	1.000E+00	0.000E+00	4.036E-15	1.211E-14	4.036E-13	1.210E-12	4.027E-11	1.206E-10	0.000E+00
Pa-231	U-235	1.000E+00	0.000E+00	1.301E-06	3.902E-06	1.301E-05	3.900E-05	1.298E-04	1.878E-04	0.000E+00
Pa-231	ΣDOSE(j):		0.000E+00	1.301E-06	3.902E-06	1.301E-05	3.900E-05	1.298E-04	1.878E-04	0.000E+00
Ac-227	Pu-239	1.000E+00	0.000E+00	2.205E-16	6.072E-15	2.130E-13	4.974E-12	1.215E-10	1.576E-09	0.000E+00
Ac-227	U-235	1.000E+00	0.000E+00	1.101E-07	9.707E-07	1.004E-05	7.462E-05	4.879E-04	1.868E-03	0.000E+00
Ac-227	ΣDOSE(j):		0.000E+00	1.101E-07	9.707E-07	1.004E-05	7.462E-05	4.879E-04	1.868E-03	0.000E+00
U-234	U-234	1.000E+00	6.999E-02	6.999E-02	6.999E-02	6.999E-02	6.998E-02	6.995E-02	6.987E-02	0.000E+00
U-234	U-238	1.000E+00	0.000E+00	6.967E-08	2.087E-07	6.956E-07	2.087E-06	6.954E-06	6.984E-05	0.000E+00
U-234	ΣDOSE(j):		6.999E-02	6.999E-02	6.999E-02	6.999E-02	6.998E-02	6.996E-02	6.988E-02	0.000E+00
Th-230	U-234	1.000E+00	0.000E+00	1.556E-06	4.668E-06	1.556E-05	4.667E-05	1.555E-04	4.657E-04	0.000E+00
Th-230	U-238	1.000E+00	0.000E+00	7.732E-11	6.959E-13	7.732E-11	6.958E-10	7.728E-09	6.947E-08	0.000E+00
Th-230	ΣDOSE(j):		0.000E+00	1.556E-06	4.668E-06	1.556E-05	4.667E-05	1.555E-04	4.658E-04	0.000E+00
Ra-226	U-234	1.000E+00	0.000E+00	2.092E-09	1.883E-08	2.090E-07	1.875E-06	2.062E-05	1.801E-04	0.000E+00
Ra-226	U-238	1.000E+00	0.000E+00	4.700E-16	1.873E-14	6.926E-13	1.866E-11	6.856E-10	1.810E-08	0.000E+00
Ra-226	ΣDOSE(j):		0.000E+00	2.092E-09	1.883E-08	2.090E-07	1.875E-06	2.062E-05	1.801E-04	0.000E+00
Pb-210	U-234	1.000E+00	0.000E+00	2.911E-13	7.796E-12	2.717E-10	6.197E-09	1.562E-07	1.993E-06	0.000E+00
Pb-210	U-238	1.000E+00	0.000E+00	0.000E+00	3.788E-18	6.891E-16	4.978E-14	4.352E-12	1.810E-10	0.000E+00
Pb-210	ΣDOSE(j):		0.000E+00	2.911E-13	7.796E-12	2.717E-10	6.197E-09	1.562E-07	1.993E-06	0.000E+00
U-238	U-238	1.000E+00	2.654E-02	2.654E-02	2.654E-02	2.654E-02	2.654E-02	2.654E-02	2.652E-02	0.000E+00

BRF(i) is the branch fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
			S(j,t), pCi/g							
Am-241	Am-241	1.000E+00	2.020E+02	2.017E+02	2.010E+02	1.988E+02	1.935E+02	1.719E+02	1.246E+02	4.034E+01
Np-237	Am-241	1.000E+00	0.000E+00	6.538E-05	1.958E-04	6.490E-04	1.916E-03	6.043E-03	1.556E-02	3.248E-02
U-233	Am-241	1.000E+00	0.000E+00	1.430E-10	1.285E-09	1.423E-08	1.367E-07	1.356E-06	1.102E-05	8.910E-05
Th-229	Am-241	1.000E+00	0.000E+00	4.505E-15	1.314E-13	4.494E-12	1.200E-10	4.317E-09	1.074E-07	3.042E-06
Pu-239	Pu-239	1.000E+00	9.200E+00	9.200E+00	9.199E+00	9.197E+00	9.191E+00	9.171E+00	9.113E+00	8.912E+00
U-235	Pu-239	1.000E+00	0.000E+00	9.061E-09	2.718E-08	9.058E-08	2.716E-07	9.038E-07	2.697E-06	8.831E-06
U-235	U-235	1.000E+00	1.460E+00	1.460E+00	1.460E+00	1.460E+00	1.459E+00	1.457E+00	1.451E+00	1.432E+00
U-235	DS(j) :		1.460E+00	1.460E+00	1.460E+00	1.460E+00	1.459E+00	1.457E+00	1.451E+00	1.432E+00
Pa-231	Pu-239	1.000E+00	0.000E+00	9.585E-14	8.626E-13	9.583E-12	8.621E-11	9.562E-10	8.563E-09	9.352E-08
Pa-231	U-235	1.000E+00	0.000E+00	3.089E-05	9.267E-05	3.088E-04	9.261E-04	3.081E-03	9.209E-03	3.025E-02
Pa-231	DS(j) :		0.000E+00	3.089E-05	9.267E-05	3.088E-04	9.261E-04	3.081E-03	9.209E-03	3.025E-02
Ac-227	Pu-239	1.000E+00	0.000E+00	1.009E-15	2.682E-14	9.409E-13	2.197E-11	9.366E-10	6.962E-09	8.789E-08
Ac-227	U-235	1.000E+00	0.000E+00	4.865E-07	4.388E-06	4.434E-05	1.296E-04	2.155E-03	8.249E-03	2.931E-02
Ac-227	DS(j) :		0.000E+00	4.865E-07	4.388E-06	4.434E-05	1.296E-04	2.155E-03	8.249E-03	2.931E-02
U-234	U-234	1.000E+00	1.660E+01	1.660E+01	1.660E+01	1.660E+01	1.660E+01	1.659E+01	1.657E+01	1.651E+01
U-234	U-238	1.000E+00	0.000E+00	1.650E-05	4.950E-05	1.650E-04	4.949E-04	1.649E-03	4.943E-03	1.643E-02
U-234	DS(j) :		1.660E+01	1.660E+01	1.660E+01	1.660E+01	1.660E+01	1.659E+01	1.658E+01	1.652E+01
Th-230	U-234	1.000E+00	0.000E+00	1.494E-04	4.483E-04	1.494E-03	4.482E-03	1.493E-02	4.473E-02	1.483E-01
Th-230	U-238	1.000E+00	0.000E+00	7.426E-11	6.684E-10	7.426E-09	6.681E-08	7.422E-07	6.672E-06	7.381E-05
Th-230	DS(j) :		0.000E+00	1.494E-04	4.483E-04	1.494E-03	4.482E-03	1.493E-02	4.474E-02	1.484E-01
Ra-226	U-234	1.000E+00	0.000E+00	3.236E-08	2.912E-07	1.232E-06	2.900E-05	3.189E-04	2.786E-03	2.800E-02
Ra-226	U-238	1.000E+00	0.000E+00	1.037E-14	2.898E-13	1.071E-11	2.884E-10	1.060E-08	2.800E-07	9.608E-06
Ra-226	DS(j) :		0.000E+00	3.236E-08	2.912E-07	1.232E-06	2.900E-05	3.189E-04	2.787E-03	2.801E-02
Pb-210	U-234	1.000E+00	0.000E+00	1.327E-10	8.845E-09	3.105E-07	7.258E-06	1.772E-04	2.261E-03	2.637E-02
Pb-210	U-238	1.000E+00	0.000E+00	0.000E+00	4.298E-15	7.819E-13	5.648E-11	4.918E-09	2.077E-07	8.766E-06
Pb-210	DS(j) :		0.000E+00	1.327E-10	8.845E-09	3.105E-07	7.258E-06	1.772E-04	2.261E-01	2.637E-02
U-238	U-238	1.000E+00	5.820E+00	5.820E+00	5.820E+00	5.820E+00	5.819E+00	5.818E+00	5.815E+00	5.803E+00

BRF(i) is the branch fraction of the parent nuclide.

Estimate of the Amount of Mixing Required to Reduce Concentrations to a Normalized Value of 1
Aggregate N - Inside of the Pipe

Noncarcinogenic Effects

Chemical	Maximum-UCL (mg/kg)	SAL (mg/kg)	Normalized Value
Antimony	18	31	0.58064516
Cadmium	911.14	38	23.9773684
Copper	2562.94	2800	0.91533571
Lead	3032.27	400	7.580675
Mercury	260.53	23	11.3273913
Nickel	89.66	1500	0.05977333
Silver	45.22	380	0.119
Thallium	1.6	5.4	0.2962963
Uranium (total)	283	230	1.23043478
Zinc	2147.34	23000	0.09336261
		Total:	46.1802826

Therefore, the concentration of each chemical must be reduced by a factor equal to the total normalized value (otherwise known as a reduction factor)

If:
Reduction Factor = Volume of Circle/Volume of Material in Pipe

Then:
Volume of Circle = Reduction Factor*Volume of Material in Pipe

If I have 0.005 ft3 material per linear foot, then 10 feet of pipe has 0.05 ft3 of material

Therefore, volume of circle = 2.30901413 ft3

If depth of circle is 0.5 feet, then area of circle = 4.61802826 ft2

The diameter of this circle = 2.42483864 ft

If I have 0.005 ft3 material per linear foot, then 50 feet of pipe has 0.25 ft3 of material

Therefore, volume of circle = 11.5450707 ft3

If depth of circle is 0.5 feet, then area of circle = 23.0901413 ft2

The diameter of this circle = 5.42210404 ft

If I have 0.005 ft3 material per linear foot, then 100 feet of pipe has 0.5 ft3 of material

Therefore, volume of circle = 23.0901413 ft3

If depth of circle is 0.5 feet, then area of circle = 46.1802826 ft2

The diameter of this circle = 7.66801308 ft

Estimate of the Amount of Mixing Required to Reduce Concentrations to a Normalized Value of 1
Aggregate N - Inside of the Pipe

Carcinogenic Effects

Chemical	Maximum-UCL (mg/kg)	SAL (mg/kg)	Normalized Value
Benzo(a)anthracene	2.3	0.61	3.7704918
Benzo(a)pyrene	21	0.061	344.262295
Benzo(b)fluoranthene	26	0.61	42.6229508
Benzo(k)fluoranthene	18	6.1	2.95081967
Chromium	95.55	210	0.455
Dibenzo(a,h)anthracene	2.7	0.061	44.2622951
1,4-dichlorobenzene	4	3.6	1.11111111
Indeno(1,2,3-cd)pyrene	4.9	0.61	8.03278689
		Total:	447.46775

Therefore, the concentration of each chemical must be reduced by a factor equal to the total normalized value (otherwise known as a reduction factor)

If:
Reduction Factor = Volume of Circle/Volume of Material

Then:
Volume of Circle = Reduction Factor*Volume of Material

If I have 0.005 ft3 material per linear foot, then 10 feet of pipe has 0.05 ft3 of material

Therefore, volume of circle = 22.3733875 ft3

If depth of circle is 0.5 feet, then area of circle = 44.746775 ft2

The diameter of this circle = 7.54806136 ft

If I have 0.005 ft3 material per linear foot, then 50 feet of pipe has 0.25 ft3 of material

Therefore, volume of circle = 111.866938 ft3

If depth of circle is 0.5 feet, then area of circle = 223.733875 ft2

The diameter of this circle = 16.8779783 ft

If I have 0.005 ft3 material per linear foot, then 100 feet of pipe has 0.5 ft3 of material

Therefore, volume of circle = 223.733875 ft3

If depth of circle is 0.5 feet, then area of circle = 447.46775 ft2

The diameter of this circle = 23.8690658 ft

Estimate of the Amount of Mixing Required to Reduce Concentrations to a Normalized Value of 1
Aggregate N - Inside of the Pipe

Radiation Effects

Chemical	Maximum-UCL (pCi/g)	SAL (pCi/g)	Normalized Value
Americium-241	94	22	4.27272727
Cesium-137	2.76	5.1	0.54117647
Plutonium-239/240	324.8	24	13.5333333
Uranium-234	192.7	13	14.8230769
Uranium-235	7.57	10	0.757
Uranium-238	96.37	67	1.43835821
		Total:	35.3656722

Therefore, the concentration of each chemical must be reduced by a factor equal to the total normalized value (otherwise known as a reduction factor)

If:
Reduction Factor = Volume of Circle/Volume of Material

Then:
Volume of Circle = Reduction Factor*Volume of Material

If I have 0.005 ft3 material per linear foot, then 10 feet of pipe has 0.05 ft3 of material

Therefore, volume of circle = 1.76828361 ft3

If depth of circle is 0.5 feet, then area of circle = 3.53656722 ft2

The diameter of this circle = 2.12200064 ft

If I have 0.005 ft3 material per linear foot, then 50 feet of pipe has 0.25 ft3 of material

Therefore, volume of circle = 8.84141805 ft3

If depth of circle is 0.5 feet, then area of circle = 17.6828361 ft2

The diameter of this circle = 4.74493768 ft

If I have 0.005 ft3 material per linear foot, then 100 feet of pipe has 0.5 ft3 of material

Therefore, volume of circle = 17.6828361 ft3

If depth of circle is 0.5 feet, then area of circle = 35.3656722 ft2

The diameter of this circle = 6.71035521 ft

Estimate of the Amount of Mixing Required to Reduce Concentrations to a Normalized Value of 1
Aggregate N - Inside of the Pipe

Noncarcinogenic Effects

Chemical	Mean-Median (mg/kg)	SAL (mg/kg)	Normalized Value
Antimony	0.245	31	0.00790323
Cadmium	332.71	38	8.75552632
Copper	1479.11	2800	0.52825357
Lead	1837.7	400	4.59425
Mercury	145.2	23	6.31304348
Nickel	57.24	1500	0.03816
Silver	26.2	380	0.06894737
Thallium	0.45	5.4	0.08333333
Uranium (total)	163	230	0.70869565
Zinc	990.96	23000	0.04308522
		Total:	21.1411982

Therefore, the concentration of each chemical must be reduced by a factor equal to the total normalized value (otherwise known as a reduction factor)

If:
Reduction Factor = Volume of Circle/Volume of Material in Pipe

Then:
Volume of Circle = Reduction Factor*Volume of Material in Pipe

If I have 0.005 ft3 material per linear foot, then 10 feet of pipe has 0.05 ft3 of material

Therefore, volume of circle = 0.08456479 ft3

If depth of circle is 0.5 feet, then area of circle = 0.16912959 ft2

The diameter of this circle = 0.46404954 ft

If I have 0.005 ft3 material per linear foot, then 50 feet of pipe has 0.25 ft3 of material

Therefore, volume of circle = 0.42282396 ft3

If depth of circle is 0.5 feet, then area of circle = 0.84564793 ft2

The diameter of this circle = 1.03764831 ft

If I have 0.0004 ft3 material per linear foot, then 100 feet of pipe has 0.04 ft3 of material

Therefore, volume of circle = 0.84564793 ft3

If depth of circle is 0.5 feet, then area of circle = 1.69129585 ft2

The diameter of this circle = 1.46745348 ft

Estimate of the Amount of Mixing Required to Reduce Concentrations to a Normalized Value of 1
Aggregate N - Inside of the Pipe

Carcinogenic Effects

Chemical	Mean-Median (mg/kg)	SAL (mg/kg)	Normalized Value
Benzo(a)anthracene	0.55	0.61	0.90163934
Benzo(a)pyrene	0.6	0.061	9.83606557
Benzo(b)fluoranthene	0.6	0.61	0.98360656
Benzo(k)fluoranthene	0.6	6.1	0.09836066
Chromium	57.63	210	0.27442857
Dibenzo(a,h)anthracene	0.205	0.061	3.36065574
1,4-dichlorobenzene	0.185	3.6	0.05138889
Indeno(1,2,3-cd)pyrene	0.6	0.61	0.98360656
		Total:	16.4897519

Therefore, the concentration of each chemical must be reduced by a factor equal to the total normalized value (otherwise known as a reduction factor)

If:
Reduction Factor = Volume of Circle/Volume of Material

Then:
Volume of Circle = Reduction Factor*Volume of Material

If I have 0.0004 ft3 material per linear foot, then 10 feet of pipe has 0.004 ft3 of material

Therefore, volume of circle = 0.06595901 ft3

If depth of circle is 0.5 feet, then area of circle = 0.13191802 ft2

The diameter of this circle = 0.4098327 ft

If I have 0.0004 ft3 material per linear foot, then 50 feet of pipe has 0.02 ft3 of material

Therefore, volume of circle = 0.32979504 ft3

If depth of circle is 0.5 feet, then area of circle = 0.65959008 ft2

The diameter of this circle = 0.91641377 ft

If I have 0.0004 ft3 material per linear foot, then 100 feet of pipe has 0.04 ft3 of material

Therefore, volume of circle = 0.05959008 ft3

If depth of circle is 0.5 feet, then area of circle = 1.31918015 ft2

The diameter of this circle = 1.29600479 ft

Estimate of the Amount of Mixing Required to Reduce Concentrations to a Normalized Value of 1
Aggregate N - Inside of the Pipe

Radiation Effects

Chemical	Mean-Median (pCi/g)	SAL (pCi/g)	Normalized Value
Americium-241	41.3	22	1.87727273
Cesium-137	1.5	5.1	0.29411765
Plutonium-239/240	156.96	24	6.54
Uranium-234	121.09	13	9.31461538
Uranium-235	4.78	10	0.478
Uranium-238	54.54	67	0.81402985
		Total:	19.3180356

Therefore, the concentration of each chemical must be reduced by a factor equal to the total normalized value (otherwise known as a reduction factor)

If:
Reduction Factor = Volume of Circle/Volume of Material

Then:
Volume of Circle = Reduction Factor*Volume of Material

If I have 0.0004 ft3 material per linear foot, then 10 feet of pipe has 0.004 ft3 of material

Therefore, volume of circle = 0.07727214 ft3

If depth of circle is 0.5 feet, then area of circle = 0.15454428 ft2

The diameter of this circle = 0.44358926 ft

If I have 0.0004 ft3 material per linear foot, then 50 feet of pipe has 0.02 ft3 of material

Therefore, volume of circle = 0.38636071 ft3

If depth of circle is 0.5 feet, then area of circle = 0.77272142 ft2

The diameter of this circle = 0.99189575 ft

If I have 0.0004 ft3 material per linear foot, then 100 feet of pipe has 0.04 ft3 of material

Therefore, volume of circle = 0.77272142 ft3

If depth of circle is 0.5 feet, then area of circle = 1.54544285 ft2

The diameter of this circle = 1.40275242 ft

RFI Report for Potential Release Sites at TA-16

16-024(c,d,f,g,k,m,o,p–s)
16-025(b2,d,g,h,j,k,m–o,y)
16-034(c–f,l,m)
C-16-005
C-16-017

Field Unit 3

Environmental Restoration Project

September 1997

A Department of Energy
Environmental Cleanup Program

Los Alamos
NATIONAL LABORATORY

LA-UR-97-3770

EXECUTIVE SUMMARY

This Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) report discusses Phase I investigations, results, and recommendations for 29 potential release sites (PRSs) within Technical Area 16 (TA-16), which is located in the southwestern quadrant of Los Alamos National Laboratory (LANL). This site has been used from 1944 to the present. Past and present activities at this site have centered around the development, fabrication, and testing of explosive components used in the United States' nuclear weapons program.

The 29 PRSs consist of the soil beneath the footprints of former structures: equipment and control buildings 16-025(d) and 16-034(l)); high explosive (HE) machining buildings 16-025(g), 16-025(h), 16-025(j), and C-16-005; HE casting buildings 16-025(b2), a barium nitrate grinding facility 16-025(y), HE magazines 16-024(c), 16-024(d), 16-024(l), 16-024(g), 16-024(k), 16-024(m), 16-024(o), 16-024(p), 16-024(q), 16-024(r), 16-024(s); machine shop 16-034(d); a radiography building 16-025(m); a storage building 16-034(e); a steam plant C-16-017; an HE inspection building 16-025(k); warehouse huts 16-034(c); laboratories 16-034(f), 16-034(m); and source hutments (storage areas)16-025(n) and 16-025(o).

The RFI work plan for Operable Unit (OU) 1082 Addendum 1 (LANL 1994, 1160), which includes sampling and analysis plans for all but one of the above PRSs, was approved by the Environmental Protection Agency (EPA) Region 6 in January 1995 (Taylor 1995, 15-16-645). The sampling and analysis plan for PRS 16-024(s) is in the RFI Work Plan for Operable Unit 1082 Addendum II (LANL 1995, 1342).

Phase I sampling for these PRSs was conducted from July 2 through August 8, 1997. Surface and near-surface soil samples were collected at each PRS. Samples were collected using a manually operated hand-auger. Locations were sampled to either 1 or 2 ft depths. Analyses were performed for HE, inorganic chemicals, cyanide, semivolatile organic compounds (SVOCs), and radionuclides as prescribed in the approved work plan. 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.

Appendix B lists the details of the data analysis, including any problems that arose during analysis. Overall the quality of the analytical results is adequate to address the decisions discussed in Section 5 of this report, which concern the presence or absence of contaminants at or above background levels and human health risk-based screening action levels.

The objective of Phase I investigation at these sites was use biased sampling to determine if releases had occurred at the PRSs using. Analytical results were used to determine if releases had caused contamination at levels above screening action levels (SALs), upper tolerance limits (UTLs), or estimated quantitation limits (EQLs). Phase I investigations at the 29 PRSs resulted in recommendation for no further action (NFA) for human health concerns.

A brief description and site recommendation for each PRS is presented below and summarized in Table ES-1. This table also identifies the section of this report in which each PRS is discussed in detail. All decisions assume a continued industrial scenario for this area.

PRS 16-024(c) is the footprint of HE magazine TA-16-30. Ten surface and near-surface soil samples were collected for screening from the door location and quadrants of the former building to support the human health decision. One sample was submitted for laboratory analysis of inorganics, SVOCs, and HE. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-024(d) is the footprint of HE magazine TA-16-34. Ten surface and near-surface soil samples were collected for screening from the door location and quadrants of the former building to support the human health decision. One sample was submitted for laboratory analysis of inorganics, SVOCs, and HE. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-024(f) is the footprint of HE magazine TA-16-493. Six surface and near-surface soil samples were collected for screening from the door location, building center, and quadrants of the former building to support the human health decision. Two samples were submitted for laboratory analysis of inorganics, SVOCs, and HE. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-024(g) is the footprint of HE magazine TA-16-494. Six surface and near-surface soil samples were collected for screening from the door location, building center, and quadrants of the former building to support the human health decision. Two samples were submitted for laboratory analysis of inorganics, SVOCs, and HE. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-024(k) is the footprint of HE magazine TA-16-57. Four surface and near-surface soil samples were collected for screening from the door location and quadrants of the former building to support the human health decision. One sample was submitted for laboratory analysis of inorganics, SVOCs, and HE. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-024(m) is the footprint of HE magazine TA-16-66. Four surface and near-surface soil samples were collected for screening from the quadrants and downgradient from the door location of the former building to support the human health decision. One sample was submitted for laboratory analysis of inorganics, SVOCs, and HE. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-024(o) is the footprint of HE magazine TA-16-67. Four surface and near-surface soil samples were collected for screening from the quadrants and downgradient from the door location of the former building to support the human health decision. One sample was submitted for laboratory analysis of inorganics, SVOCs, and HE. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-024(p) is the footprint of HE magazine TA-16-70. Four surface and near-surface soil samples were collected for screening from the quadrants and downgradient from the door location of the former building to support the human health decision. One sample was submitted for laboratory analysis of inorganics, SVOCs, and HE. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-024(q) is the footprint of HE magazine TA-16-71. Four surface and near-surface soil samples were collected for screening from the quadrants and downgradient from the door location of the former building to support the human health decision. One sample was submitted for laboratory analysis of inorganics, SVOCs, and HE. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-024(r) is the footprint of HE magazine TA-16-68. Four surface and near-surface soil samples were collected for screening from the quadrants and downgradient from the door location of the former building to support the human health decision. One sample was submitted

for laboratory analysis of inorganics, SVOCs, and HE. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-024(s) is the footprint of HE magazine TA-16-60. Eight surface and near-surface soil samples were collected for screening from the door location and quadrants of the former building to support the human health decision. One sample was submitted for laboratory analysis of inorganics, SVOCs, and HE. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-025(b2) is the footprint of HE casting building TA-16-52. Twelve surface and near-surface soil samples were collected for screening from the door locations, building center, and quadrants of the former building to support the human health decision. Two samples were submitted for laboratory analysis of inorganics, SVOCs, and HE. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-025(d) is the footprint of equipment and control building TA-16-94. Eight surface and near-surface soil samples were collected for screening from quadrants of the former building to support the human health decision. One sample was submitted for laboratory analysis of inorganics, SVOCs, and HE. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-025(g) is the footprint of HE machining building TA-16-95. Twelve surface and near-surface soil samples were collected for screening from the door location, building center, and quadrants of the former building to support the human health decision. Three samples were submitted for laboratory analysis of inorganics, SVOCs, and HE. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-025(h) is the footprint of HE machining building TA-16-96. Eleven surface and near-surface soil samples were collected for screening from the door location, building center, and quadrants of the former building to support the human health decision. Three samples were submitted for laboratory analysis of inorganics, SVOCs, and HE. No contamination was detected above levels of concern. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-025(j) is the footprint of HE machining building TA-16-98. Ten surface and near-surface soil samples were collected for screening from the door location and quadrants of the former building to support the human health decision. Three samples were submitted for laboratory analysis of inorganics, SVOCs, and HE. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-025(k) is the footprint of HE inspection building TA-16-25. Twelve surface and near-surface soil samples were collected for screening from the door locations and quadrants of the former building to support the human health decision. Three samples were submitted for laboratory analysis of inorganics, SVOCs, and HE. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-025(m) is the footprint of x-ray and gamma-ray radiography building TA-16-495. Ten surface and near-surface soil samples were collected for screening from the building center and quadrants of the former building to support the human health decision. Two samples were submitted for laboratory analysis of inorganics, SVOCs, HE, isotopic uranium, radium-226, strontium-90, cobalt-60, and radionuclides by gamma spectroscopy. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-025(n) is the footprint of storage hutment TA-16-499. Ten surface and near-surface soil samples were collected for screening from the building center and quadrants of the former building to support the human health decision. Two samples were submitted for laboratory analysis of inorganics, SVOCs, HE, isotopic uranium, radium-226, strontium-90, cobalt-60, and radionuclides by gamma spectroscopy. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-025(o) is the footprint of source hutment TA-16-500. Ten surface and near-surface soil samples were collected for screening from the building center and quadrants of the former building to support the human health decision. Two samples were submitted for laboratory analysis of inorganics, SVOCs, HE, isotopic uranium, radium-226, strontium-90, cobalt-60, and radionuclides by gamma spectroscopy. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-025(y) is the footprint of barium nitrate grinding facility TA-16-55. Ten surface and near-surface soil samples were collected for screening from the door location, building center, and quadrants of the former building to support the human health decision. Two samples were submitted for laboratory analysis of inorganics, SVOCs, and HE. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-034(c) is the footprint of warehouse hut TA-16-491. Five surface and near-surface soil samples were collected for screening from the building center and quadrants of the former building to support the human health decision. Two samples were submitted for laboratory analysis of inorganics, SVOCs, and HE. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-034(d) is the footprint of machine shop TA-16-492 where HE was not machined. Five surface and near-surface soil samples were collected for screening from the building center and quadrants of the former building to support the human health decision. Two samples were submitted for laboratory analysis of inorganics, SVOCs, and HE. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-034(e) is the footprint of storage building TA-16-496. Five surface and near-surface soil samples were collected for screening from the building center and quadrants of the former building to support the human health decision. Two samples were submitted for laboratory analysis of inorganics, SVOCs, total uranium, and HE. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-034(f) is the footprint of laboratory building TA-16-498. Five surface and near-surface soil samples were collected for screening from the building center and quadrants of the former building to support the human health decision. Two samples were submitted for laboratory analysis of inorganics, SVOCs, isotopic uranium, isotopic plutonium, cyanide, and HE. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-034(l) is the footprint of equipment and control building TA-16-47. Eight surface and near-surface soil samples were collected for screening from quadrants of the former building to support the human health decision. One sample was submitted for laboratory analysis of

Inorganics, SVOCs, and HE. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS 16-034(m) is the footprint of laboratory building TA-16-86. Five surface and near-surface soil samples were collected for screening from the building center and quadrants of the former building to support the human health decision. Two samples were submitted for laboratory analysis of inorganics, SVOCs, and HE. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS C-16-005 is the footprint of storage and HE machining building TA-16-53. Twelve surface and near-surface soil samples were collected for screening from the door location, building center, and quadrants of the former building to support the human health decision. Two samples were submitted for laboratory analysis of inorganics, SVOCs, and HE. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

PRS C-16-017 is the footprint of steam plant TA-16-502. Seven surface and near-surface soil samples were collected for screening from the building center and quadrants of the former building to support the human health decision. One sample was submitted for laboratory analysis of inorganics and SVOCs. No contamination was detected above SALs. This PRS is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

TABLE ES-1
SUMMARY OF PRSS

PRS NO.	HSWA[A]	RAD COMPONENT[B]	NFA CRITERIA[A]	FURTHER ACTION[C]	ADD TO HSWA MODULE[D]	RATIONALE	SECTION
16-024(c)			5	NFA		No analytes above SALs	5.1
16-024(d)			5	NFA		No analytes above SALs	5.2
16-024(l)			5	NFA		No analytes above SALs	5.3
16-024(g)			5	NFA		No analytes above SALs	5.4
16-024(k)			5	NFA		No analytes above SALs	5.5
16-024(m)			5	NFA		No analytes above SALs	5.6
16-024(o)			5	NFA		No analytes above SALs	5.7
16-024(p)			5	NFA		No analytes above SALs	5.8
16-024(q)			5	NFA		No analytes above SALs	5.9
16-024(r)			5	NFA		No analytes above SALs	5.10
16-024(s)			5	NFA		No analytes above SALs	5.11
16-025(b2)	x		5	NFA		No analytes above SALs	5.12
16-025(d)	x		5	NFA		No analytes above SALs	5.13
16-025(g)	x		5	NFA		No analytes above SALs	5.14
16-025(h)	x		5	NFA		No analytes above SALs	5.15
16-025(j)	x		5	NFA		No analytes above levels of concern	5.16
16-025(k)	x		5	NFA		No analytes above SALs	5.17
16-025(m)	x		5	NFA		No analytes above SALs	5.18
16-025(n)	x		5	NFA		No analytes above SALs	5.19
16-025(o)	x		5	NFA		No analytes above SALs	5.20
16-025(y)	x		5	NFA		No analytes above SALs	5.21
16-034(c)	x		5	NFA		No analytes above SALs	5.22
16-034(d)	x		5	NFA		No analytes above SALs	5.23
16-034(e)	x		5	NFA		No analytes above SALs	5.24

16-034(l)	x		5	NFA		No analytes above SALs	5.25
16-034(l)	x		5	NFA		No analytes above SALs	5.26
16-034(m)	x		5	NFA		No analytes above SALs	5.27
C-16-005			5	NFA		No analytes above SALs	5.28
C-16-017			5	NFA		No analytes above SALs	5.29

a. An x in this column indicates that the site is listed on the Hazardous and Solid Waste Amendments (HSWA) Module (Module VIII) of the Laboratory's RCRA operating permit (EPA 1994, 1185).
b. An x in this column indicated that the site has a radionuclide that was detected
c. VCA, EC, further investigation, CMS, or NFA.
d. An x in this column indicates that hazardous constituents were confirmed at a site not already listed on the HSWA Module. The site requires further action; therefore, the site needs to be added to the Module.
*NFA Criterion (See No Further Action Criteria Policy, EM/ER:95-PCT-015, R1, August 30, 1996 (Project Consistency Team, 1210).

TABLE OF CONTENTS

EXECUTIVE SUMMARY I

TABLE OF CONTENTS X

TABLE OF FIGURES XVIII

LIST OF TABLES XX

1.0 INTRODUCTION 1

1.1 General Site History 1

1.2 RFI Overview 4

1.3 Field Activities 6
1.3.1 Land Surveys 6
1.3.2 Screening Surveys 7
1.3.3 Field Sampling Activities 8

2.0 ENVIRONMENTAL SETTING 9

2.1 Climate 9

2.2 Geology 9
2.2.1 Geologic Setting 9
2.2.2 Soils 10
2.3 Hydrology 11
2.3.1 Surface Water 11
2.3.2 Groundwater 13

2.4 Biological Surveys 14

2.5 Cultural Surveys 14

3.0 APPROACH TO SAMPLE ANALYSES AND DATA ASSESSMENT 15

3.1 Sample Analyses 15
3.1.1 Analytical Methods 16
3.1.2 Data Verification and Validation 16

3.2 Process for Identification of COPCs 19
3.2.1 Inorganic Chemicals 19
3.2.2 Radionuclides 19
3.2.3 Organic Chemicals 20
3.2.4 Risk-Based Screening Assessment 21

3.3 Human Health Assessment 21
3.3.1 Risk Due to Naturally Occurring Inorganic Chemicals in Soils (Background) 21
3.3.2 Risk Assessment 23

3.4 Ecological Assessment 23

4.0 RESULTS OF QUALITY ASSURANCE/QUALITY CONTROL ACTIVITIES 24

4.1 Inorganic Analysis 26

4.2 Radiochemistry Analysis 29

4.3 Organic Analyses 32
4.3.1 Semivolatile Organic Analyses 32
4.3.2 Field Screening for High Explosives 34
4.3.3 Laboratory Analyses for High Explosives 34

5.0 SPECIFIC RESULTS, CONCLUSIONS, AND RECOMMENDATIONS 35
5.0.1 Polynuclear aromatic hydrocarbons without SALs 35

5.1 PRS 16-024(c) 38
5.1.1 History 38
5.1.2 Description 38
5.1.3 Previous Investigation(s) 38
5.1.4 Field Investigation 38
5.1.5 Evaluation of Inorganic Chemicals 42
5.1.6 Evaluation of Radionuclides 42
5.1.7 Evaluation of Organic Chemicals 43
5.1.8 Risk-Based Screening Assessment 43
5.1.9 Preliminary Human Health Assessment 43
5.1.10 Preliminary Ecological Assessment 43
5.1.11 Conclusions and Recommendations 43

5.2 PRS 16-024(d) 44
5.2.1 History 44
5.2.2 Description 44
5.2.3 Previous Investigation(s) 44
5.2.4 Field Investigation 45
5.2.5 Evaluation of Inorganic Chemicals 49
5.2.6 Evaluation of Radionuclides 49
5.2.7 Evaluation of Organic Chemicals 49
5.2.8 Risk-Based Screening Assessment 50
5.2.9 Preliminary Human Health Assessment 50
5.2.10 Preliminary Ecological Assessment 50
5.2.11 Conclusions and Recommendations 50

5.3 PRS 16-024(f) 51
5.3.1 History 51
5.3.2 Description 51
5.3.3 Previous Investigation(s) 51
5.3.4 Field Investigation 51
5.3.5 Evaluation of Inorganic Chemicals 55
5.3.6 Evaluation of Radionuclides 55
5.3.7 Evaluation of Organic Chemicals 56
5.3.8 Risk-Based Screening Assessment 55
5.3.9 Preliminary Human Health Assessment 56
5.3.10 Preliminary Ecological Assessment 56
5.3.11 Conclusions and Recommendations 56

5.4 PRS 16-024(g) 56
5.4.1 History 57

5.4.2 Description 57
5.4.3 Previous Investigation(s) 57
5.4.4 Field Investigation 57
5.4.5 Evaluation of Inorganic Chemicals 61
5.4.6 Evaluation of Radionuclides 61
5.4.7 Evaluation of Organic Chemicals 61
5.4.8 Risk-Based Screening Assessment 61
5.4.9 Preliminary Human Health Assessment 61
5.4.10 Preliminary Ecological Assessment 61
5.4.11 Conclusions and Recommendations 62

5.5 PRS 16-024(k) 62
5.5.1 History 62
5.5.2 Description 63
5.5.3 Previous Investigation(s) 63
5.5.4 Field Investigation 63
5.5.5 Evaluation of Inorganic Chemicals 66
5.5.6 Evaluation of Radionuclides 67
5.5.7 Evaluation of Organic Chemicals 67
5.5.8 Risk-Based Screening Assessment 67
5.5.9 Preliminary Human Health Assessment 67
5.5.10 Preliminary Ecological Assessment 67
5.5.11 Conclusions and Recommendations 68

5.6 PRS 16-024(m) 68
5.6.1 History 68
5.6.2 Description 69
5.6.3 Previous Investigation(s) 69
5.6.4 Field Investigation 69
5.6.5 Evaluation of Inorganic Chemicals 72
5.6.6 Evaluation of Radionuclides 72
5.6.7 Evaluation of Organic Chemicals 73
5.6.8 Risk-Based Screening Assessment 73
5.6.9 Preliminary Human Health Assessment 73
5.6.10 Preliminary Ecological Assessment 73
5.6.11 Conclusions and Recommendations 74

5.7 PRS 16-024(o) 74
5.7.1 History 74
5.7.2 Description 75
5.7.3 Previous Investigation(s) 75
5.7.4 Field Investigation 75
5.7.5 Evaluation of Inorganic Chemicals 78
5.7.6 Evaluation of Radionuclides 79
5.7.7 Evaluation of Organic Chemicals 79
5.7.8 Risk-Based Screening Assessment 79
5.7.9 Preliminary Human Health Assessment 79
5.7.10 Preliminary Ecological Assessment 79
5.7.11 Conclusions and Recommendations 79

5.8 PRS 16-024(p) 80
5.8.1 History 80
5.8.2 Description 80
5.8.3 Previous Investigation(s) 81
5.8.4 Field Investigation 81
5.8.5 Evaluation of Inorganic Chemicals 84
5.8.6 Evaluation of Radionuclides 84
5.8.7 Evaluation of Organic Chemicals 84

5.8.8 Risk-Based Screening Assessment 84
5.8.9 Preliminary Human Health Assessment 84
5.8.10 Preliminary Ecological Assessment 85
5.8.11 Conclusions and Recommendations 85

5.9 PRS 16-024(q) 85
5.9.1 History 85
5.9.2 Description 86
5.9.3 Previous Investigation(s) 86
5.9.4 Field Investigation 86
5.9.5 Evaluation of Inorganic Chemicals 89
5.9.6 Evaluation of Radionuclides 90
5.9.7 Evaluation of Organic Chemicals 90
5.9.8 Risk-Based Screening Assessment 90
5.9.9 Preliminary Human Health Assessment 91
5.9.10 Preliminary Ecological Assessment 91
5.9.11 Conclusions and Recommendations 91

5.10 PRS 16-024(r) 92
5.10.1 History 92
5.10.2 Description 92
5.10.3 Previous Investigation(s) 92
5.10.4 Field Investigation 92
5.10.5 Evaluation of Inorganic Chemicals 96
5.10.6 Evaluation of Radionuclides 96
5.10.7 Evaluation of Organic Chemicals 96
5.10.8 Risk-Based Screening Assessment 96
5.10.9 Preliminary Human Health Assessment 96
5.10.10 Preliminary Ecological Assessment 96
5.10.11 Conclusions and Recommendations 97

5.11 PRS 16-024(s) 97
5.11.1 History 97
5.11.2 Description 98
5.11.3 Previous Investigation(s) 98
5.11.4 Field Investigation 98
5.11.5 Evaluation of Inorganic Chemicals 102
5.11.6 Evaluation of Radionuclides 103
5.11.7 Evaluation of Organic Chemicals 103
5.11.8 Risk-Based Screening Assessment 103
5.11.9 Preliminary Human Health Assessment 103
5.11.10 Preliminary Ecological Assessment 103
5.11.11 Conclusions and Recommendations 104

5.12 PRS 16-025(b2) 104
5.12.1 History 104
5.12.2 Description 105
5.12.3 Previous Investigation(s) 105
5.12.4 Field Investigation 105
5.12.5 Evaluation of Inorganic Chemicals 109
5.12.6 Evaluation of Radionuclides 110
5.12.7 Evaluation of Organic Chemicals 110
5.12.8 Risk-Based Screening Assessment 110
5.12.9 Preliminary Human Health Assessment 111
5.12.10 Preliminary Ecological Assessment 112
5.12.11 Conclusions and Recommendations 112

5.13 PRS 16-025(d) 112

5.13.1 History 113
5.13.2 Description 113
5.13.3 Previous Investigation(s) 113
5.13.4 Field Investigation 113
5.13.5 Evaluation of Inorganic Chemicals 116
5.13.6 Evaluation of Radionuclides 117
5.13.7 Evaluation of Organic Chemicals 117
5.13.8 Risk-Based Screening Assessment 117
5.13.9 Preliminary Human Health Assessment 117
5.13.10 Preliminary Ecological Assessment 117
5.13.11 Conclusions and Recommendations 117

5.14 PRS 16-025(g) 118
5.14.1 History 118
5.14.2 Description 118
5.14.3 Previous Investigation(s) 119
5.14.4 Field Investigation 119
5.14.5 Evaluation of Inorganic Chemicals 123
5.14.6 Evaluation of Radionuclides 123
5.14.7 Evaluation of Organic Chemicals 123
5.14.8 Risk-Based Screening Assessment 123
5.14.9 Preliminary Human Health Assessment 123
5.14.10 Preliminary Ecological Assessment 124
5.14.11 Conclusions and Recommendations 124

5.15 PRS 16-025(h) 125
5.15.1 History 125
5.15.2 Description 125
5.15.3 Previous Investigation(s) 125
5.15.4 Field Investigation 125
5.15.5 Evaluation of Inorganic Chemicals 129
5.15.6 Evaluation of Radionuclides 130
5.15.7 Evaluation of Organic Chemicals 130
5.15.8 Risk-Based Screening Assessment 131
5.15.9 Preliminary Human Health Assessment 133
5.15.10 Preliminary Ecological Assessment 133
5.15.11 Conclusions and Recommendations 133

5.16 PRS 16-025(i) 134
5.16.1 History 134
5.16.2 Description 134
5.16.3 Previous Investigation(s) 134
5.16.4 Field Investigation 135
5.16.5 Evaluation of Inorganic Chemicals 138
5.16.6 Evaluation of Radionuclides 139
5.16.7 Evaluation of Organic Chemicals 139
5.16.8 Risk-Based Screening Assessment 139
5.16.9 Preliminary Human Health Assessment 139
5.16.10 Preliminary Ecological Assessment 139
5.16.11 Conclusions and Recommendations 139

5.17 PRS 16-025(k) 140
5.17.1 History 140
5.17.2 Description 141
5.17.3 Previous Investigation(s) 141
5.17.4 Field Investigation 141
5.17.5 Evaluation of Inorganic Chemicals 145
5.17.6 Evaluation of Radionuclides 146

5.17.7 Evaluation of Organic Chemicals 146
5.17.8 Risk-Based Screening Assessment 146
5.17.9 Preliminary Human Health Assessment 146
5.17.10 Preliminary Ecological Assessment 147
5.17.11 Conclusions and Recommendations 147

5.18 PRS 16-025(m) 148
5.18.1 History 148
5.18.2 Description 148
5.18.3 Previous Investigation(s) 148
5.18.4 Field Investigation 148
5.18.5 Evaluation of Inorganic Chemicals 152
5.18.6 Evaluation of Radionuclides 153
5.18.7 Evaluation of Organic Chemicals 153
5.18.8 Risk-Based Screening Assessment 153
5.18.9 Preliminary Human Health Assessment 153
5.18.10 Preliminary Ecological Assessment 153
5.18.11 Conclusions and Recommendations 154

5.19 PRS 16-025(n) 154
5.19.1 History 154
5.19.2 Description 155
5.19.3 Previous Investigation(s) 155
5.19.4 Field Investigation 155
5.19.5 Evaluation of Inorganic Chemicals 159
5.19.6 Evaluation of Radionuclides 159
5.19.7 Evaluation of Organic Chemicals 159
5.19.8 Risk-Based Screening Assessment 160
5.19.9 Preliminary Human Health Assessment 161
5.19.10 Preliminary Ecological Assessment 161
5.19.11 Conclusions and Recommendations 161

5.20 PRS 16-025(o) 162
5.20.1 History 162
5.20.2 Description 162
5.20.3 Previous Investigation(s) 162
5.20.4 Field Investigation 162
5.20.5 Evaluation of Inorganic Chemicals 166
5.20.6 Evaluation of Radionuclides 167
5.20.7 Evaluation of Organic Chemicals 167
5.20.8 Risk-Based Screening Assessment 167
5.20.9 Preliminary Human Health Assessment 168
5.20.10 Preliminary Ecological Assessment 168
5.20.11 Conclusions and Recommendations 168

5.21 PRS 16-025(y) 169
5.21.1 History 169
5.21.2 Description 169
5.21.3 Previous Investigation(s) 169
5.21.4 Field Investigation 169
5.21.5 Evaluation of Inorganic Chemicals 174
5.21.6 Evaluation of Radionuclides 174
5.21.7 Evaluation of Organic Chemicals 175
5.21.8 Risk-Based Screening Assessment 175
5.21.9 Preliminary Human Health Assessment 175
5.21.10 Preliminary Ecological Assessment 175
5.21.11 Conclusions and Recommendations 175

5.22 PRS 16-034(c) 176
5.22.1 History 176
5.22.2 Description 176
5.22.3 Previous Investigation(s) 177
5.22.4 Field Investigation 177
5.22.5 Evaluation of Inorganic Chemicals 180
5.22.6 Evaluation of Radionuclides 180
5.22.7 Evaluation of Organic Chemicals 181
5.22.8 Risk-Based Screening Assessment 181
5.22.9 Preliminary Human Health Assessment 182
5.22.10 Preliminary Ecological Assessment 182
5.22.11 Conclusions and Recommendations 182

5.23 PRS 16-034(d) 183
5.23.1 History 183
5.23.2 Description 183
5.23.3 Previous Investigation(s) 184
5.23.4 Field Investigation 184
5.23.5 Evaluation of Inorganic Chemicals 187
5.23.6 Evaluation of Radionuclides 187
5.23.7 Evaluation of Organic Chemicals 187
5.23.8 Risk-Based Screening Assessment 188
5.23.9 Preliminary Human Health Assessment 188
5.23.10 Preliminary Ecological Assessment 188
5.23.11 Conclusions and Recommendations 188

5.24 PRS 16-034(e) 189
5.24.1 History 189
5.24.2 Description 189
5.24.3 Previous Investigation(s) 189
5.24.4 Field Investigation 189
5.24.5 Evaluation of Inorganic Chemicals 193
5.24.6 Evaluation of Radionuclides 193
5.24.7 Evaluation of Organic Chemicals 193
5.24.8 Risk-Based Screening Assessment 194
5.24.9 Preliminary Human Health Assessment 194
5.24.10 Preliminary Ecological Assessment 194
5.24.11 Conclusions and Recommendations 194

5.25 PRS 16-034(f) 195
5.25.1 History 195
5.25.2 Description 196
5.25.3 Previous Investigation(s) 196
5.25.4 Field Investigation 196
5.25.5 Evaluation of Inorganic Chemicals 199
5.25.6 Evaluation of Radionuclides 200
5.25.7 Evaluation of Organic Chemicals 200
5.25.8 Risk-Based Screening Assessment 200
5.25.9 Preliminary Human Health Assessment 201
5.25.10 Preliminary Ecological Assessment 201
5.25.11 Conclusions and Recommendations 201

5.26 PRS 16-034(l) 202
5.26.1 History 202
5.26.2 Description 202
5.26.3 Previous Investigation(s) 202
5.26.4 Field Investigation 202
5.26.5 Evaluation of Inorganic Chemicals 206

5.26.6 Evaluation of Radionuclides 206
5.26.7 Evaluation of Organic Chemicals 206
5.26.8 Risk-Based Screening Assessment 207
5.26.9 Preliminary Human Health Assessment 207
5.26.10 Preliminary Ecological Assessment 207
5.26.11 Conclusions and Recommendations 207

5.27 PRS 16-034(m) 208
5.27.1 History 208
5.27.2 Description 208
5.27.3 Previous Investigation(s) 208
5.27.4 Field Investigation 208
5.27.5 Evaluation of Inorganic Chemicals 211
5.27.6 Evaluation of Radionuclides 212
5.27.7 Evaluation of Organic Chemicals 212
5.27.8 Risk-Based Screening Assessment 213
5.27.9 Preliminary Human Health Assessment 213
5.27.10 Preliminary Ecological Assessment 213
5.27.11 Conclusions and Recommendations 213

5.28 PRS C-16-005 214
5.28.1 History 214
5.28.2 Description 215
5.28.3 Previous Investigation(s) 215
5.28.4 Field Investigation 215
5.28.5 Evaluation of Inorganic Chemicals 218
5.28.6 Evaluation of Radionuclides 219
5.28.7 Evaluation of Organic Chemicals 219
5.28.8 Risk-Based Screening Assessment 219
5.28.9 Preliminary Human Health Assessment 219
5.28.10 Preliminary Ecological Assessment 219
5.28.11 Conclusions and Recommendations 220

5.29 PRS C-16-017 220
5.29.1 History 220
5.29.2 Description 221
5.29.3 Previous Investigation(s) 221
5.29.4 Field Investigation 221
5.29.5 Evaluation of Inorganic Chemicals 225
5.29.6 Evaluation of Radionuclides 225
5.29.7 Evaluation of Organic Chemicals 225
5.29.8 Risk-Based Screening Assessment 226
5.29.9 Preliminary Human Health Assessment 226
5.29.10 Preliminary Ecological Assessment 226
5.29.11 Conclusions and Recommendations 226

6.0 REFERENCES 228

APPENDIX A ANALYTICAL SUITES 235

APPENDIX B DATA VALIDATION 237

TABLE OF FIGURES

FIGURE 1.1-1 LOCATION OF OPERABLE UNIT 1082 2
FIGURE 1.1-2 LOCATION OF OPERABLE UNIT 1082 WITH RESPECT TO LABORATORY TAS 3
FIGURE 2.3.1-1 TOPOGRAPHY OF TA-16 SHOWING SPRINGS, SEEPS, AND WETLANDS... 12
FIGURE 5.0-1 LOCATION OF PRS IN THIS RFI REPORT 37
FIGURE 5.1.4-1 LOCATIONS OF PRS 16-024(C) SAMPLES 41
FIGURE 5.2.4-1 LOCATIONS OF PRS 16-024(D) SAMPLES 48
FIGURE 5.3.4-1, LOCATIONS OF PRS 16-024(F) SAMPLES 54
FIGURE 5.4.4-1, LOCATIONS OF PRS 16-024(G) SAMPLES 59
FIGURE 5.5.4-1, LOCATIONS OF PRS 16-024(K) SAMPLES 65
FIGURE 5.6.4-1, LOCATIONS OF PRS 16-024(M) SAMPLES 71
FIGURE 5.7.4-1, LOCATIONS OF PRS 16-024(O) SAMPLES 77
FIGURE 5.8.4-1, LOCATIONS OF PRS 16-024(P) SAMPLES 83
FIGURE 5.9.4-1, LOCATIONS OF PRS 16-024(Q) SAMPLES 88
FIGURE 5.10.4-1, LOCATIONS OF PRS 16-024(R) SAMPLES 94
FIGURE 5.11.4-1, LOCATIONS OF PRS 16-024(S) SAMPLES 100
FIGURE 5.12.4-1, LOCATIONS OF PRS 16-025(B2) SAMPLES 107
FIGURE 5.13.4-1, LOCATIONS OF PRS 16-025(D) SAMPLES 115
FIGURE 5.14.4-1, LOCATIONS OF PRS 16-025(G) SAMPLES 121
FIGURE 5.15.4-1, LOCATIONS OF PRS 16-025(H) SAMPLES 127
FIGURE 5.16.4-1, LOCATIONS OF PRS 16-025(J) SAMPLES 137
FIGURE 5.17.4-1, LOCATIONS OF PRS 16-025(K) SAMPLES 143
FIGURE 5.18.4-1, LOCATIONS OF PRS 16-025(M) SAMPLES 151
FIGURE 5.19.4-1, LOCATIONS OF PRS 16-025(N) SAMPLES 157
FIGURE 5.20.4-1, LOCATIONS OF PRS 16-025(O) SAMPLES 165
FIGURE 5.21.4-1, LOCATIONS OF PRS 16-025(Y) SAMPLES 171
FIGURE 5.22.4-1, LOCATIONS OF PRS 16-034(C) SAMPLES 179
FIGURE 5.23.4-1, LOCATIONS OF PRS 16-034(D) SAMPLES 186
FIGURE 5.24.4-1, LOCATIONS OF PRS 16-034(E) SAMPLES 191

FIGURE 5.25.4-1. LOCATIONS OF PRS 16-034(F) SAMPLES..... 198
FIGURE 5.26.4-1. LOCATIONS OF PRS 16-034(L) SAMPLES..... 204
FIGURE 5.27.4-1. LOCATIONS OF PRS 16-034(M) SAMPLES..... 210
FIGURE 5.28.4-1. LOCATIONS OF PRS C-16-005 SAMPLES..... 217
FIGURE 5.29.4-1. LOCATIONS OF PRS C-16-017 SAMPLES..... 223

LIST OF TABLES

TABLE ES-1 VIII
SUMMARY OF PRSS .....
TABLE 3.1.2-1 18
DEFINITION OF DATA QUALIFIERS .....
TABLE 3.3.1-1 23
RISK DUE TO BACKGROUND CONCENTRATIONS .....
TABLE 4.0-1 24
FIELD DUPLICATE SAMPLES .....
TABLE 4.2-1 30
SHORT-LIVED NATURALLY OCCURRING RADIONUCLIDES .....
TABLE 4.2-2 31
ANALYTES, MDA AND ANALYTICAL METHODS FOR LONG-LIVED RADIONUCLIDES .....
TABLE 5.1.4-1 42
SUMMARY OF FIELD SCREENING RESULTS - PRS 16-024(C) .....
TABLE 5.1.4-2 42
SUMMARY OF REQUEST NUMBERS FOR PRS 16-024(C) .....
TABLE 5.2.4-1 47
SUMMARY OF FIELD SCREENING RESULTS - PRS 16-024(D) .....
TABLE 5.2.4-2 49
SUMMARY OF REQUEST NUMBERS FOR PRS 16-024(D) .....
TABLE 5.2.5-1 49
INORGANIC CHEMICALS AT OR ABOVE SCREENING VALUES FOR PRS 16-024(D) .....
TABLE 5.3.4-1 53
SUMMARY OF FIELD SCREENING RESULTS - PRS 16-024(F) .....
TABLE 5.3.4-2 55
SUMMARY OF REQUEST NUMBERS FOR PRS 16-024(F) .....
TABLE 5.4.4-1 60
SUMMARY OF FIELD SCREENING RESULTS - 16-024(G) .....
TABLE 5.4.4-2 60
SUMMARY OF REQUEST NUMBERS FOR PRS 16-024(G) .....
TABLE 5.5.4-1 66
SUMMARY OF FIELD SCREENING RESULTS - 16-024(K) .....
TABLE 5.5.4-2 66
SUMMARY OF REQUEST NUMBERS FOR PRS 16-024(K) .....
TABLE 5.5.5-1 67
INORGANIC CHEMICALS AT OR ABOVE SCREENING VALUES FOR PRS 16-024(K) .....
TABLE 5.6.4-1 72
SUMMARY OF FIELD SCREENING RESULTS - 16-024(M) .....
TABLE 5.6.4-2 72
SUMMARY OF REQUEST NUMBERS FOR PRS 16-024(M) .....
TABLE 5.6.7-1 73
DETECTED ORGANIC CHEMICALS FOR PRS 16-024(M) .....
TABLE 5.7.4-1 78
SUMMARY OF FIELD SCREENING RESULTS - 16-024(O) .....
TABLE 5.7.4-2 78
SUMMARY OF REQUEST NUMBERS FOR PRS 16-024(O) .....
TABLE 5.7.5-1 78
INORGANIC CHEMICALS AT OR ABOVE SCREENING VALUES FOR PRS 16-024(O) .....
TABLE 5.8.4-1 82
SUMMARY OF FIELD SCREENING RESULTS - 16-024(P) .....
TABLE 5.8.4-2 84
SUMMARY OF REQUEST NUMBERS FOR PRS 16-024(P) .....
TABLE 5.9.4-1 89
SUMMARY OF FIELD SCREENING RESULTS - 16-024(Q) .....
TABLE 5.9.4-2 89
SUMMARY OF REQUEST NUMBERS FOR PRS 16-024(Q) .....

TABLE 5.9.5-1 90
INORGANIC CHEMICALS AT OR ABOVE SCREENING VALUES FOR PRS 16-024(Q) .....
TABLE 5.9.7-1 90
DETECTED ORGANIC CHEMICALS FOR PRS 16-024(Q) .....
TABLE 5.10.4-1 95
SUMMARY OF FIELD SCREENING RESULTS - 16-024(R) .....
TABLE 5.10.4-2 95
SUMMARY OF REQUEST NUMBERS FOR PRS 16-024(R) .....
TABLE 5.11.4-1 101
SUMMARY OF FIELD SCREENING RESULTS - 16-024(S) .....
TABLE 5.11.4-2 101
SUMMARY OF FIELD SCREENING RESULTS FOR QA/QC SAMPLES - 16-024(S) .....
TABLE 5.11.4-3 102
SUMMARY OF REQUEST NUMBERS FOR PRS 16-024(S) .....
TABLE 5.11.5-1 102
INORGANIC CHEMICALS AT OR ABOVE SCREENING VALUES FOR PRS 16-024(S) .....
TABLE 5.12.4-1 108
SUMMARY OF FIELD SCREENING RESULTS - 16-025(B2) .....
TABLE 5.12.4-2 109
SUMMARY OF REQUEST NUMBERS FOR PRS 16-025(B2) .....
TABLE 5.12.5-1 109
INORGANIC CHEMICALS AT OR ABOVE SCREENING VALUES FOR PRS 16-025(B2) .....
TABLE 5.12.7-1 110
DETECTED ORGANIC CHEMICALS FOR PRS 16-025(B2) .....
TABLE 5.12.8-1 111
MCE CALCULATION FOR PRS 16-025(B2) .....
TABLE 5.13.4-1 116
SUMMARY OF FIELD SCREENING RESULTS - 16-025(D) .....
TABLE 5.13.4-2 116
SUMMARY OF REQUEST NUMBERS FOR PRS 16-025(D) .....
TABLE 5.14.4-1 122
SUMMARY OF FIELD SCREENING RESULTS - 16-025(G) .....
TABLE 5.14.4-2 122
SUMMARY OF REQUEST NUMBERS FOR FOR PRS 16-025(G) .....
TABLE 5.14.5-1 123
INORGANIC CHEMICALS AT OR ABOVE SCREENING VALUES FOR PRS 16-025(G) .....
TABLE 5.15.4-1 129
SUMMARY OF FIELD SCREENING RESULTS - 16-025(H) .....
TABLE 5.15.4-2 129
SUMMARY OF REQUEST NUMBERS FOR PRS 16-025(H) .....
TABLE 5.15.5-1 130
INORGANIC CHEMICALS AT OR ABOVE SCREENING VALUES FOR PRS 16-025(H) .....
TABLE 5.15.7-1 131
DETECTED ORGANIC CHEMICALS FOR PRS 16-025(H) .....
TABLE 5.15.8-1 132
MCE CALCULATION FOR PRS 16-025(H) .....
TABLE 5.16.4-1 138
SUMMARY OF FIELD SCREENING RESULTS - 16-025(J) .....
TABLE 5.16.4-2 138
SUMMARY OF REQUEST NUMBERS FOR PRS 16-025(J) .....
TABLE 5.16.5-1 139
INORGANIC CHEMICALS AT OR ABOVE SCREENING VALUES FOR PRS 16-025(J) .....
TABLE 5.17.4-1 144
SUMMARY OF FIELD SCREENING RESULTS - 16-025(K) .....
TABLE 5.17.4-2 144
SUMMARY OF REQUEST NUMBERS FOR PRS 16-025(K) .....
TABLE 5.17.5-1 145
INORGANIC CHEMICALS AT OR ABOVE SCREENING VALUES FOR PRS 16-025(K) .....

TABLE 5.18.4-1 150
SUMMARY OF FIELD SCREENING RESULTS - 16-025(M) .....
TABLE 5.18.4-2 152
SUMMARY OF REQUEST NUMBERS FOR PRS 16-025(M) .....
TABLE 5.18.5-1 152
INORGANIC CHEMICALS AT OR ABOVE SCREENING VALUES FOR PRS 16-025(M) .....
TABLE 5.19.4-1 158
SUMMARY OF FIELD SCREENING RESULTS - 16-025(N) .....
TABLE 5.19.4-2 158
SUMMARY OF REQUEST NUMBERS FOR PRS 16-025(N) .....
TABLE 5.19.5-1 159
INORGANIC CHEMICALS AT OR ABOVE SCREENING VALUES FOR PRS 16-025(N) .....
TABLE 5.19.8-1 160
MCE CALCULATION FOR PRS 16-025(N) .....
TABLE 5.20.4-1 164
SUMMARY OF FIELD SCREENING RESULTS - 16-025(O) .....
TABLE 5.20.4-2 166
SUMMARY OF REQUEST NUMBERS FOR PRS 16-025(O) .....
TABLE 5.20.5-1 167
INORGANIC CHEMICALS AT OR ABOVE SCREENING VALUES FOR PRS 16-025(O) .....
TABLE 5.21.4-1 173
SUMMARY OF FIELD SCREENING RESULTS - 16-025(Y) .....
TABLE 5.21.4-2 173
SUMMARY OF FIELD SCREENING RESULTS FOR QA/QC SAMPLES - 16-025(Y) .....
TABLE 5.21.4-3 174
SUMMARY OF REQUEST NUMBERS FOR PRS 16-025(Y) .....
TABLE 5.21.5-1 174
INORGANIC CHEMICALS AT OR ABOVE SCREENING VALUES FOR PRS 16-025(Y) .....
TABLE 5.22.4-1 178
SUMMARY OF FIELD SCREENING RESULTS - 16-034(C) .....
TABLE 5.22.4-2 180
SUMMARY OF REQUEST NUMBERS FOR PRS 16-034(C) .....
TABLE 5.22.5-1 180
INORGANIC CHEMICALS AT OR ABOVE SCREENING VALUES FOR PRS 16-034(C) .....
TABLE 5.22.7-1 181
DETECTED ORGANIC CHEMICALS FOR PRS 16-034(C) .....
TABLE 5.22.7-1 182
MCE CALCULATION FOR PRS 16-034(C) .....
TABLE 5.23.4-1 185
SUMMARY OF FIELD SCREENING RESULTS - 16-034(D) .....
TABLE 5.23.4-2 187
SUMMARY OF REQUEST NUMBERS FOR PRS 16-034(D) .....
TABLE 5.23.5-1 187
INORGANIC CHEMICALS AT OR ABOVE SCREENING VALUES FOR PRS 16-034(D) .....
TABLE 5.24.4-1 192
SUMMARY OF FIELD SCREENING RESULTS - 16-034(E) .....
TABLE 5.24.4-2 193
SUMMARY OF REQUEST NUMBERS FOR PRS 16-034(E) .....
TABLE 5.24.5-1 193
INORGANIC CHEMICALS AT OR ABOVE SCREENING VALUES FOR PRS 16-034(E) .....
TABLE 5.24.7-1 194
DETECTED ORGANIC CHEMICALS FOR PRS 16-034(E) .....
TABLE 5.25.4-1 199
SUMMARY OF FIELD SCREENING RESULTS - 16-034(F) .....
TABLE 5.25.4-2 199
SUMMARY OF REQUEST NUMBERS FOR PRS 16-034(F) .....
TABLE 5.25.5-1 200
INORGANIC CHEMICALS AT OR ABOVE SCREENING VALUES FOR PRS 16-034(F) .....

TABLE 5.25.7-1 200
DETECTED ORGANIC CHEMICALS FOR PRS 16-034(F) .....
TABLE 5.26.4-1 205
SUMMARY OF FIELD SCREENING RESULTS - 16-034(L) .....
TABLE 5.26.4-2 206
SUMMARY OF REQUEST NUMBERS FOR PRS 16-034(L) .....
TABLE 5.26.5-1 206
INORGANIC CHEMICALS AT OR ABOVE SCREENING VALUES FOR PRS 16-034(L) .....
TABLE 5.27.4-1 211
SUMMARY OF FIELD SCREENING RESULTS - 16-034(M) .....
TABLE 5.27.4-2 211
SUMMARY OF REQUEST NUMBERS FOR PRS 16-034(M) .....
TABLE 5.27.5-1 212
INORGANIC CHEMICALS AT OR ABOVE SCREENING VALUES FOR PRS 16-034 (M) .....
TABLE 5.27.7-1 213
DETECTED ORGANIC CHEMICALS FOR PRS 16-034(M) .....
TABLE 5.28.4-1 218
SUMMARY OF FIELD SCREENING RESULTS - C-16-005 .....
TABLE 5.28.4-2 218
SUMMARY OF REQUEST NUMBERS FOR PRS C-16-005 .....
TABLE 5.28.5-1 219
INORGANIC CHEMICALS AT OR ABOVESCREENING VALUES FOR PRS C-16-005 .....
TABLE 5.29.4-1 224
SUMMARY OF FIELD SCREENING RESULTS - C-16-017 .....
TABLE 5.29.4-2 225
SUMMARY OF FIELD SCREENING RESULTSFOR QA/QC SAMPLES - C-16-017 .....
TABLE 5.29.4-3 225
SUMMARY OF REQUEST NUMBERS FOR PRS C-16-017 .....
TABLE B-1 237
DATA QUALITY EVALUATION FOR RADIOCHEMISTRY ANALYSES AT TA-16 .....
TABLE B-2 238
DATA QUALITY EVALUATION FOR HIGH EXPLOSIVES ANALYSES AT TA-16 .....
TABLE B-3 238
DATA QUALITY EVALUATION FOR INORGANIC ANALYSES AT TA-16 .....
TABLE B-4 240
DATA QUALITY EVALUATION FOR SVOC ANALYSES AT TA-16 .....
TABLE B-5 241
DATA QUALITY EVALUATION FOR TOTAL URANIUM ANALYSES AT TA-16 .....

THIS PAGE LEFT INTENTIONALLY BLANK

1.0 INTRODUCTION

This report presents the results of the Phase I RFI for 29 PRSs at Technical Area (TA) 16 at Los Alamos National Laboratory (LANL). The 29 PRSs represent soils associated with building footprints in the World War II era TA-16 complex. This report describes the sampling conducted during Phase I, examines the analytical results, and proposes NFA for human health.

1.1 General Site History

TA-16 is located in the southwestern corner of the Laboratory (Figs. 1.1-1 and 1.1-2). It contains 2 410 acres or 3.8 square miles. The land is a portion of that which was acquired by the Department of Army for the Manhattan Project in 1943. It was used prehistorically by the ancestral Indians of the Pajarito Plateau and before World War II for farming and a sawmill operation. TA-16 is bordered by Bandelier National Monument along New Mexico (NM) state road 4 to the south and the Santa Fe National Forest along NM state road 501 to the west. To the north and east, it is bordered by TAs 8, 9, 14, 15, and 49. TA-16 is fenced and posted along NM State Road 4. Water Canyon, a 200-ft-deep ravine with steep walls, separates State Road 4 from active sites at TA-16. Cañon de Valle forms the northern border of TA-16. Security fences surround the HE production facilities.

TA-16 was established to develop explosive formulations, cast and machine explosive charges, and to assemble and test explosive components for the US nuclear weapons program. Almost all of the work was conducted in support of the development, testing, and production of explosive charges for the implosion method. Present-day use of this site is essentially unchanged, although facilities have been upgraded and expanded as explosive and manufacturing technologies have advanced.

All of the PRSs included in this report are footprints of former buildings. These buildings included HE magazines, HE machining buildings, HE casting buildings, HE inspection buildings, radiography buildings, barium nitrate grinding facilities, steam plants, laboratories, equipment and control buildings, warehouse and source huts, machining buildings, and storage buildings. The buildings were used in the 1940s and 1950s and most of them were decommissioned by intentional burning in the late 1950s and early 1960s. Significant contamination was not anticipated at these sites. However, contamination at these sites could include inorganic chemicals, cyanide, organics (particularly HE), and radionuclides. Although radionuclides are regulated by the DOE and are not regulated under

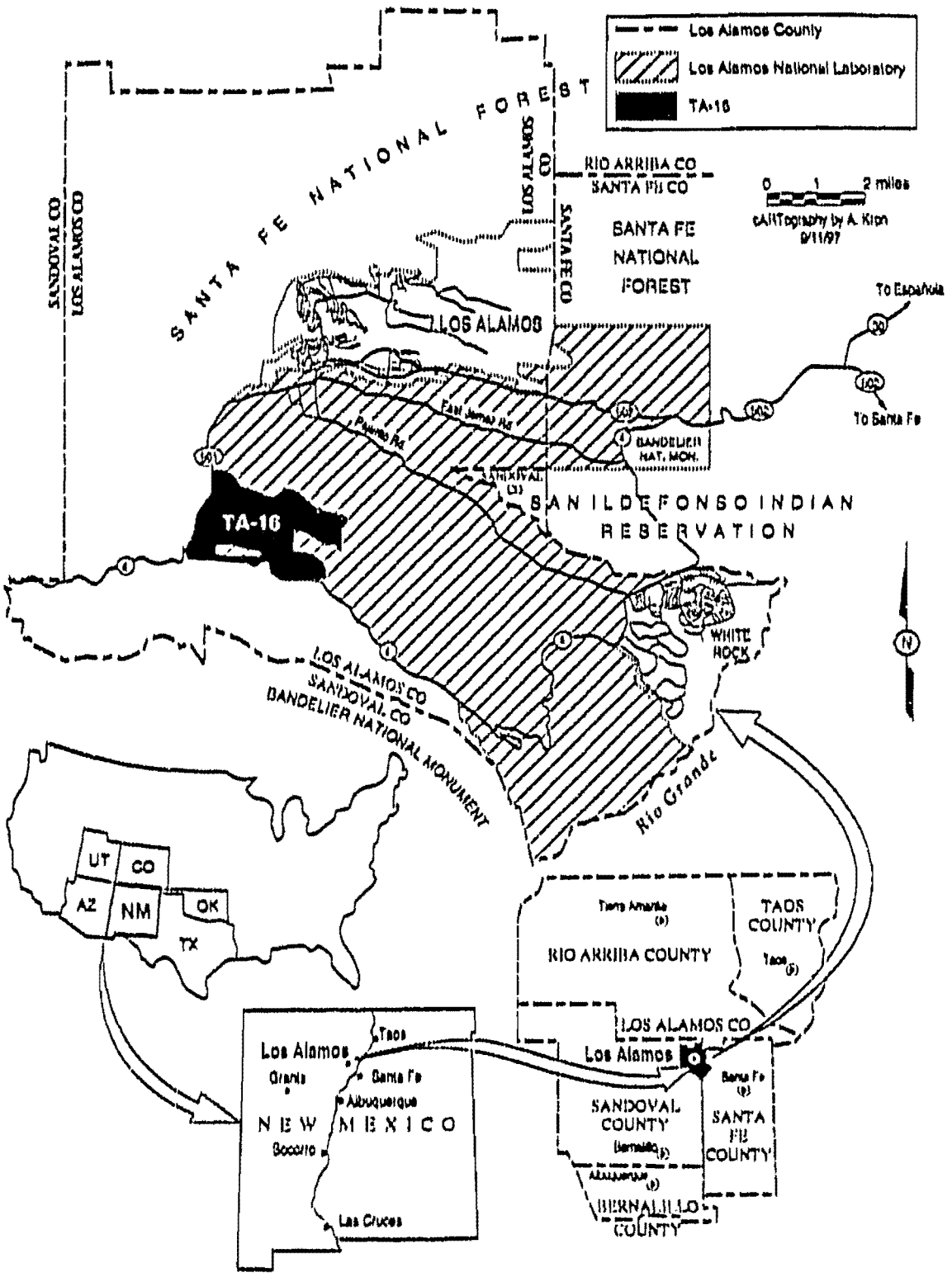


Fig. 1.1-1 Location of TA-16 within Los Alamos National Laboratory, Los Alamos County, NM.

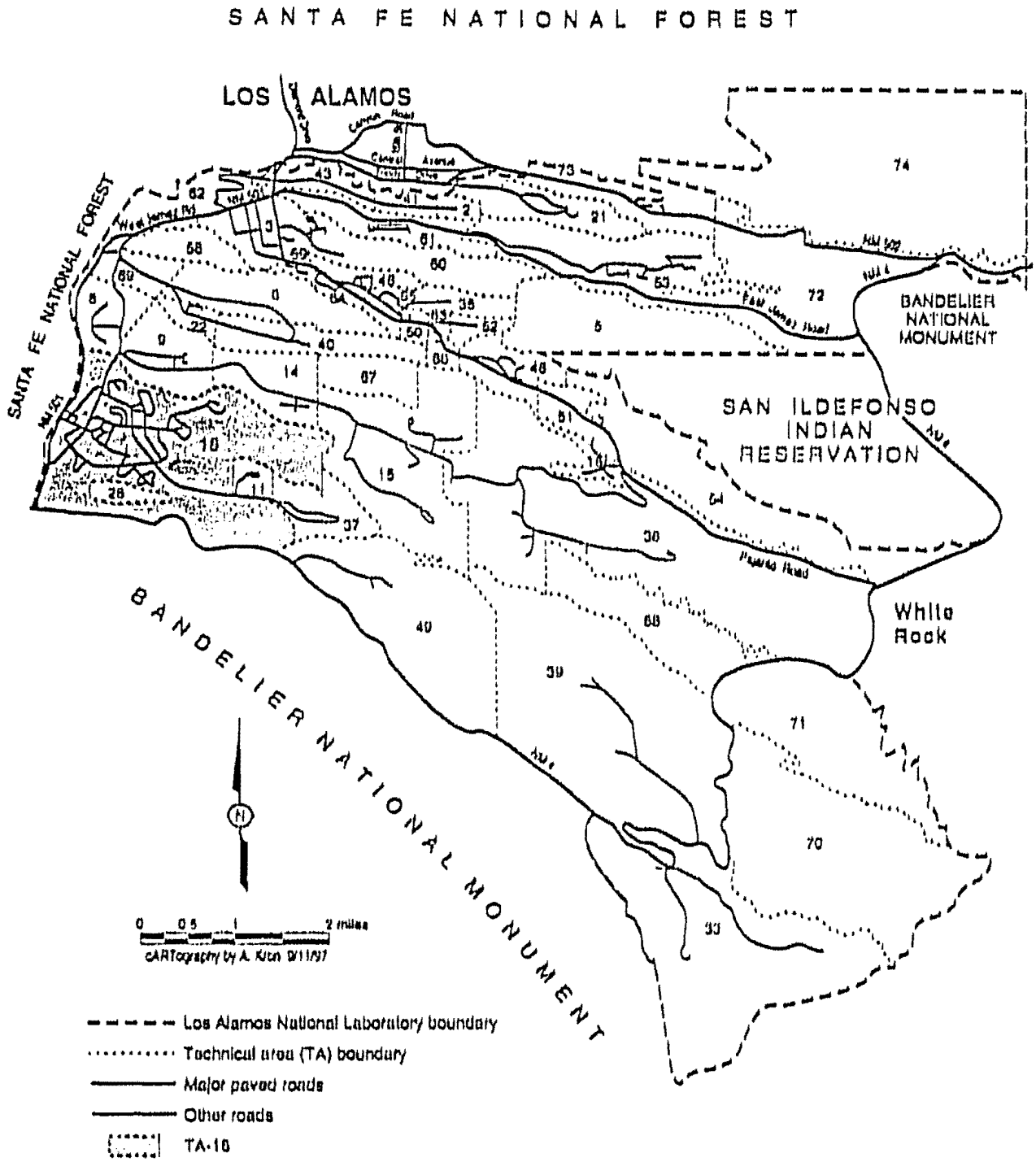


Fig. 1.1-2 Location of TA-16 with respect to Laboratory TAs and surrounding landholdings.

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.

A comprehensive table of the contaminants of potential concern (COPCs) that were expected at these sites is contained in Section 4 of the RFI Work Plan for Operable Unit 1082, Addendum II (LANL 1995, 1342). This table includes a wide range of HE used at LANL over the years, as well as standard industrial solvents, inorganic chemicals, and a few radionuclides.

1.2 RFI Overview

The RFI work plan that describes the 20 PRSs included in this report was submitted to the EPA Region 6 in July 1994 and was approved by EPA with minor modifications in 1995 (Taylor 1995, 15-16-645). The technical approach of the plan utilized phased sampling to locate the sources of any contamination associated with past LANL activities. This Phase I reconnaissance sampling and investigation is in compliance with the HSWA Module VIII of the LANL RCRA Facility Permit (EPA 1990, 0306).

The objective of the sampling activities at the 20 PRSs was to ascertain whether potential contaminants were present at levels of concern. Biased sampling was utilized to ensure that a release would be detected if it had occurred at a PRS. Analytical results were used to determine if releases had caused contamination at levels above SALs, UTLs, or EQLs.

The sampling design was based on the conceptual model described in Section 4.3 of the RFI Work Plan for Operable Unit 1082 (LANL 1994, 1160). The conceptual model was developed to identify potential contamination release and migration pathways and any potential human receptors. The PRSs represent decommissioned buildings that have been removed or destroyed by intentional burning (all ashes and remnants from the burning were removed from the sites).

The potential contamination mechanism at the PRSs is hypothesized to be from either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former buildings were burned and remnants removed. The potential release mechanisms are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former buildings. There were no intrusive activities at the PRSs. Because all of the sites lie within relatively level mesa-top areas, there are few surface water collection points or drainages present that would evaluate lateral spreading and vertical infiltration of contaminants.

The conceptual model guided the selection of screening sample locations that were used to characterize the PRSs. These locations were within or adjacent to the former buildings and included: (1) building quadrants; (2) building centers; and (3) door locations.

Quadrant sample locations were either within or near the corners of the former buildings. The criteria for selecting quadrant locations were as follows.

- If the former building foundation and floor were constructed of concrete, the quadrant sample locations were biased to the building corners. This selection was made because the contaminant dispersal mechanism for concrete floors is hypothesized to be from leakage at the floor/wall joints.
- If the former floor was constructed of wood, the quadrant sample locations were biased within the quadrant. This selection was made because the contaminant dispersal mechanism for wooden floors is hypothesized to be from leakage from cracks within the wooden structure. Because leaks could have occurred anywhere within the structure, the samples were collected within the quadrants.

Screening samples were collected at door locations (and downgradient from door locations) where operations at the former building may have resulted in release of material. Door locations are likely areas for spills to have occurred or for material to have been swept out of the structures.

Screening samples were collected at center locations where operations at the former building may have resulted in release of material near the center of the structure. The buildings that had center pits for radioactive sources were likely to have had contamination at the building center.

The conceptual model also guided the screening sample depths that were used to characterize the PRSs. Potential contaminants from possible leaks and spills are hypothesized to have infiltrated into the near-surface and not to have been transported to depths greater than 1 ft. Samples collected from 0 to 1 ft depths were believed to capture potential contaminants from leaks and spills.

The possible dispersal of soil during removal of the former buildings is hypothesized to differ between concrete floored and wood foundation buildings. The criteria for selecting sample depths is therefore dependent on the type of building foundation. Decommissioning of buildings with concrete foundations was likely to have resulted in movement and disturbances of soil at near-surface depths beneath the structures. Screening samples from PRSs with concrete foundations were collected at 0 to 1 ft and 1 to 2 ft intervals to confirm that the contamination beneath the concrete-floored buildings had not been mixed to depths greater than 1 ft. Decommissioning of buildings with wood foundations was likely to have disturbed soils at the

surface and not at depths greater than 1 ft. Screening samples from PRSs with wood foundations were collected at 0 to 1 ft intervals because contamination is most likely present directly below the former structure. In all cases, however, contamination in the 0 to1 ft interval is deemed to be much more likely than in the 1 to 2 ft interval.

Laboratory samples were selected from the screening samples based on site-specific prioritization schemes that are discussed in Section 5 of this report. The majority of the laboratory samples were collected from the 0 to 1 ft depth intervals. This depth interval was selected for three reasons: (1) contamination is most likely present at shallow depths directly beneath the structures (in accordance with the conceptual model); (2) sample logs confirm that the samples at depths of 1 to 2 ft were undisturbed; and (3) results for screening samples at the deeper intervals (at all locations) indicated little contamination was present at depths greater than 1 ft.

Eight laboratory samples collected from the 1 to 2-ft depth intervals were quality assurance/quality control (QA/QC) samples which were collected to confirm no contamination was present at depth.

1.3 Field Activities

Fieldwork was performed at TA-16 from July 2 through August 8, 1997. The following field activities were completed at each PRS.

- Land survey
- Screening survey
- Field sampling activities

1.3.1 Land Surveys

A land survey was conducted to locate positions of former buildings at each PRS. The center of each building was surveyed, and screening sample locations were further surveyed relative to the center point of each former building. A Trimble™ global positioning system (GPS) total station was used to perform the survey to an estimated accuracy of ± 2 ft.

The land survey consisted of the following:

- Aerial photos were used to determine the positions of the former buildings. The primary aerial photo used in the survey was taken June 28, 1965. Photos taken November 15, 1956, and October 10, 1951, were used to locate buildings that had been destroyed before 1965.
- Corrections were made for the distortions in the aerial photos by deriving a scale based on known structures. Structures that exist today and were present in the aerial photos, were

used as photo control points. These photo control points (manholes and fire hydrants) were surveyed in the field, and the actual distances between these control points were compared with scaled distances on the aerial photos.

- Former buildings were located on the aerial photos. Distances were scaled from three photo control points to the center of each former building.
- Drawings were created for each former building using Softdesk Civil™ software. Three circles were drawn using the photo control points as radius points and the scaled distance as the radius of each circle. If all of the circles intersected at the same point, the position was accepted. Planar coordinates for the former buildings were calculated.
- If the three circles did not intersect at the same point, additional distances were scaled from other photo control points until acceptable positions were determined.
- The center of the former buildings was surveyed in from existing control points, and final checks were performed.
- The screening sample locations were determined and surveyed relative to the center of the former buildings.

1.3.2 Screening Surveys

Field screening was used to bias sample collection to the locations of greatest potential contamination. Soil samples were screened for HE, inorganic chemicals, radioactivity, and organics (depending on the chemicals potentially present). Screening results were used to bias the selection of samples that were submitted to the off-site laboratories for further analysis. Field screening was conducted both in place and at the field chemistry trailer.

All soil samples were screened in place for HE using an HE spot test kit with modified Griess™ reagents , for beta/gamma radiation (using an Eberline ESP1™ radiological meter with HP-260™ probe), and for volatile organics (using an HNu photoionization detector).

Soil samples collected from the 0 to 1 ft depth intervals were brought back to the field chemistry trailer for more detailed screening analysis. The soil was analyzed for hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX), trinitrotoluene (TNT), metals, and benzene, toluene, ethylbenzene, and xylene (BTEX) as appropriate. RDX and TNT were measured using a D-Tech™ analysis kit. Metals were measured using a Tracor Northern Spectrace 9000 energy dispersive x-ray fluorescence spectrometer (XRF). BTEX was measured using a D-Tech™ immunoassay analysis kit.

1.3.3 Field Sampling Activities

Field sampling activities at TA-16 were conducted from July 2 through August 8, 1997. Soil samples were collected and analyzed for screening purposes. Laboratory samples were selected from the screening samples based on site specific prioritization schemes which are discussed in Section 5. The screening samples were taken from 0 to 1-ft depth intervals at PRSs that had had wood floors and from 0 to 1-ft and 1 to 2-ft depth intervals at PRSs that had had concrete floors.

The samples were collected using a manually operated hand-auger. All of the soil was screened in place as discussed in Section 1.3.2 of this report. The soil types and locations were described, photographed, and information logged. The samples that screened positive for any potential contaminant were placed in sealable plastic bags on ice in a cooler and transported to the field chemistry trailer for further analysis as discussed in Section 1.3.2. If no samples screened positive at any given location, then the 0 to 1 ft depth interval samples were brought back to the field chemistry trailer for further screening analysis. The 1 to 2 ft depth interval soils that were not used for further analysis were placed back into the holes from which they originated.

The 0 to 1-ft soil depth intervals were selected for further screening and laboratory analysis (rather than the 1 to 2-ft depth intervals) because contamination is most likely present at shallow depths directly beneath the structures (in accordance with the conceptual model).

All ER activities were conducted using appropriate LANL Environmental Restoration (ER) Standard Operating Procedures (SOPs). Subsurface soil samples were collected according to LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler. Sample handling procedures conformed to LANL-ER-SOP-1.01, R0, General Instructions for Field Investigations, LANL-ER-SOP-1.02, R0, Sample Containers and Preservation, and LANL-ER-SOP 1.03, R1, Handling, Packaging, and Shipping of Samples. Sample control and documentation procedures conformed to LANL-ER-SOP-1.04, R3, Sample Control and Field Documentation.

2.0 ENVIRONMENTAL SETTING

The environmental setting of the Laboratory is described in Subsection 2.4 of the Installation Work Plan (IWP) for Environmental Restoration Revision 4 (LANL 1995, 1164). A discussion of the environmental setting, including climate, geology, hydrology, and a conceptual hydrogeologic model for the area and surroundings, is presented in Chapter 3 of the RFI Work Plan for Operable Unit 1082 (LANL 1993, 1094). A summary of that and new data collected since 1993 are 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 mean summer temperatures to range from 60° F to 68° F at TA-16. Winter mean temperatures typically range from 30° F to 37° F. The average annual rainfall in the area of TA-16 is estimated to range from 18 to 20 in. (Bowen 1990, 0333). Of this total, 40% occurs as brief, intense thunderstorms during July and August

2.2 Geology

2.2.1 Geologic Setting

A detailed discussion of the geology of the entire Los Alamos area can be found in Subsection 2.5.1 of the IWP (LANL 1995, 1164). The geology of TA-16 is described in Subsection 3.4 of the RFI Work Plan for Operable Unit 1082 (LANL 1993, 1094). However, significant additional information on the geology of TA-16 has become available during the last four years. These new data are described below.

The operations area at TA-16 is bounded on the south by Water Canyon and on the north by Cañon de Valle. Cañon de Valle is a tributary to Water Canyon; they join at the east end of TA-16. Water Canyon drains into the Rio Grande approximately 7 miles east of the easternmost boundary of TA-16.

Operational areas at TA-16 are located on the mesa tops, composed of Unit 4 (Qbt4) of the Tshirege Member of the Bandelier Tuff. Unit 3 (Qbt3) of the Tshirege Member of the Bandelier Tuff crops out on the mesa tops at the east end of TA-16 and in the bottoms and walls of Cañon de Valle and Water Canyon. Correlation of recent mapping at Material Disposal Area-P with the recently-released bedrock geologic map of Rogers (Rogers 1995, 1353) suggests that mesa top

portions of TA-16 are underlain by approximately 80-110 ft of Unit 4 of the Tshirege Member of the Bandelier Tuff.

At Material Disposal Area-P, Qbt4 is a lithologically complex unit consisting of in ascending order: (1) a poorly indurated, white to light-gray, nonwelded ignimbrite, (2) an indurated light tan, nonwelded, cliff-forming tuff overlain by a broad bench, (3) a varicolored, nonwelded cliff-forming tuff with devitrified base and a 10-ft thick glassy upper part, (4) a crystal-rich surge bed up to 1-ft thick, and (5) a hard, densely-welded tuff that forms the caprock for the mesa (Broxton et al. 1996, 1305). The latter subunit correlates with Unit Qbt1 and the first 3 units correlate with Unit Qbt4 of Rogers (Rogers 1995, 1353). The crystal-rich surge bed was mapped by Rogers as the boundary between the units Qbt4 and Qbt1. This high-permeability sandy parting may represent a possible perched zone - provided it also overlies a low-permeability zone. Examination of this contact in the walls of Cañon de Valle suggests that the surge bed is discontinuous. Rogers subunit Qbt4 contains a unit characterized by horizontal fractures that also may represent a possible perched-flow pathway. Recent drilling behind building TA-16-260 suggests that lithologic units in the subsurface at TA-16 are heterogeneous.

Qbt3 in Cañon de Valle adjacent to Material Disposal Area-P consists of two hard, pinkish-brown, partially to moderately welded, cliff-forming ignimbrites that are separated by a soft, pinkish-orange, nonwelded, slope-forming tuff. The uppermost subunit within Unit 3 contains significant horizontal fractures.

Detailed information on the mineralogy, modes, whole-rock chemistry, and outcrop characteristics of Unit 3 and Unit 4 at TA-16 are provided in Broxton et al. (Broxton et al. 1996, 1305).

A large, near-vertical fault, the Frijoles segment of the Pajarito fault zone, has been mapped to the west of TA-16. This fault is the largest segment of the Pajarito fault system in the Los Alamos area, with down-to-the-east displacement ranging up to 400 ft during the last 1.1 million years. Fault zones may provide pathways for water flow.

2.2.2 Soils

A discussion of soils in the Los Alamos area can be found in Subsection 2.5.1.3 of the IWP (LANL 1995, 1164). Soil at TA-16 is described in Subsection 3.4.3.2 of the RFI Work Plan for Operable Unit 1082 (LANL 1993, 1094). A recent study of background soils on the north and south slopes of Cañon de Valle near the TA-16 burning ground suggests that: (1) soil horizons ranged from 40 to 237 cm in depth, (2) soils are poorly developed and consist of A-R, A-Bw-R, or A-Bw-C soil profiles, and (3) soils are classified as Lithic Ustorthents, Typic Haplumbredt, Cumulic Haplumbredt, Typic Ustochrept, and Udic Paleoustalf soils (McDonald et al. 1996, 1354). No

detailed site specific soil surveys have been completed in the area where the PRSs covered in this report are located.

2.3 Hydrology

The hydrology of the Pajarito Plateau is summarized in Subsection 2.5.2 of the IWP (LANL 1995, 1164). The shallowest depth to groundwater at TA-16 is unknown. Shallow perched aquifers at TA-16 are quite heterogeneous. Several moderate depth (up to 200 ft) boreholes drilled at the TA-16 burning ground near Material Disposal Area-P did not intersect a saturated zone. Shallow (less than 100 ft) boreholes drilled at TA-16-260 between October 1996 and August 1997 do not contain saturated zones. The depth to the regional aquifer at TA-16 is estimated to be greater than 1000 ft. Four deep groundwater wells to the regional aquifer are scheduled in and around TA-16 as part of sitewide hydrogeologic studies scheduled for FY98 to FY05. These wells are proposed to be located: (1) in Cañon de Valle near Material Disposal Area-P (2) at the confluence of Cañon de Valle and Water Canyon (3) at New Mexico State Road 501 and Cañon de Valle, and (4) at New Mexico 501 and Water Canyon.

2.3.1 Surface Water

Surface water issues at TA-16 are described in Subsection 3.5.1 of the RFI Work Plan (LANL 1993, 1094). Additional information on surface waters at TA-16, collected since 1993, is summarized below.

Perennial and intermittent surface water exist at many locations at TA-16, due both to natural and anthropogenic sources. Cañon de Valle contains what appears to be a perennial reach, the surface water between TA-16-260 outfall and a location beyond Material Disposal Area-P has flowed continuously since initial investigations in 1992. Several intermittent saturated areas are present in small, tributary, drainages to Cañon de Valle and Water Canyon. Many of these zones are due to the discharge of process waters from TA-16 operations (Fig 2.3.1-1).

Surface waters in many of these locations have been analyzed as part of Framework Studies surface water characterization activities by New Mexico Environment Department (NMED) Agreement-in-Principle (AIP) personnel as part of their surveillance activities, and as part of non-RFI hydrogeologic sampling at TA-16. Information on constituents above background in surface waters is summarized below.

Surface waters in Cañon de Valle are contaminated with several constituents at levels above drinking water standards and above background levels. Barium in Cañon de Valle is up to 6 mg/kg,

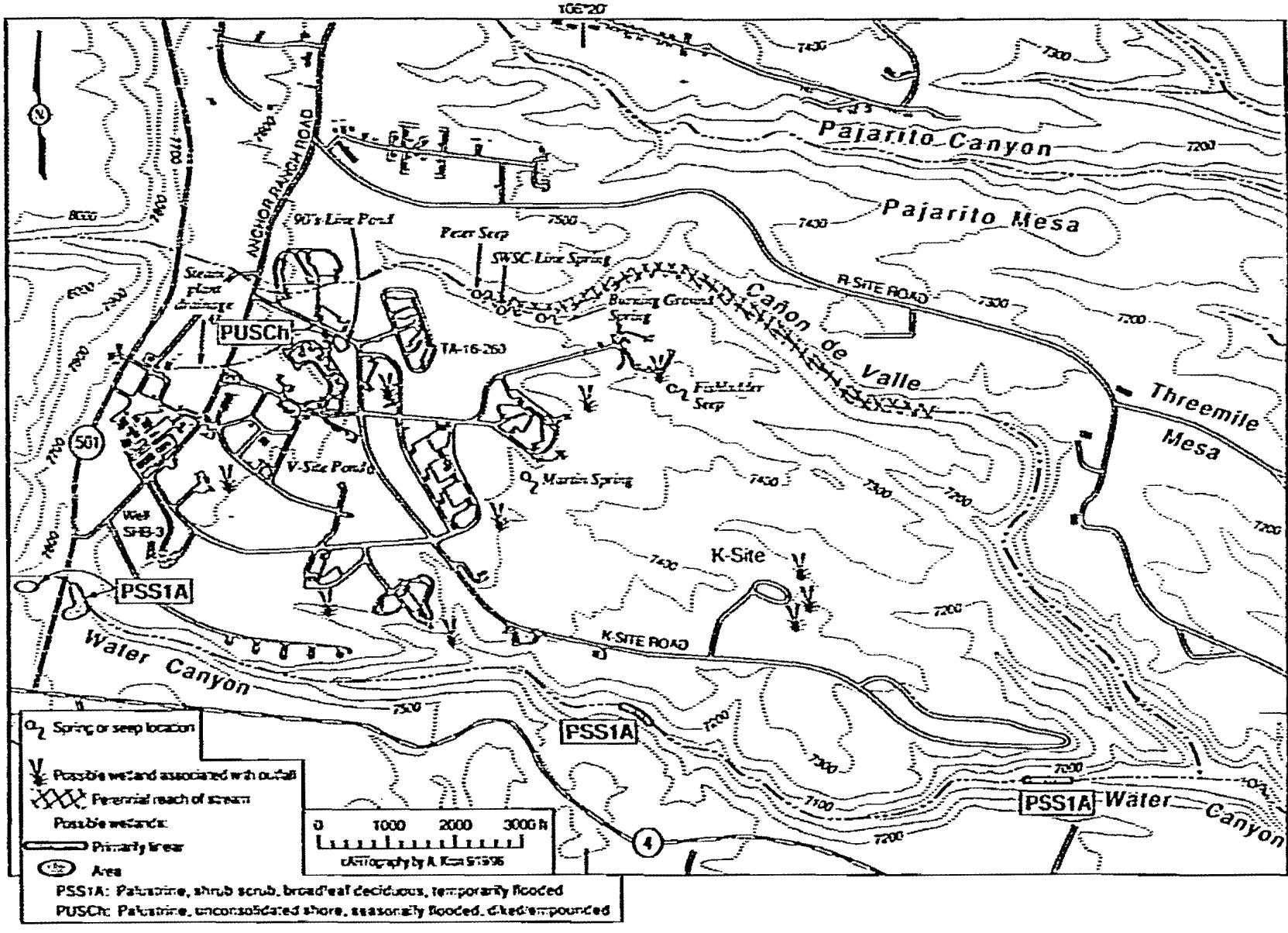


Fig. 2.3.1-1. Topography, springs, seeps, National Wetlands Inventory, and LANL-defined wetlands associated with National Pollution Discharge Elimination System (NPDES) HE outfalls (active and inactive) at TA-16.

which is above the New Mexico maximum concentration level (MCL) of 1 mg/kg. The high explosive RDX is also consistently at levels above 100 ppb, which is greater than the New Mexico MCL for that constituent. Several other constituents in Cañon de Valle are at levels above regional spring background including HMX, chlorine, sodium, and manganese. A detailed discussion of constituents in surface waters at TA-16 is provided in Appendix C to the RFI Report for Potential Release Sites in TA-16 - 16-003(k) and 16-021(c) (Environmental Restoration Project 1996, 1419).

Other surface waters at TA-16 that have anomalously high levels of constituents include the pond behind the 90s-Line, which contains barium at levels above the drinking water MCL and a surface water zone at potassium-Site, which contains barium and boron above background (Environmental Restoration Project 1996, 1419).

The PRSs described in this report are all located on level terrain in the west-central portion of TA-16. Most show no evidence of surface water runoff channels and most are vegetated with grasses.

2.3.2 Groundwater

Groundwater issues at TA-16 are described in Subsection 3.5.2 of the RFI Work Plan for Operable Unit 1082 (LANL 1993, 1094). Additional information on groundwaters, collected or reinterpreted since 1993, is summarized below.

Seismic Hazards Well SHB-3 drilled in November 1991, encountered groundwater, hypothesized to have been derived from a depth of between 350 to 750 ft (Gardner et al. 1993, 0848). This water may represent a perched zone or it could represent the regional aquifer. Water samples were taken from SHB-3 during the summer of 1993. These data show sporadic elevated values of lead, phosphate, rubidium, and ammonium relative to background spring data (Blake et al. 1995, 1355). Static water depth in SHB-3 was roughly 664 ft during 1992 (Environmental Restoration Group 1994, 1179)

Several springs and seeps have been identified at TA-16 during the past five years (Fig. 2.3-1). SWSC Line and Burning Ground spring discharge from within the uppermost, platy, subunit of Tshirege Unit 3. Martin spring apparently discharges from the lower portion of Tshirege Unit 4. All of the springs and seeps are contaminated with constituents (e.g. barium, boron, HE, solvents) at levels above background (Environmental Restoration Project 1996, 1419). All of these springs are also contaminated at levels above human health criteria for RDX. Martin spring appears to be most highly contaminated. The presence of these springs suggests the existence of one or more

perched zones at a shallow level beneath TA-16 (Environmental Restoration Project 1996, 1419). Most of the constituents in these springs are currently hypothesized to be derived from the significant contamination present at the TA-16-260 outfall, PRSs 16-003(k) and 16-021(c).

2.4 Biological Surveys

Biological surveys were performed at TA-16 before sampling. Appendix B of the RFI Work Plan for Operable Unit 1082 and Raymer (1990, 15-16-621) describes the results of field surveys for threatened, endangered, and sensitive species (LANL 1993, 1094). Ten plant and animal species of concern were identified in these surveys. These species were: the Jemez Mountain salamander, northern goshawk, peregrine falcon, Mexican spotted owl, broad billed hummingbird, pine marten, meadow jumping mouse, spotted bat, checker lily, and wood lily. Appropriate notifications and mitigation measures for each species were also identified in Appendix B of the RFI Work Plan for Operable Unit 1082. One of these species is known to reside in Cañon de Valle (Dunham 1996, 15-16-622; Raymer 1996 15-16-621).

Additional results of biological surveys and the habitat description for the PRSs described in this report will be included in the ecological RFI report prepared by the Decision Support Council Ecological Risk Assessment Team for the ecological exposure units in which these PRSs are located.

2.5 Cultural Surveys

As required by the National Historic Preservation Act of 1966 (as amended), a cultural resource survey was conducted during the summer of 1992 at Operable Unit 1082. The methods and techniques used for this survey conform to those specified in "Archeology and Historic Preservation, the Secretary of the Interior's Standards and Guidelines" (National Park Service 1983, 0632). A cultural resource survey has also been conducted in the area of the PRSs in this RFI report, as required by the National Historic Preservation Act (amended).

Thirty-three archaeological sites eligible for inclusion on the National Register of Historic Places under Criterion D are located within the survey area.

The attributes that make these sites eligible for inclusion on the National Register of Historic Places will not be affected by any ER Program sampling activities proposed at Operable Unit 1082.

3.0 APPROACH TO SAMPLE ANALYSES AND DATA ASSESSMENT

The approach to data assessment used by the ER Project is described in the "Technical Approach to Data Assessment for ER Project Site Characterization Decisions" (Knudson et al. 1996, 1299). The approach includes:

- sampling and analysis design,
- field investigation and collection of field and QA samples,
- chemical and radiological analyses of samples and reporting of analytical data,
- routine verification and validation of analytical data,
- organization of field and analytical data into PRS-specific data packages,
- exploratory data analysis,
- focused validation when necessary to further assess questionable data,
- comparison of validated analytical results with LANL background data,
- comparison of validated analytical results with SALs,
- assessment of human health risk, and
- formulation of decisions

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

3.1 Sample Analyses

Samples were collected in accordance with sample design specified in the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160) as modified in response to the EPA Notice of Deficiency (NOD) (EPA 1994, 15-16-644) and based on other issues raised by NMED comments on related ER Project work. During the sampling activities, field data were collected for each sample. This data includes unique sample identification number, location number, time and date of collection, soil type, sampling anomalies, etc. Field screening analyses were completed using photoionization detectors (PID), radiological screening instruments, the HE spot test, D-Tech™ immunoassay kits, and portable XRF. All samples requiring laboratory chemical and radiochemical analyses and chain-of-custody documentation were submitted to the Sample Management Office (SMO) for analyses. Samples with radionuclides as potential contaminants

were submitted to TA-21 for radioactivity screening, and screening results were submitted to the SMO before sending samples to off site laboratories.

3.1.1 Analytical Methods

High explosives are the principle chemicals potentially present at the sites included in this report. A minimum of four HE screening samples were analyzed using the D-Tech™ immunoassay kits at each PRS with the exception of PRS C-16-017. Two types of kits were used, one for RDX and one for TNT. Both have nominal detection limits of 0.5 mg/kg.

The following laboratory analytical suites were used for the sample analyses in this RFI report: inorganic chemicals, VOCs, SVOCs, HE, and radionuclides. A list of target analytes for which analyses were performed for 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, 1278). The allowed methods are current EPA SW-846 and Contract Laboratory Program (CLP) methods or equivalent. All solid samples for inorganic and organic analyses were digested using EPA's 3050 digestion procedure (EPA 1992, 1207) or equivalent. The subcontracts require the use of LANL-approved methods for radiochemical analyses for each of the technologies identified in the subcontract (e.g. multiple isotopes by gamma spectroscopy). Samples for uranium analysis were prepared by a total digestion procedure comparable to LANL/CST method ER 320, "Uranium in Environmental Matrices-KPA" (Gautier 1417).

Analytical method selection is described in Appendix II of the ER Project Quality Assurance Project Plan (QAPP) Requirements for Sampling and Analysis (LANL 1996, 1292). For each analyte, quantitation or detection limits are specified as contract required 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 QAPP along with the target analytes for each analytical suite, and their appropriateness for the investigations described in this report is discussed in Section 4.

3.1.2 Data Verification and Validation

Data verification and baseline validation procedures are used to determine whether analytical data packages have been generated according to specifications and contain the information necessary to determine data sufficiency for decision-making. Data verification includes ascertaining that data packages are complete, including results for all requested analyses and all supporting information such as chromatograms. It also includes the comparison of results

reported in the hard-copy data package with those delivered electronically and uploaded into the Facility for Information Management and Display (FIMAD). All field data and some (but not all) of the QC results in FIMAD have been verified by comparing electronic data with hard copy reports. Discrepancies are resolved in favor of the hard copy reports. All sample results presented in this report are in FIMAD.

For analytical data used for decisions discussed in this RFI report, baseline data validation was performed under the auspices of the SMO as described in the ER Project Quality Assurance Project Plan Requirements for Sampling and Analysis (QAPP) (LANL 1996, 1292). The product of this process is a validation report, including data qualifiers that designate potential deficiencies for affected results. Each data qualifier is accompanied by a reason code that provides information about how the deficiency might impact data use. Data qualifiers assigned by baseline validation, together with their reason codes, are also recorded in FIMAD. The validation report is used in the decision-making process, and it may also be used to direct a focused validation for evaluating the usability of the data of interest.

Data may be qualified for a variety of reasons during the baseline validation process, each of which may or may not limit the use of data for a specific purpose. It is important to recognize that qualified data (i.e., a result together with its assigned data qualifiers) generally have great utility. The baseline validation procedure is designed to provide information about the reason the qualifier has been applied and what its potential impact is on the affected data. The object is not to reject data but rather to ensure that its merit is understood and that the data are used appropriately. The use of qualified data in this report is consistent with EPA guidance (EPA 1992, 1166) and is further discussed in Section 4.0 of this report.

Data qualifiers used in the LANL ER Project baseline validation process are defined in Table 3.1.2-1.

TABLE 3.1.2-1
DEFINITION OF DATA QUALIFIERS ASSIGNED DURING BASELINE VALIDATION

U	Analyte was not detected above the reported EQL.
J	Analyte was positively identified, but the result is estimated to be more uncertain than would normally be expected for that analysis.
UJ	Analyte was not detected; the associated value is an estimate of the detection limit or quantitation limit.
J+	Analyte was positively identified, result is likely biased high.
J-	Analyte was positively identified, result is likely biased low.
P	Professional judgment should be applied, depending on proposed use of the data.
PM	Professional judgment should be applied before using the data. Manual review of the raw data is recommended.
R	Sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet QC criteria. Any results qualified as "R" should be further evaluated for relevance for data use. Thus "R" implies "PM".
RPM	Sample results should not be used without further review of the raw data.
A	Missing required QC data, or QC results not available to the baseline validator.

Focused validation was performed on several data packages as a follow-up to the baseline validation. The purpose of a focused validation is to determine the adequacy of reported results for their intended use when

- the data have been qualified as deficient or as requiring professional judgment during the verification/baseline validation process, or
- 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

Results of the data quality assessment process, including a review of baseline and focused validation results, are presented in Section 4 of this RFI report. Qualifiers assigned by baseline and focused validation are shown in the analytical results tables included in Section 5 of this RFI report. Summaries of data quality evaluations and focused validation of analytical data relevant to this RFI report are given in Appendix B.

3.2 Process for Identification of COPCs

3.2.1 Inorganic Chemicals

Detected inorganic chemicals are compared with natural background distributions to determine if they should be retained as COPCs or eliminated from further consideration. The inorganic background data used in this RFI report are from the following sources:

- Background comparison geochemistry issues, field identification of soil horizons, and statistical tests for background comparisons are discussed by Ryti et al. (1996, 1298)
- The most recent screening values for use in the "hot measurement comparison" (Ryti et al., 1996, 1298) were used. The UTLs are updated as more background information becomes available; the current values are available in FIMAD. The "all horizons" background soil screening values were used because the soil master horizon could not be identified in the disturbed material sampled for the investigations described herein.
- The FIMAD screening value for mercury was not used because it represents only the contract-required detection limit that was in effect when the background samples were analyzed. Background screening decisions for data in this report are based on results reported by Forenbaugh et al. (1990, 0099).

In this report, comparisons between site data and background data are performed by comparing each observed concentration datum with a chemical-specific background screening value that is either an UTL or the maximum reported concentration in the background data sets. The maximum reported concentration is used only for chemicals that are reported as undetected in most background samples (including mercury, antimony, cadmium, and selenium). The derivation of these background screening levels is discussed by Ryti et al. (1996, 1298). Inorganic chemicals below these background screening levels are not reported in the Section 5 data tables.

In the case of analytes that were never detected in background samples (such as silver), all detected results are considered to be above background and are reported in Section 5.

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 or to naturally occurring radionuclides and those used as indicators of the quality of the radiological measurement process. Determination of detection status by comparison with minimum detectable activities and other criteria is discussed in Section 4.2 of this report.

Detected radionuclides are retained as COPCs or eliminated from further consideration based on a comparison with natural or anthropogenic background distributions. Methods for these comparisons together with radionuclide background data are provided in (Environmental Restoration Decision Support Council and Earth Science Council 1997, 1414) and reviewed in Section 4. Sources of background data cited in that document include Longmire et al. (1995, 1266) and Fresquez et al. (1996, 1360).

In this report, comparisons between site data and background data are performed by comparing each observed concentration datum with a radionuclide-specific background screening value calculated as an UTL for the background data. Radionuclides detected below these background screening levels are not reported in the Section 5 data tables. In the case of radionuclides for which there are no applicable background data and no other guidance (as defined in Section 4.2), all detected results are considered to be above background and are reported in Section 5.

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 to the screening assessment process for the PRSs in this RFI report. Chemicals not detected in any sample have been removed from further consideration.

Based on previous investigations conducted by the ER Project, polycyclic aromatic hydrocarbons (PAHs) have been detected at multiple PRSs across the Laboratory and its surrounding area. In most cases, the presence of PAHs is not related to historical PRS operations, but rather is attributable to non-PRS activities such as runoff from asphalt roads, parking lots, or roofs, combustion of fossil fuels, or forest fires (ATSDR 1995, 1408; Bradley et al. 1994, 1144; Edwards 1983, 1407). In this report, PAHs are not attributed to historical PRS operations. Archival information regarding historical PRS operations, indicates non-PRS-related sources for these PAHs are asphalt and also forest fires, one of which burned within two miles of these sites in 1977). Also the low levels at which the PAHs are detected indicate these contaminants are not a result of historical operations.

In particular, at the one site where one PAH was detected above its SAL (benzo[a]pyrene), which has an extremely low SAL of 0.061 mg/kg, and was detected at 0.08 mg/kg, an entire suite of 11 PAHs were detected at low levels. This site, PRSs 16-025 (h), is in the highly disturbed 40s/90s line area and close to one of the main roads leading to the modern TA-16 operational areas.

3.2.4 Risk-Based Screening Assessment

Inorganic chemicals and radionuclides that exceed background, and organic chemicals positively identified in one or more samples and potentially attributable to PRS operations, 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 (EPA 1995, 1307). 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, the potential for additive effects of chemicals present below SALs must be considered, and a multiple chemical evaluation (MCE) is performed. The ratio of each chemical detected above background to its SAL is estimated. If the sum of these ratios exceeds one, then there could be a potential for additive effects even if no individual chemical was reported above its SAL. The method for performing this MCE calculation is summarized in the policy document Risk-Based Corrective Action Process (Dorries 1996, 1297). No PRS in this report contained ratios which approached one, and as a result, no COPCs remain after screening assessment. Because no COPCs remained after inspection of the data, NFA recommendations are proposed for the PRSs based on human health concerns.

3.3 Human Health Assessment

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

Background risks can result from inorganics that are naturally occurring for a site. 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., cancer risk of 1E-6 or hazard index of 1. Background risks can also affect decisions at sites that have constituents for which there is a threshold of toxicity. For some inorganics, background intakes may be near a toxicity threshold such that incremental intakes associated with contamination may be unacceptable.

Background risks calculated here use the same exposure assumptions by which SALs are calculated. SALs are based on health-protective assumptions for a residential scenario (EPA 1995, 1307). For soil exposure, the pathways include incidental soil ingestion, inhalation of resuspended dust, and dermal contact with soil. Because background soil data represent geographically diverse locations, background risks are estimated for both a median concentration and the UTL from the entire background data set to present the range of potential risk associated

with different soil constituent concentrations found in and around Los Alamos. The background risks based on the SAL residential exposure model are provided in Table 3.3.1-1.

Risks due to background are presented for both noncarcinogenic and carcinogenic outcomes. The potential for adverse noncarcinogenic health effects is estimated by a hazard quotient. Intakes leading to a hazard quotient up to 1 are 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, given the unlikely occurrence of this concentration, the conservative assumptions in the exposure assessment, the margin of safety in the reference dose, and the exceedance of less than a factor of two, this intake estimate is not expected to be associated with adverse health effects.

Four of the background inorganics are also carcinogens. According to the default exposure assumptions used for SALs, the lifetime cancer risks due to background residential soil exposure are estimated at 1 to 2 in 100 000 for each arsenic and beryllium.

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

TABLE 3.3.1-1
RISK DUE TO BACKGROUND CONCENTRATIONS OF INORGANIC CHEMICALS IN SOIL ASSUMING A RESIDENTIAL SCENARIO[a]

Soil Inorganic	Soil Concentration[b] mg/kg		Hazard Quotient		Lifetime Cancer Risk	
	Median	UTL	Median	UTL	Median	UTL
Aluminum	10 000	38 700	0.13	0.5	nc[c]	nc
Antimony	0.6	1.0[d]	0.019	0.032	nc	nc
Arsenic	4.0	7.82	0.18	0.36	1E-5	2E-5
Barium	130	315	0.025	0.059	nc	nc
Beryllium	0.895	1.95	0.0027	0.0059	6E-8	1E-5
Cadmium[e]	0.20	2.6[d]	0.0053	0.071	1E-10	2E-9
Chromium[f]	8.6	19.3	0.00009	0.0002	nc	nc
Cobalt	6.0	19.2	0.0013	0.0042	nc	nc
Copper	5.75	15.5	0.0021	0.011	nc	nc
Lead[g]	12	23.3	0.03	0.058	nc	nc
Manganese	320	714	0.84	1.9	nc	nc
Mercury	0.05	0.1[d]	0.0022	0.0043	nc	nc
Nickel	7.0	15.2	0.0047	0.01	nc	nc
Selenium	0.3	1.7[d]	0.00078	0.0045	nc	nc
Thallium	0.2	1.0[d]	0.033	0.16	nc	nc
Uranium	0.9	1.87	0.0039	0.0081	nc	nc
Vanadium	21	41.9	0.039	0.078	nc	nc
Zinc	30.7	50.8	0.0013	0.0022	nc	nc

nc = Noncarcinogen

a. Risk estimates are based on reference doses, slope factors, and EPA Region IX default exposure assumptions effective in April 1996.
b. Cancer risks for cadmium are based solely on inhalation of resuspended dust.
c. Not calculated
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.

3.3.2 Risk Assessment

No human health risk assessments were performed for these PRSs.

3.4 Ecological Assessment

In cooperation with the NMED 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 QUALITY ASSURANCE/QUALITY CONTROL ACTIVITIES

This section reviews the impact on data usability of laboratory QC results summarized in Appendix B of this report, as well as results from field QA samples and the overall performance of the HE field screening methods.

A total of 77 laboratory samples were collected from 29 PRSs in the decommissioned World War I area of TA-16 during summer of 1997. All samples were surface or near-surface (not more than 2 ft deep) soil samples. Fifty-six of these samples from 29 PRSs are discussed in Section 5 of this report. This section discusses results and associated QA/QC indicators for all 77 samples.

Four pairs of duplicate (field split) samples were collected. These are listed in Table 4.0-1.

TABLE 4.0-1
FIELD DUPLICATE SAMPLES

SAMPLE ID	SITE ID	DEPTH (ft)	PRS	DUPLICATE SAMPLE ID
0316-97-0592	16-4193	1-2	C-16-017	0316-97-0593
0316-97-0594	16-4012	1-2	16-025(p)*	0316-97-0595
0316-97-0596	16-4020	1-2	16-025(y)	0316-97-0597
0316-97-0598	16-4093	1-2	16-024(s)	0316-97-0599

* sample was collected from TA-16, however is not included in this report

LANL QC requirements for all routine sample analyses performed by external subcontractor laboratories are given in the Environmental Restoration Project analytical services statement of work (SOW) (LANL 1995, 1278). For routine organic and inorganic analyses, the LANL requirements are based either on requirements contained in the EPA CLP SOW or guidance provided in the EPA SW-846 guidelines. LANL requirements for the routine radiochemical analyses have been adapted from the EPA requirements for organic and inorganic analyses. Batch-specific QC samples, such as blank, matrix spike, and duplicate samples, must be analyzed at a frequency of one QC sample for each instrumental method, each sample matrix, and/or each analytical batch, whichever is more frequent. The inorganic and radiochemical methods also require the analysis of a laboratory control sample with each analytical batch. Known amounts of surrogates are added to most organic analyses, and their recovery during analysis provides a sample-specific QC measure. Tracers and carriers play a similar role for some radiochemical analyses, such as alpha spectrometry for uranium and plutonium isotopes. The LANL

requirements for the frequency of QC procedures that are not batch-specific, such as initial calibration and continuing calibration verification, adhere to EPA requirements for each specific organic and inorganic instrumental technique.

In addition to reporting results for QC samples and other QC procedures, analytical laboratories routinely supply qualifier codes with their results indicating which results may be affected by problems indicated by out-of-control QC results. These laboratory qualifiers, included in FIMAD, are to be distinguished from data qualifiers added by baseline or focused validation, which are discussed below. QC indicators that are not batch-specific (e.g., results for duplicate, blank, spike, and laboratory control samples), surrogate and tracer recoveries, and laboratory qualifiers are also available in FIMAD. Batch-specific QC indicators are not provided electronically in LANL's current electronic deliverable.

All of the data discussed in this report have also undergone baseline validation by data validators, who have access to all of the QA/QC indicators reported by the analytical laboratories including indicators that are not batch-specific such as initial and continuing calibration results. Where these indicators suggest that a result is of less than expected accuracy or precision, this is communicated to the data user both in hard copy validation reports and also by the assignment of data qualifiers that are recorded in the FIMAD database. Table 3.1.2-1 provides definitions of data qualifiers. As discussed in Section 3.1.2, the purpose of data qualification is not to reject data but rather to ensure that its merit is understood and that the data are used appropriately.

"U", meaning that the analyte was analyzed for but not detected, is the most common laboratory qualifier. For the sake of efficiency, baseline validators do not copy a laboratory "U" qualifier into the data qualifier field in FIMAD. If they agree with the laboratory "U", they leave the data qualifier field blank. Therefore, where the data qualifier field is empty and the laboratory qualifier is "U", the result is accepted as a nondetect.

After "U", the most commonly occurring laboratory and data qualifier is "J", indicating that the result is "estimated" (see Table 3.1.2-1). While there are other reasons why a result may be "J" qualified, by far the most common one is that the result lies between the instrument detection limit (IDL) and the EQL. Below the EQL, quantitation is less precise than above the EQL. Thus, the "J" qualifier most often indicates that a chemical has been detected, but at levels so low that it cannot be well quantified. This is not an indication of any deficiency in the data beyond the limitations inherent in the analytical method. "J"-qualified results are used freely in this report. Where the "J" qualifier has been assigned for some other reason, that is noted both in Appendix B and in the appropriate section of Section 5.

Where baseline validation or preliminary review of the data has indicated a need, additional focused data validation has been performed on some of the data discussed in this report. The purpose of focused data validation is specifically to assess the implications (if any) of identified deficiencies in the data for the decisions considered in this report. The results of focused data validation and consequent modifications to the data qualifiers assigned by the baseline validators are discussed in detail in the following subsections.

4.1 Inorganic Analysis

A total of 76 samples were submitted for inorganic analyses, including cyanide for four of the samples. Analyses were performed by four different laboratories. Batch-specific QC samples include at least one matrix spike and duplicate analysis per batch (for which material from one of the customer's samples is used), plus preparation blanks and in some cases laboratory control samples prepared by the analytical laboratory.

QA/QC results for these analytical requests are summarized in Appendix B. The methods used were adequate to detect all analytes at concentrations below their SALs, and most within background concentration levels. The QA/QC results were satisfactory for most requests. Exceptions are itemized in Table B-3 and further discussed below. Overall, the data are judged to be of adequate quality for their uses in Section 5 of this report. The remainder of this subsection discusses the results of focused validation and problematic areas in more detail.

Baseline data validation indicated that QA/QC information was unavailable for all analytes in requests 3334R, 3339R, 3343R and 3528R, for mercury in 3352R, and for a few of analytes in a few samples in 3334R. In all cases, this was because the matrix spike and duplicate analyses for the analytical batch were performed on a sample from a different request number, which is permissible under the terms of LANL's contracts with the analytical laboratories. In all but one case, the sample selected for these QC analyses was another of the samples associated with the investigations described in this report. In the exceptional case the selected sample was another field unit 3 TA-16 soil sample from the LANL ER Project. Therefore, the quality of the data is unaffected and the qualifier assigned by baseline validation ("A") has been removed from results in the four requests listed above.

Inorganic chemicals that are not readily detected at background concentrations by the methods used are antimony, cadmium, mercury, selenium, silver, and thallium. Other chemicals that cannot be well quantified over at least part of their background range are beryllium, nickel, cobalt, and sodium. When not reported as undetected, these chemicals are frequently qualified as "B" (estimated) by the analytical laboratory. Another common baseline data qualifier in these cases is

"P", often applied because the duplicate analysis was not within control limits (indicated by a laboratory qualifier of "*"). Duplicate recoveries outside control limits are not surprising when the chemical is present at background concentrations and these background levels are near the detection limit for the analytical methods. These "P" qualifiers have been replaced by "J" during focused validation (for example, silver in request number 3419R).

Antimony analyses were generally problematic throughout these investigations. Detection limits varied by more than an order of magnitude, from 0.7 to 11 mg/kg, depending on the instrumental method used by the laboratory. Background levels of antimony are less than 1 mg/kg, infrequently detectable by atomic absorption methods and not detectable by inductively coupled plasma emission spectroscopy (ICPES). Either method is acceptable under the terms of the LANL SOW (LANL 1995, 1278).

- Thirty-eight samples were analyzed by one laboratory providing a detection limit in the range of 0.7 to 0.75 mg/kg (requests 3334R, 3352R, 3440R, 3443R and 3528R). No antimony was detected in these samples, although some results were qualified as estimated undetected by baseline validation because matrix spike recoveries were low (48 to 53%). However, because the reported detection limit is less than 3% of SAL (which is 31 mg/kg), the potential negative bias is insignificant. Because the reported detection limit is also below the UTL for antimony, no results from these 30 samples appear in the data tables of Section 5.

- A second laboratory provided detection limits of 4 to 5 mg/kg for six samples (request 3320R), in which no antimony was detected and for which all QC indicators were satisfactory.

- A third laboratory, which analyzed 20 samples in requests 3419R and 3459R, had detection limits from 6 to 9 mg/kg. Antimony was detected at 14.2 mg/kg in one sample (0316-97-0566 from PRS 16-025(*n*). The remaining, non-detect results were qualified UJ by baseline validation because matrix spike recovery was below 75% (52% for 3419R and 68% for 3459R). Again, the reported detection limits are far enough below the SAL that the potential negative bias is not significant.

EPA guidance (EPA 1992, 1166) states that " 'UJ' qualified data can be used to represent background concentrations for establishing an observed release when there is confidence that the background concentration is not detectable above the contract required quantitation limits (CRQL)". This is the case for antimony, for which the CRQL in soil is 12 mg/kg. Based on this guidance, all reported antimony data from this laboratory, including non detects at all levels as well as estimated results, are used in this report. The undetected values are excluded from Section 5 tables.

- Finally, all antimony data from the fourth laboratory (13 samples from request 3403R) were provisionally rejected ("RPM") by baseline validation because of a problem with the continuing calibration. These results were uniformly reported as undetected with a detection limit of 10 to 11 mg/kg. Also in this laboratory batch, recovery for the matrix spike was 26.4%, while recovery for the laboratory control sample was 48.3%. Following focused validation, these results were rejected as unusable for this report.

Antimony has not been implicated by historical information as a likely contaminant for the sites under investigation in this report. In addition, more than 700 samples from TA-16 have been analyzed for antimony, and antimony has been detected in only about 1% of the sample, and never at more than 50% of SAL. Based on these considerations, the lack of antimony data for PRSs 16-025(h) and 16-034(c,d,e,f) is not considered critical.

Mercury is problematic primarily because of the lack of comparable background data. Existing background data for soils (Ryti et al., 1996, 1298) is reported at or below an estimated quantitation level (EQL) of 0.1 mg/kg, while current data are being reported (usually as "estimated" or "B" qualified) as low as 0.01 mg/kg. In this report we use the only other available local background data, that of Ferenbaugh et al. (1990, 0099) to determine whether the data indicate the presence of mercury above background levels. Their data, all of which was collected from an undeveloped part of Sigma Mesa in 0-2" soil samples, indicate a range of up to 0.029 mg/kg of mercury. Only detected results at or above 0.03 mg/kg are reported in Section 5.

Many of the selenium results were qualified by baseline validation, usually because of low matrix spike recoveries. However, all reported detection limits and detected results were within the background range and below the SAL. Selenium has not been implicated by historical information as a likely contaminant for the sites under investigation in this report. It has been detected above background levels in fewer than 1% of TA-16 samples to date, and then only at levels that are less than 2% of the SAL. Therefore the results for these analytes are accepted as reported. In particular, results qualified by baseline data validation as "UJ" (estimated undetected) are evaluated as non-detects for the purposes of decision making in Section 5. No selenium results appear in the Section 5 data tables because all are below the UTL for selenium in soils.

Inorganic results for the field duplicate pairs listed in Table 4.0-1 were within 15% of each other in all cases except for the copper and lead results for samples 0316-97-0594 and 0316-97-0595, in which the relative standard deviations were up to 30%. These results are comparable to, or better than, results for laboratory duplicates, for which the relative standard deviations for lead and copper exceeded 15% in two of nine laboratory duplicate analyses provided with the samples discussed in this report. Thus sample collection, handling and shipping have not increased the

variability in the results over what would naturally be obtained from heterogeneity within the sites and analytical error.

In summary, the quality of the inorganic analyses provided is adequate to support the decisions described in Section 5.

4.2 Radiochemistry Analysis

A total of 10 samples were submitted for gamma spectroscopy plus radium-226 analysis by alpha spectroscopy. Nine samples were submitted for strontium-90 analysis, 10 for isotopic uranium analysis, three for total uranium, and two for isotopic plutonium. Radiochemistry analyses were performed by two different laboratories. Batch-specific QC samples for isotopic analyses include at least one matrix spike and duplicate analysis per batch (for which material from one of the customer's samples is used), plus preparation blanks, blank spikes, and laboratory control samples prepared by the analytical laboratory. Tracers are used in the isotopic uranium and plutonium analyses, and carriers in the strontium-90 and radium-226 analyses. Batch-specific QC for total uranium is similar to that used for inorganic analyses.

The methods used were adequate to detect all analytes implicated by historical information below their screening action levels and most within background concentration levels. The QA/QC results were satisfactory for most requests. Exceptions are itemized in Appendix B and further discussed below. Overall the data are judged to be of adequate quality for the uses to which it is put in Section 5 of this report. The remainder of this subsection discusses use of these data and the results of focused validation in more detail.

Activities of radium-226 and uranium-235 can be measured by both alpha and gamma spectrometry. Where results are reported by both gamma and alpha spectrometry for a given sample, only the more accurate alpha spectrometry result is used. Thus no radium-226 gamma spectrometry results, and only two uranium-235 gamma spectrometry results, are retained for use in Section 5.

Gamma spectrometry measures a very large number of analytes, many of which are of no interest for this investigation although they are important in evaluating the overall quality of the analysis. Gamma emitters identified on the basis of historical evidence for the sites under investigation were cobalt-60, radium-226 and uranium-235, but as explained above alpha spectroscopy is the preferred analytical method for the latter two of these.

Several gamma-emitting isotopes are used solely as radiological process indicators (ER DSC and ESC 1997, 1414). These include potassium-40, strontium-85, cadmium-109, and annihilation

radiation, all of which were detected above minimum detectable activity (MDA) levels in at least one analysis of the samples discussed in this report. These radiological indicators are not considered further. In addition, several short-lived isotopes in the decay chains of uranium-238, uranium-235 and thorium-232 are observed at the levels that are consistent with the presence of uranium and thorium in these soils at background levels. As daughters of the longer-lived radionuclides that head these decay chains, they are expected to be in approximate secular equilibrium with the latter, that is, to be found at approximately the same levels of activity, although because they are so short-lived they are measured with greater statistical variability. Thus these results also serve as indicators that the measurement process is under control. Table 4.2-1 lists these analytes if they were detected above MDAs, together with the maximum reported value (with the qualifier applied by baseline validation, if appropriate). These analytes are excluded from Section 5 tables.

TABLE 4.2-1
SHORT-LIVED NATURALLY OCCURRING RADIONUCLIDES

Isotope	Decay chain	Half-life[a]	Maximum (pCi/g)	UTL (pCi/g)[b]
Actinium-228	Thorium-232	6.13 h	1.71	3.3
Bismuth-211	Uranium-235	2.16 m	2.8(J)	NA
Bismuth -212	Thorium-232	60 m	2.96(U)	NA
Bismuth -214	Uranium-238	19.7 m	1.61	1.39
Lead-212	Thorium-232	10.6 h	2.28	2.36
Lead-214	Uranium-238	26.8 m	1.43	1.97
Radium-224	Thorium-232	3.64 d	3.88	NA

a m = minutes, h = hours, d = days

b These values are based on sediment, not soil samples. NA indicates that no UTL has been calculated. (ER DSC and ESC 1997, 1414)

The remaining detected isotopes, together with the analytical methods used, SALs, and MDAs, are given in Table 4.2-2. A comparison of the MDAs with the SALs indicates that the radiochemical methods employed were sufficiently sensitive to detect all potential radiological contaminants in soil at concentrations below SALs, except for radium-226. However, the soil SAL for radium-226 is well below the background levels of this radioisotope, which is in the decay chain of uranium-238 and is observed in uncontaminated soils at approximately the same levels of activity as uranium-238 and uranium-234 (i.e., up to about 2.3 pCi/g). Alpha spectrometry can detect radium-226 well below this level.

TABLE 4.2-2.
ANALYTES, MDA AND ANALYTICAL METHODS FOR LONG-LIVED RADIONUCLIDES

Analyte	Half-Life (yr)	Soil SAL (pCi/g)	MDA (pCi/g)[a]	Analytical Method
Americium-241	432.2	22	0.35	Gamma-Spectrometry
Cobalt-60	5.27	1.1	0.06	Gamma-Spectrometry
Cesium-137	30.17	5.1	0.05	Gamma-Spectrometry
Neptunium-237	2.14×10^6	1.9	0.33	Gamma-Spectrometry
Plutonium-238	87.7	27	0.1	Alpha-Spectrometry
Plutonium-239/240[b]	2.4×10^4	24	0.1	Alpha-Spectrometry
Radium-226	1602	0.1	0.25	Alpha-Spectrometry
Strontium-90	28.8	4.4	1.0	Gas proportional counter
Uranium-234	2.46×10^5	13	0.04	Alpha-Spectrometry
Uranium-235	7.04×10^8	10	0.04	Alpha-Spectrometry
			0.06	Gamma-Spectrometry
Uranium-238	4.47×10^9	67	0.03	Alpha-Spectrometry
Total uranium[c]	NA	29	0.5	KPA with total digestion

a Reported MDAs are sample specific. Some laboratories report MDLs (method detection limits based on a blank sample) instead of MDAs. Typical figures for the data in this report are provided.

b The plutonium-239 and plutonium-240 isotopes cannot be distinguished by alpha spectrometry. The half-life of plutonium-239 is given.

c The SAL and MDA for total uranium are reported in mg/kg. Natural uranium is a mixture of uranium-234, uranium-235 and uranium-238, in which uranium-238 predominates by weight (about 99.3%) but uranium-234 and uranium-238 are present at about equal levels of activity.

In evaluating results for the analytes included in Table 4.2-2, detection status was determined first by comparison with the MDA, if an MDA was reported. Baseline validation further qualified many analytes as undetected when the result was less than five times the amount found in the blank, or when it was less than the EQL (provided for isotopic uranium results only). Because gamma spectrometry is subject to interferences from sources from which the instrument can not be

shielded, the detection of analytes in a blank does not indicate a problem with the analysis. Rather, blank analyses are used for calibration of the gamma spectrometry process.

Only results above the MDA for analytes that are not radiological indicators, are not one of the short-lived naturally occurring radionuclides in Table 4.2-1, and were not qualified as undetected by baseline validation, are reported in Section 5. These may include a few analytes in addition to those listed in Table 4.2-2 for which SALs are not calculated because their half-lives are less than half a year (for example, lanthanum-140 has a half-life of 40.3 hours).

The only laboratory QC problem affecting the analytes in Table 4.2-2 that was identified by baseline validation is the high bias imputed to sample 0316-97-0572 from PRS 16-034(f) for uranium-235 in request number 3404R, because recovery in the laboratory control sample was reported above the acceptable limit. In addition, there was no information available to baseline validators to assess the radium-226 analyses in request number 3420R. However, all radium-226 results reported in request number 3420R are within the background range.

In summary, the quality of the radiochemical analyses provided is adequate to support the decisions described in Section 5.

4.3 Organic Analyses

4.3.1 Semivolatile Organic Analyses

A total of 77 samples were submitted for semivolatile organic analyses. Analyses were performed by four different laboratories. QA/QC results for these analytical requests are summarized in Appendix B. Batch-specific QC samples vary among laboratories. Most include at least a blank, and often a blank spike and spike duplicate analysis (samples prepared by the analytical laboratory). Some use customer samples for matrix spike or duplicate analyses. Several surrogates are analyzed in each sample.

The methods used were adequate to detect most analytes below their SALs. The QA/QC results were satisfactory for most samples; exceptions are itemized in Appendix B and discussed below. Overall, the data are judged to be of adequate quality for the uses to which it is put in Section 5 of this report. The remainder of this subsection discusses the results of focused validation and problematic areas in more detail.

Detected semivolatile organic chemicals include:

- phthalates, a common laboratory contaminant, detected at 5% of their SALs or less;

- PAHs, which are common in industrialized areas especially in association with asphalt, at levels of less than 2 mg/kg (see Section 3.2.3); and
- a small number of other chemicals, benzoic acid, chloronaphthalene(2-), methyl-naphthalene(2-), phenol and chorophenol(2-), none of which were detected above 2% of their SALs.

Many undetected analytes were requalified "UJ" by baseline validation, most often because an internal standard was out of control (see Table B-4). Based on focused validation, which looked at other available indicators, and examination of unqualified data from the same or nearby sites, it was determined that these analytes were unlikely to have been present in the sample, and the non detect status indicated by the laboratory is accepted for the purposes of Section 5. Detected chemicals for these samples were qualified as estimated ("J").

In the case of request number 3401R, five samples were reanalyzed because an internal standard was out of control. There are no differences in the reported results except for the single detected result, a J-qualified result of 0.097 mg/kg bis(2-ethylhexyl)phthalate in the reanalysis of sample 0316-97-0561 from PRS 16-034(l), slightly higher than the original detected result of 0.091 mg/kg.

Extraction holding times were missed by one or two days for nine of the eleven samples in request number 3457R. Recent EPA findings indicate that minor deviations from the extraction holding times have little effect on sample results for solid samples (West et al. 1997, 1416). The data were accepted as reported, but qualified as "J" if detected and "UJ" if undetected. The nine samples come from PRSs 16-025(b2 and k).

Low-level PAHs were detected in one pair of field duplicate samples (0316-97-0594 and 0316-97-0595). Relative standard deviations were less than 10% except for phenanthrene, which was reported at 0.28 and 0.19 mg/kg, respectively. Except for pyrene, all results were below the EQL. Thus sample collection, handling and shipping have not increased the variability in the results over what would naturally be obtained from heterogeneity within the sites and analytical error.

In summary, no semivolatile organic chemicals were reported at levels of concern in any of the samples discussed in this report, and a review of the data suggests no reason to suspect that they were present in any samples at such levels despite a number of minor problems with the analyses.

4.3.2 Field Screening for High Explosives

The majority of samples selected for laboratory analysis at the sites evaluated in this report were selected based on low but positive field screening results for RDX (a nitramine/nitrate ester) or TNT (a nitroaromatic) obtained using D-Tech™ immunoassay kits. In spite of this, HE (specifically, RDX) was detected in only two of these laboratory samples. This finding is in agreement with published studies of these kits. One such comparative study of HE field screening kits, such as D-Tech™, indicated that at levels of approximately 1 ppm, these kits "... had significant positive bias...sometimes resulting in false positives..." (Crockett et al. 1997, 1411). This positive bias has been attributed to the presence of humic substances, naturally occurring colored compounds, which are present in soil and which are extracted along with the HE, interfering with visual or colorimetric evaluation of the extract. As a result, "... on-site method results are biased high as compared to laboratory results." (Crockett et al. 1996, 1412). No false negatives were reported in this comparative study. Thus the field screening methods used in these investigations tend to err in the direction of incorrectly identifying the presence of HE.

The D-Tech™ kits have a detection range of 0.5 to 5 mg/kg, and produce semiquantitative results (concentration ranges) as reported in Section 5. This range is appropriate for the samples at the sites under investigation here, at which high levels of HE were not anticipated, and are below their SALs for RDX and TNT (4 and 15 mg/kg, respectively). Higher detection ranges are achievable via sample dilutions.

4.3.3 Laboratory Analyses for High Explosives

A total of 74 samples were submitted for HE analyses. Analyses were performed by two different laboratories. Batch QC samples include a method blank and a blank spike (laboratory control sample), and one laboratory also includes matrix spikes and matrix spike duplicates. One surrogate was analyzed in each sample.

The methods used were adequate to detect all analytes below their screening action levels. No data were qualified by baseline validation (Appendix B). There were only two detected results, RDX in sample 0316-97-0530 from PRS 16-015(c) and RDX and HMX in sample 0316-97-0538 from PRS 16-025(a2). (These PRSs are not discussed in Section 5.)

No HE was detected in any of the field duplicate samples (Table 4.0-1).

Overall the data are judged to be of adequate quality for the uses to which it is put in Section 5 of this report.

5.0 SPECIFIC RESULTS, CONCLUSIONS, AND RECOMMENDATIONS

This RFI report discusses the Phase I sampling and analysis for 29 PRSs (Fig 5.0-1). Site information, results and analyses, and evaluation of contamination are presented in this section. All samples were screened in place for radioactivity and volatile organic compounds and were within background levels. All of the samples screened low or no detect for RDX, TNT, metals, and BTEX when such screening was performed. The screening results were used to bias the samples that were submitted to the laboratory for confirmation sampling.

All of the PRSs in this report were evaluated for surface water concerns during FY 1997 in accordance with LANL-ER-AP-4.5, "Evaluation and Notification of Potential Surface and Ground Water Concerns at Environmental Restoration Sites". All of these sites are located on level ground, none exhibit evidence for significant runoff channels. Thus, none of the sites were ranked as high-priority surface-water sites based on the AP 4.5 review.

No contamination was present above SALs in 28 PRSs. Contamination was present above one SAL in 16-025(h), however not at levels that a present risk to human health. All of the PRSs are recommended for human-health NFA based on NFA Criterion 5 because contamination is not present at levels that present risks to human health. NFA Criterion 5 is: "The PRS has been characterized or remediated in accordance with current applicable state or federal regulations, and the available data indicate that contaminants pose an acceptable level of risk under current and projected future land use" (Project Consistency Team 1996, 1210).

5.0.1 Polynuclear aromatic hydrocarbons without SALs

A select group of Polynuclear aromatic hydrocarbons (PAHs) without SALs were detected at the PRSs presented in this report at low detection frequencies, and at low concentrations (low parts per million). Infrequent detections of these compounds at low concentrations do not represent a contamination problem posing a potential risk to human health or the environment. SALs are not available for these compounds due to the absence of EPA-accepted toxicity criteria to calculate screening values. In general, the potential impacts from the low detections of these compounds is addressed during the evaluation of the PAHs that do have toxicity criteria and SALs. The PAHs consist of a large family of compounds with a rather large range of toxic potency. In calculating site risks, EPA and most state agencies separate the PAH into two categories: carcinogens and noncarcinogens. Carcinogenic PAH are evaluated by considering the available data on the carcinogenic potency of different PAHs to develop toxicity equivalency factors (TEFs) for the individual PAHs. These TEFs indicate the carcinogenic potency of each compound relative to

benzo(a)pyrene (BaP). Consequently, the PAHs analyzed that do have SALs encompass a substantial portion of the risk due to low levels of these compounds in soils.

The list of PAH without SALs in this report includes: benzo(g,h,i)perylene, a noncarcinogenic PAH; phenanthrene, a noncarcinogenic PAHs very similar to pyrene; and 2-methylnaphthalene, a noncarcinogenic PAH very similar to naphthlene. All of the non-carcinogenic PAHs have SALs greater than 1000 mg/kg. The non-carcinogenic PAHs without SALs are likely to have SALs of equivalent magnitude. Because the PAHs without SALs were detected infrequently and at concentrations that are orders of magnitude below SALs for similar compounds; the evaluation of PAHs is considered to be complete after the evaluation of PAHs with SALs available.

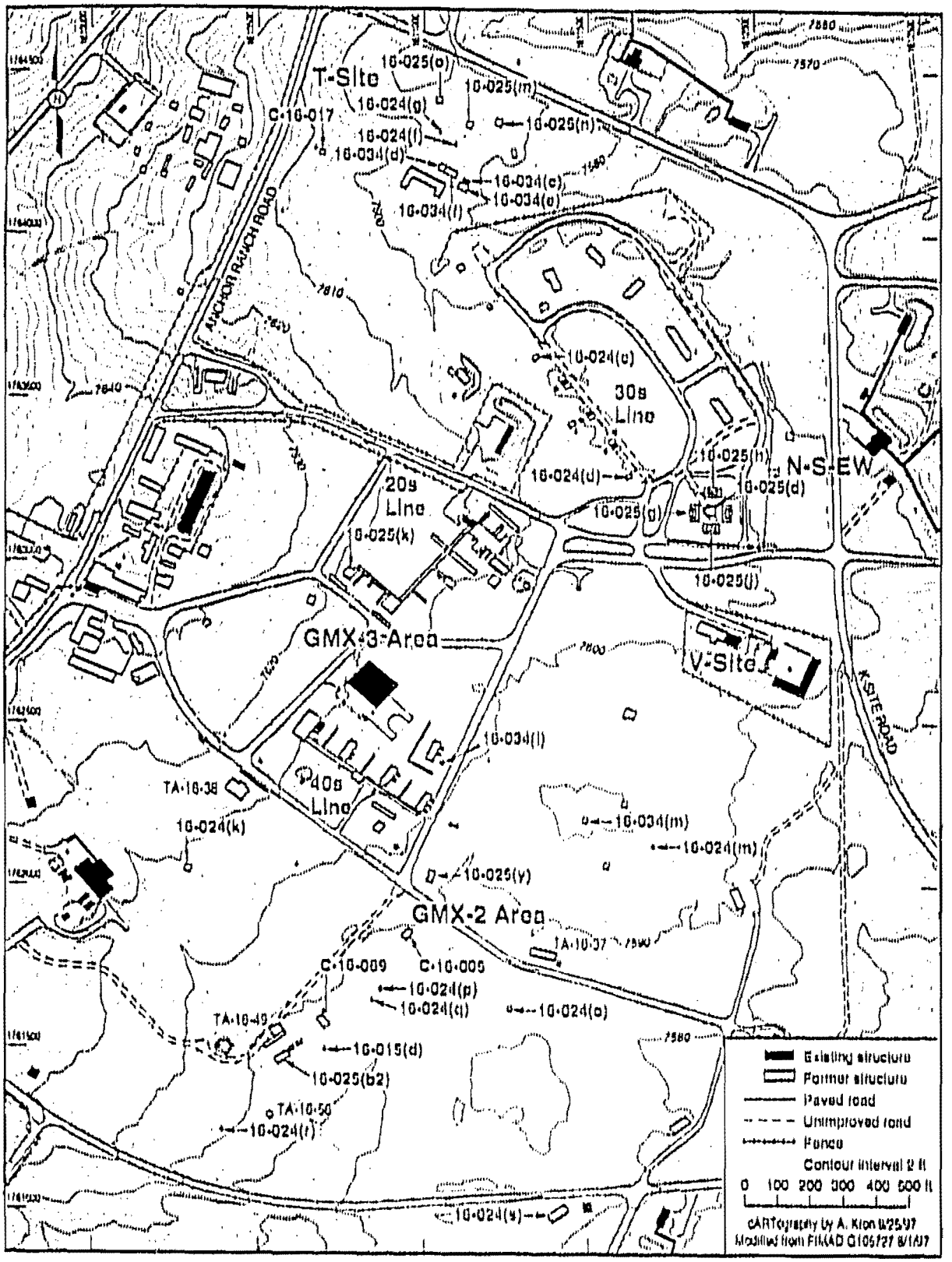


Fig. 5.0-1 Locations of PRSs in this RFI report.

5.1 PRS 16-024(c)

This PRS is the site of former HE magazine TA-16-30, located in the northern portion of World War II TA-16 (GMX-3 area). It is recommended for human-health NFA because contamination is not present at levels that present a potential risk to human health.

5.1.1 History

PRS 16-024(c) is discussed in detail in Subsection 5.19 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

TA-16-30 stored raw HE powder or finished HE product. HE magazines were used to store packaged HE and finished HE products before and after processing. No HE processing was done in such magazines. It stored castings to be machined at TA-16-31, TA-16-32, and TA-16-33. The building contained no sumps or plumbing. The magazine was built in June 1945. It was regarded as HE contaminated when it was surveyed in the 1950's (Engineering Department 1959, 15-16-256), and abandoned in December 1959. It was intentionally burned in 1960 (Wingfield 1960, 15-16-117).

The potential contamination at this PRS was identified as metals, SVOCs, and HE.

5.1.2 Description

The magazine was 12 ft wide x 17.5 ft long x 8 ft high and of wooden-frame construction with a concrete floor. The magazine was bermed on three sides and on top. This magazine was located within the 30s-Line on level terrain.

5.1.3 Previous Investigation(s)

No previous investigations were conducted at this PRS.

5.1.4 Field Investigation

The goal of the Phase I investigation at PRS 16-024(c), as outlined in the approved RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized

to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect residual HE in the surface and near-surface soil at the site of the magazine footprint. The mode of decommissioning of the magazine and the fact that magazines were used for HE storage, but not for HE processing suggest that residual contamination is unlikely at this PRS.

Addendum 1 specified screening soil samples, 0 to 1 ft depth intervals, from four locations and selecting one laboratory sample only if positive field screening results were obtained. The plan called for taking the samples at the four quadrants of the building. The laboratory sample was to be selected from the screening samples using the following prioritized biasing scheme: (1) a sample with positive HE spot test kit results; and (2) a sample with above-two-times background radiation readings. In response to an EPA NOD (EPA 1994, 15-16-844), screening samples were collected from 1 to 2 ft depth intervals (as well as the required 0 to 1 ft intervals) to confirm that the soil beneath this concrete floored building had not been disturbed during decommissioning, and one laboratory sample was collected (based on the above scheme) even if all field screening results were negative.

Two deviations were made from the work plan.

- A fifth screening location was selected at the former location of the door because the door location is a likely place for spills to have occurred or for material to have been swept out of the structures.

- The screening samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of 10 field screening samples were taken from five locations in the building footprint. The samples were collected from 0 to 1 ft and 1 to 2 ft depth intervals. The field screening samples

were taken near the corners of the four quadrants of the building and near the location of the door (Fig. 5.1.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for the operations in this building, which had concrete floors, is hypothesized to be via either: (1) HE spills near door areas; or (2) leakage at the floor/wall joints.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). The 0 to 1 ft interval samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050). The 0 to 1 ft intervals were selected for further characterization, rather than the 1 to 2 ft intervals, because the soil beneath the PRS structure is undisturbed, as confirmed by the soil descriptions in the sample collection logs. If contamination is present within the structure footprint, it is most likely present at shallow depths directly beneath the structure. The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. Two samples screened positive for HE using the D-Tech™ kit (Table 5.1.4-1).

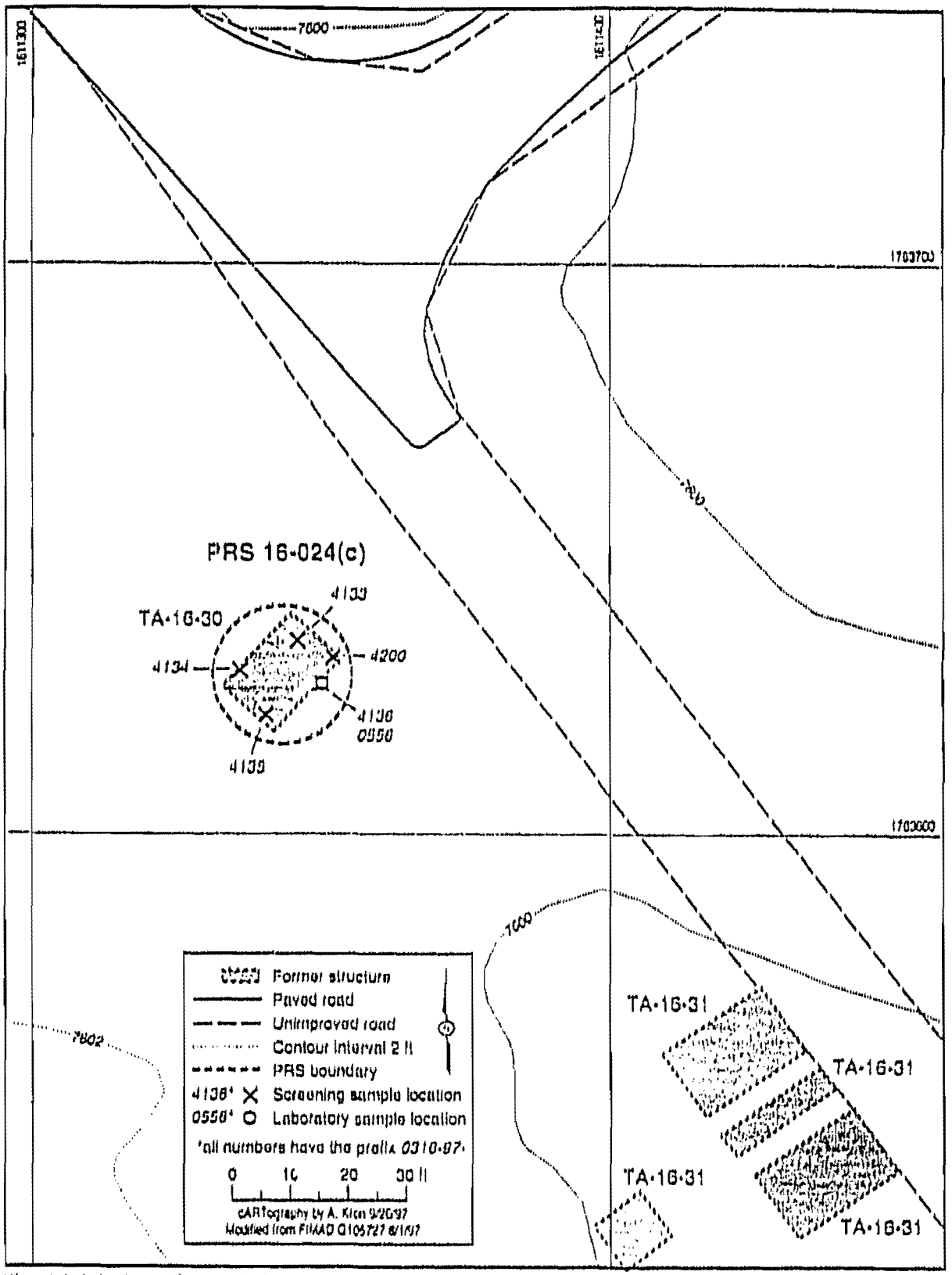


Fig. 5.1.4-1 Locations of PRS 16-024(c) samples.

TABLE 5.1.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4133 northeast quadrant	16-4133	0 - 1	NA[a]	negative	background	< 0.5	0.5 - 1.5
0316-97-4134 northwest quadrant	16-4134	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4135 southwest quadrant	16-4135	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4136 southeast quadrant	16-4136	0 - 1	0316-97-0556	negative	background	< 0.5	0.5 - 1.5
0316-97-4200 door	16-4200	0 - 1	NA	negative	background	< 0.5	< 0.5

a. NA = Not analyzed.

Screening sample 0316-97-4136 contained 0.5 to 1.5 mg/kg TNT and was located in the downgradient (southeast) part of the building footprint. This sample was submitted to the laboratory for analysis (Table 5.1.4-1). The sample was analyzed for metals, SVOCs, and HE (Table 5.1.4-2)

TABLE 5.1.4-2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES FOR PRS 16-024(c)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MATRIX	INORGANICS	SVOCS	HE
16-4136	0316-97-0556	0 - 1	soil	3440R	3438R	3439R

5.1.5 Evaluation of Inorganic Chemicals

No inorganic chemicals were present at levels greater than background UTLs at PRS 16-024(c). Baseline validation indicated no problems that affect the use of these inorganic data.

5.1.6 Evaluation of Radionuclides

Radionuclides were not analyzed for at PRS 16-024(c) because historical evidence indicated that radioactive material was not stored or used in this HE magazine. Additionally, field screening did not indicate the presence of radioactive constituents.

5.1.7 Evaluation of Organic Chemicals

No HE was detected in sample 0316-97-0556, despite indications of the presence of TNT in the associated field screening sample. The positive D-Tech™ result, which suggested that low levels of TNT were present, was not confirmed by the fixed laboratory analysis. The D-Tech™ kits have been shown to provide false positives due to interferences with humic materials. See Section 4.3.2 for further details.

No organic chemicals were detected in sample 0316-97-0536. Baseline validation indicated no data quality problems associated with these analyses that affect the use of these organic data.

5.1.8 Risk-Based Screening Assessment

No screening assessment was performed because no chemicals were present at or above UTLs or EQLs at PRS 16-024(c).

5.1.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-024(c) because contamination was not detected at or above SALs.

5.1.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.1.11 Conclusions and Recommendations

Ten screening samples and one laboratory sample were collected in and adjacent to the footprint of the former HE magazine TA-16-30. The laboratory sample was selected from one of two screening samples that screened positive for HE. It was located in the downgradient (southeast) part of the building footprint. The laboratory sample contained no inorganic or organic contamination above detection limits.

The biased sampling and analysis strategy at this former magazine was designed to ensure that residual contamination would be detected if present within the PRS. Screening locations and depths were selected based on information about the location, orientation, construction, use of the former building, and mode of decommissioning. Because the likelihood of contamination

within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, a single confirmatory laboratory sample is sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory sample was selected from screening samples based on field screening results, and was analyzed for all potential contaminants based on historical knowledge of operations in TA-16-30.

PRS 16-024(c) is recommended for human-health NFA based on NFA Criterion 5 because contamination is not present at levels that present a potential risk to human health.

5.2 PRS 16-024(d)

This PRS is the site of former HE magazine TA-16-34, located in the northern portion of World War II TA-16 at GMX-3 area (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.2.1 History

PRS 16-024(d) is discussed in detail in Subsection 5.19 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

Magazine TA-16-34 stored raw or finished HE product and machined product for physical and x-ray examination. HE magazines were used to store packaged HE and finished HE products before and after processing. No HE processing was done in such magazines. The magazine contained no sump or plumbing. It was built in June 1945. The structure was not burned with the other nearby magazines in 1960, but it had caved in. The structure was demolished at a later, unknown, date.

The potential contamination at this PRS was identified as metals, SVOCs, and HE.

5.2.2 Description

The magazine was 12 ft wide x 17.5 ft long x 8 ft high and of wooden-frame construction with a concrete floor. It was bermed on three sides and on top. The magazine was located within the 30s-Line on level terrain.

5.2.3 Previous Investigation(s)

No previous investigations were conducted at this PRS.

5.2.4 Field Investigation

The goal of the Phase I investigation at PRS 16-024(d), as outlined in the approved RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect residual HE in the surface and near-surface soil at the site of the magazine footprint. The mode of decommissioning of the magazine and the fact that magazines were used for HE storage, but not for HE processing, suggests that residual contamination is unlikely at this PRS.

Addendum 1 specified screening soil samples, 0 to 1 ft depth intervals, from four locations and selecting one laboratory sample only if positive field screening results were obtained. The plan called for taking the samples at the four quadrants of the building. The laboratory sample was to be selected from the screening samples using the following prioritized biasing scheme: (1) a sample with positive HE spot test kit results; and (2) a sample with above-two-times background radiation readings. In response to an EPA NOD (EPA 1994, 15-16-644), screening samples were collected from 1 to 2 ft depth intervals (as well as the required 0 to 1 ft intervals) to confirm that the soil beneath this concrete floored building had not been disturbed during decommissioning, and one laboratory sample was collected (based on the above scheme) even if all field screening results were negative.

Two deviations were made from the work plan.

- A fifth screening location was selected at the former location of the door, because the door location is a likely place for spills to have occurred or for material to have been swept out of the structures.

- The screening samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide

lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of 10 field screening samples were taken from 5 locations in and adjacent to the building footprint. The samples were collected from 0 to 1 ft and 1 to 2 ft depth intervals. The field screening samples were taken near the corners of the four quadrants of the building and adjacent to the location of the door (Fig. 5.2.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which had concrete floors, is hypothesized to be via either: (1) HE spills near door areas; or (2) leakage at the floor/wall joints.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels).)The 0 to 1 ft interval samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050). The 0 to 1 ft intervals were selected for further characterization, rather than the 1 to 2 ft intervals, because the soil beneath the PRS structure is undisturbed, as confirmed by the soil descriptions in the sample collection logs. If contamination is present within the structure footprint, it is most likely present at shallow depths directly beneath the structure. The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. Three samples screened positive for HE using the D-Tech™ kit (Table 5.2.4-1).

TABLE 5.2.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4107 northeast quadrant	16-4107	0 - 1	NA[a]	negative	background	< 0.5	0.5 - 1.5
0316-97-4108 northwest quadrant	16-4108	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4109 southwest quadrant	16-4109	0 - 1	NA	negative	background	< 0.5	0.5 - 1.5
0316-97-4110 southeast quadrant	16-4110	0 - 1	0316-97-0549	negative	background	< 0.5	0.5 - 1.5
0316-97-4201 door	16-4201	0 - 1	NA	negative	background	< 0.5	< 0.5

a. NA = Not analyzed

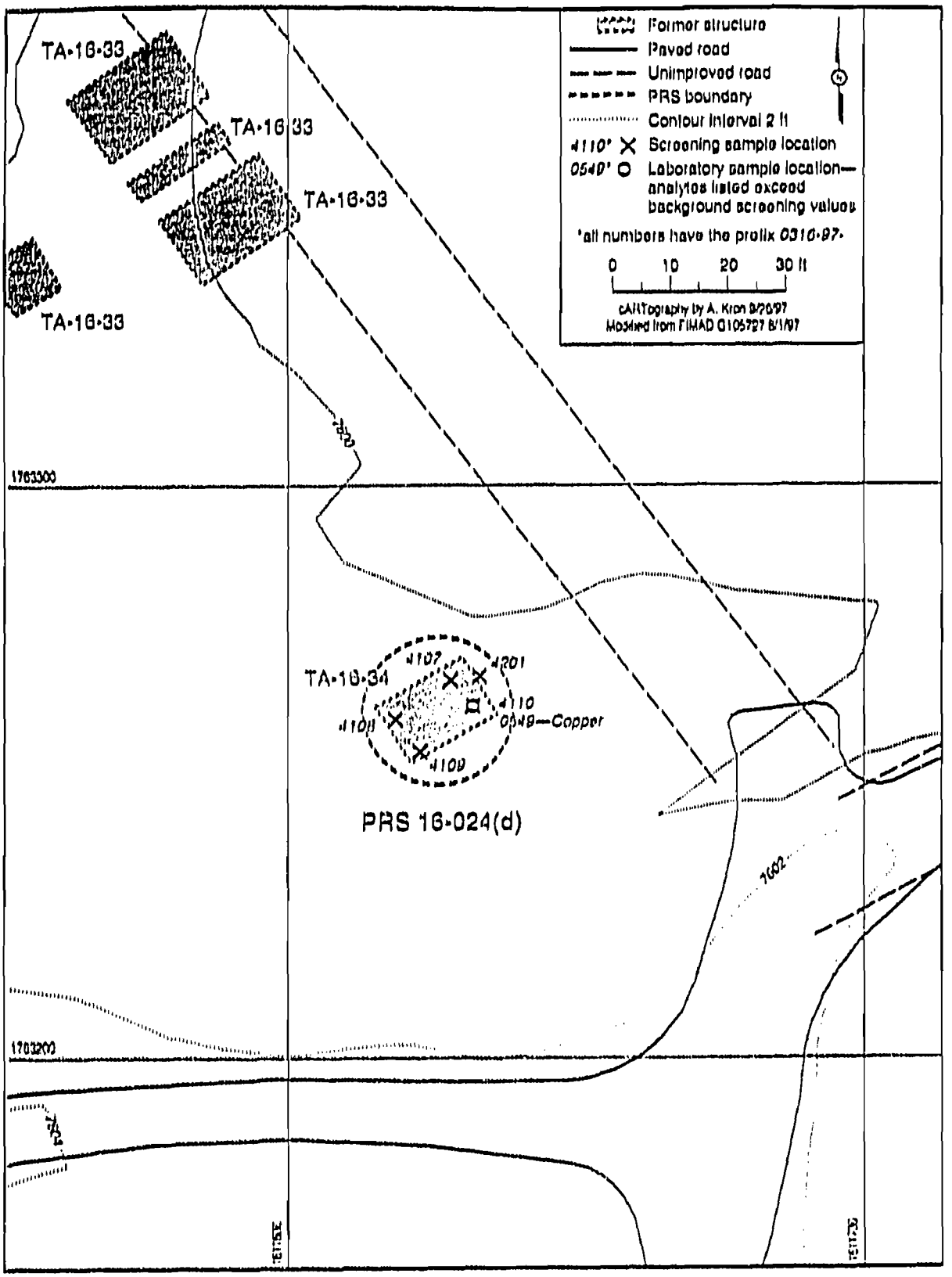


Fig. 5.2.4-1 Locations of PRS 16-024(d) samples.

Screening sample 0316-97-4110 was one of three samples which contained 0.5 to 1.5 mg/kg TNT and it was located in the downgradient (southeast) part of the building footprint. This sample was submitted to the laboratory for analysis (Table 5.2.4-1). The sample was analyzed for metals, SVOCs, and HE (Table 5.2.4-2).

TABLE 5.2.4-2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES FOR PRS 16-024(d)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MATRIX	SVOC	HE	INORGANIC
16-4110	0316-97-0549	0-1	Soil	3441R	3442R	3443R

5.2.5 Evaluation of Inorganic Chemicals

Copper was detected above background UTL (Table 5.2.5-1). The A-qualifier (absent) assigned to this result by baseline validation was removed as described in Section 4.1. Focused validation revealed no problems with the inorganic analyses affecting the use of these inorganic data.

TABLE 5.2.5-1
INORGANIC CHEMICALS WITH CONCENTRATIONS AT OR ABOVE BACKGROUND SCREENING VALUES FOR PRS 16-024(d)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	UTL (MG/KG)	MEDIA	DEPTH (FT)
Copper	0316-97-0549	17	2800	15.5	Soil	0-1

5.2.6 Evaluation of Radionuclides

Radionuclides were not analyzed for at PRS 16-024(d) because historical evidence indicated that radioactive material was not stored or used in this HE magazine. Additionally, field screening did not indicate the presence of radioactive constituents.

5.2.7 Evaluation of Organic Chemicals

No HE was detected in sample 0316-97-0549, despite indications of the presence of TNT in the associated field screening sample. The positive D-Tech™ result, which suggested that low levels of TNT were present, was not confirmed by the fixed laboratory analysis. The D-Tech™ kits have been shown to provide false positives due to interferences with humic materials. See Section 4.3.2 for further details.

No semivolatile organic chemicals were detected in sample 0316-97-0549. Baseline validation indicates no data quality problems associated with these analyses that affect these use of the organic data.

5.2.8 Risk-Based Screening Assessment

The only chemical present at PRS 16-024(d) above EQLs and UTLs was copper, at less than 1% of SAL.

5.2.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-024(d) because contamination was not detected at or above SALs.

5.2.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.2.11 Conclusions and Recommendations

Ten screening samples and one laboratory sample were collected in and adjacent to the footprint of the former HE magazine TA-16-34. The laboratory sample was selected from one of three screening samples that screened positive for HE. It was located in the downgradient (southeast) part of the building footprint. Copper was detected 10% above the background UTL in this sample, but the value was far below the SAL. No HE or organic compounds were detected.

The biased sampling and analysis strategy at this former magazine was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on the information about the location, orientation, construction, use of the former building, and mode of decommissioning. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, a single confirmatory laboratory sample is sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory sample was selected from screening samples based on field screening results, and was analyzed for all potential contaminants based on historical knowledge of operations in TA-16-34.

PRS 16-024(d) is recommended for human-health NFA based on NFA Criterion 5 because no hazardous chemicals are present.

5.3 PRS 16-024(l)

This PRS is the site of former HE magazine TA-16-493, located at T-Site (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.3.1 History

PRS 16-024(l) is discussed in detail in Subsection 5.24 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

The HE magazine was located northeast of TA-16-490 and constructed in 1945. HE magazines were used to store packaged HE and finished HE products before and after processing. No HE processing was done in such magazines. A former site worker described an incident that occurred in 1950 in which a large chunk of baratol was dropped in the building (Martin and Hickmott 1993, 15-16-500). The magazine had no sumps or plumbing. Before being abandoned in 1959 and burned in 1960, the building was found to be contaminated with HE (Engineering Department 1959, 15-16-256).

The potential contamination at this PRS was identified as metals, SVOCs, and HE.

5.3.2 Description

TA-16-493 was a magazine 6 ft wide x 6 ft long x 7 ft high of wooden-frame construction with a wood floor and with earthen barricades on three sides and the top.

5.3.3 Previous Investigation(s)

No previous field investigations were conducted at this PRS.

5.3.4 Field Investigation

The goal of the Phase I investigation at PRS 16-024(l), as outlined in the approved RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from

the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect residual HE in the surface and near-surface soil at the site of the magazine footprint. The mode of decommissioning of the magazine and the fact that magazines were used for HE storage, but not for HE processing suggest that residual contamination is unlikely at this PRS.

The RFI work plan (LANL 1994, 1160) specified screening soil samples, 0 to 1 ft depth interval, from five locations and selecting one laboratory sample only if positive field screening results were obtained. The plan called for taking the screening samples at the four quadrants of the building and at the building center. The laboratory sample was to be selected from the screening samples using the following prioritized biasing scheme: (1) a sample with a positive HE spot test kit result; and (2) a sample with above two times background radiation readings. In response to an EPA NOD (EPA 1994, 15-16-644), two laboratory samples were collected (based on the above scheme), even if all field screening results were negative.

Two deviations were made from the work plan.

- A sixth screening location was selected at the former location of the door, because the door location is a likely place for spills to have occurred or for material to have been swept out of the structure.

- The screening samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of six field screening samples were taken from six locations in and adjacent to the building footprint. The samples were collected from the 0 to 1 ft depth interval. The field screening

samples were taken within the four quadrants of the building, the former location of the door, and at the building center (Fig. 5.3.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which

had wooden floors, is hypothesized to be via either: (1) HE spills near door areas; or (2) leakage from cracks within wooden floors.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). Samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050). The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. Five samples screened positive for HE using the D-Tech™ kit (Table 5.3.4-1).

TABLE 5.3.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4162 southwest quadrant	16-4162	0 - 1	0316-97-0584	negative	background	< 0.5	1.5 - 3.0
0316-97-4163 northwest quadrant	16-4163	0 - 1	NA[a]	negative	background	0.5 - 1.5	< 0.5
0316-97-4164 northeast quadrant	16-4164	0 - 1	NA	negative	background	< 0.5	0.5 - 1.5
0316-97-4165 southeast quadrant	16-4165	0 - 1	0316-97-0588	negative	background	< 0.5	0.5 - 1.5
0316-97-4166 center	16-4166	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4197 door	16-4197	0 - 1	NA	negative	background	< 0.5	0.5 - 1.5

a. NA = Not analyzed.

Screening sample 0316-97-4162 contained the highest concentration of HE (1.5 to 3.0 mg/kg TNT). Screening sample 0316-97-4165 was one of four samples with elevated HE (0.5 to 1.5 mg/kg TNT) and was located in the downgradient (southeast) part of the building footprint. These

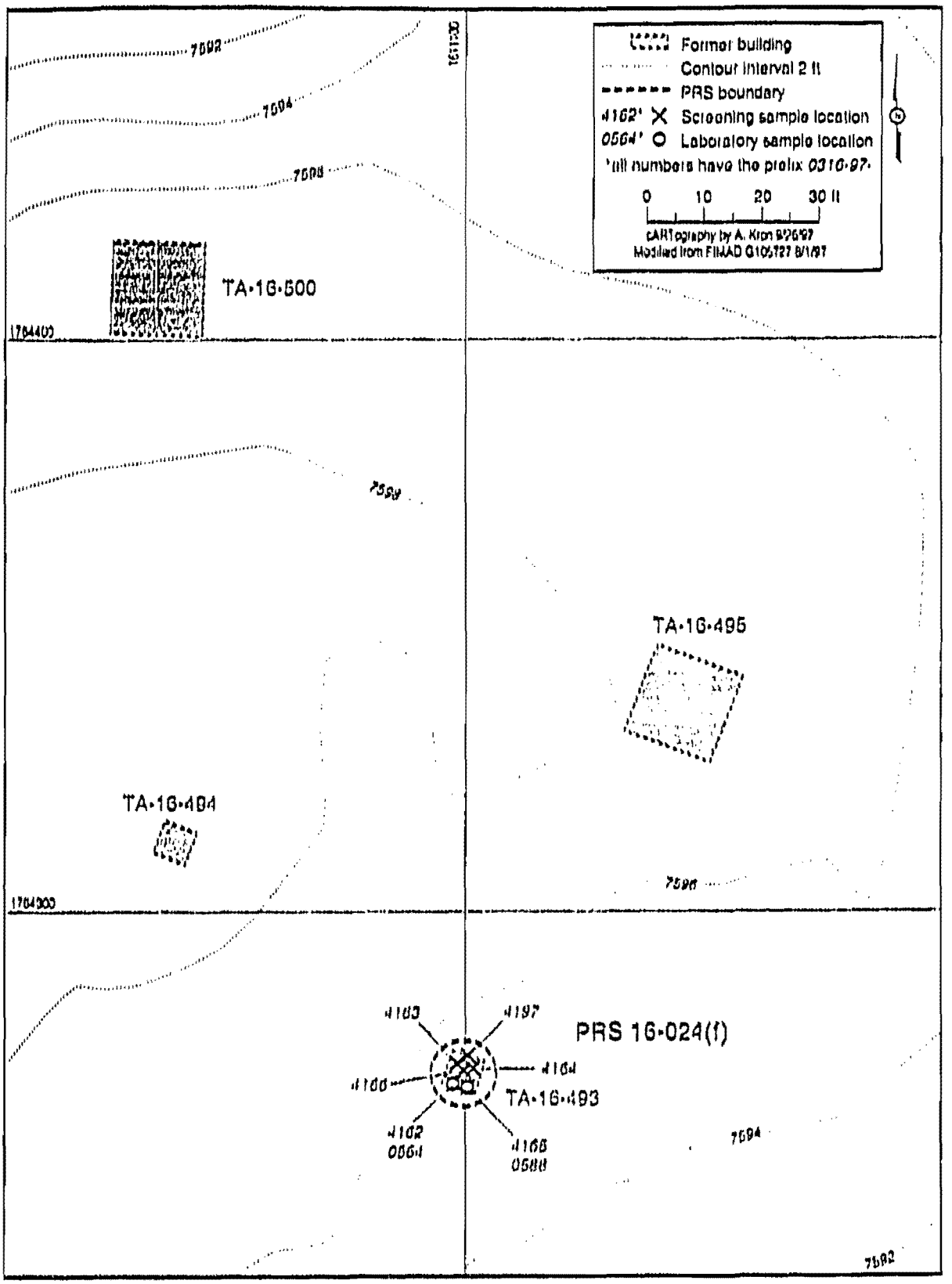


Fig. 5.3.4-1 Locations of PRS 16-024(f) samples.

two samples were submitted to the laboratory for analysis (Table 5.3.4-1). The samples were analyzed for metals, SVOCs, and HE (Table 5.3.4-2).

TABLE 5.3.4-2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES TAKEN AT PRS 16-024(f)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MATRIX	INORGANICS	SVOCS	HE
16-4162	0316-97-0564	0 - 1	soil	3440R	3438R	3439R
16-4165	0316-97-0588	0 - 1	soil	3440R	3438R	3439R

5.3.5 Evaluation of Inorganic Chemicals

No inorganic chemicals were present at levels greater than background UTLs at PRS 16-024(f). Baseline validation indicated no problems that affect the use of these inorganic data.

5.3.6 Evaluation of Radionuclides

Radionuclides were not analyzed for at PRS 16-024(f) because historical evidence indicated that radioactive material was not stored or used in this HE magazine. Additionally, field screening did not indicate the presence of radioactive constituents.

5.3.7 Evaluation of Organic Chemicals

No HE was detected in sample 0316-97-0564 and 0316-97-0588, despite indications of the presence of TNT in the associated field screening samples. The positive D-Tech™ results, which suggested that low levels of TNT were present, were not confirmed by the fixed laboratory analysis. The D-Tech™ kits have been shown to provide false positives due to interferences with humic materials. See Section 4.3.2 for further details.

No semivolatile organic chemicals were detected in sample 0316-97-0564 and 0316-97-0588. Baseline validation indicates no data quality problems associated with these analyses that affect the use of these organic data.

5.3.8 Risk-Based Screening Assessment

No screening assessment was performed because no chemicals were present at or above UTLs or EQLs at PRS 16-024(f).

5.3.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-024(f) because contamination was not detected at or above SALs.

5.3.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.3.11 Conclusions and Recommendations

Six screening samples and two laboratory samples were collected in and adjacent to the former HE magazine TA-16-493. The laboratory samples were selected from five screening samples that screened positive for HE, including one reported in the 1.5 to 3 ppm range. No organic or inorganic compounds were detected in the laboratory samples.

The biased sampling and analysis strategy at this former magazine was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on information about the location, orientation, construction, use of the former building, and mode of decommissioning. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, two confirmatory laboratory samples are sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory samples were selected from screening samples based on field screening results, and were analyzed for all potential contaminants based on historical knowledge of operations in TA-16-493.

PRS 16-024(f) is recommended for human-health NFA based on NFA Criterion 5 because contamination is not present at this site at levels that present a potential risk to human health.

5.4 PRS 16-024(g)

This PRS is the site of former HE magazine TA-16-494, in the T-Site area (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.4.1 History

PRS 16-024(g) is discussed in detail in Subsection 5.24 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

The HE magazine was located northeast of TA-16-490 and constructed in 1945. HE magazines were used to store packaged and finished HE products before and after processing. No HE processing was done in such magazines. The magazine had no sumps or plumbing. Before being abandoned in 1959 and burned in 1960, the building was found to be contaminated with HE (Engineering Department 1959, 15-16-256).

The potential contamination at this PRS was identified as metals, SVOCs, and HE.

5.4.2 Description

TA-16-494 was a magazine 6 ft wide x 6 ft long x 7 ft high of wooden-frame construction with a wooden floor and earthen barricades on three sides and the top.

5.4.3 Previous Investigation(s)

No previous field investigations were conducted at this PRS.

5.4.4 Field Investigation

The goal of the Phase I investigation at PRS 16-024(g), as outlined in the approved RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect residual HE in the surface and near-surface soil at the site of the magazine footprint. The mode of decommissioning of the magazine and the fact that magazines were used for HE storage, but not for HE processing suggest that residual contamination is unlikely at this PRS.

Addendum 1 (LANL 1994, 1160) specified screening soil samples, 0 to 1 ft depth intervals, from five locations and selecting one laboratory sample only if positive field screening results were obtained. The plan called for taking the screening samples at the four quadrants of the building and at the building center. The laboratory sample was to be selected from the screening samples using the following prioritized biasing scheme: (1) a sample with a positive HE spot test kit result; and (2) a sample with above two times background radiation readings. In response to an EPA NOD (EPA 1994, 15-16-644), two laboratory samples were collected (based on the above scheme), even if all field screening results were negative.

Two deviations were made to the approved work plan.

- A sixth screening location was selected at the former location of the door because the door location is a likely place for spills to have occurred or for material to have been swept out of the structures.

- The screening samples were analyzed for RDX and TNT using the D-Tech™ Immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of 6 field screening samples were taken from 6 locations in and adjacent to the building footprint. The samples were collected from the 0 to 1 ft depth interval. The field screening samples were taken within the four quadrants of the building, the former location of the door, and at the building center (Fig. 5.4.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which had wooden floors, is hypothesized to be via either: (1) HE spills near door areas; or (2) leakage from cracks within wooden floors.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe

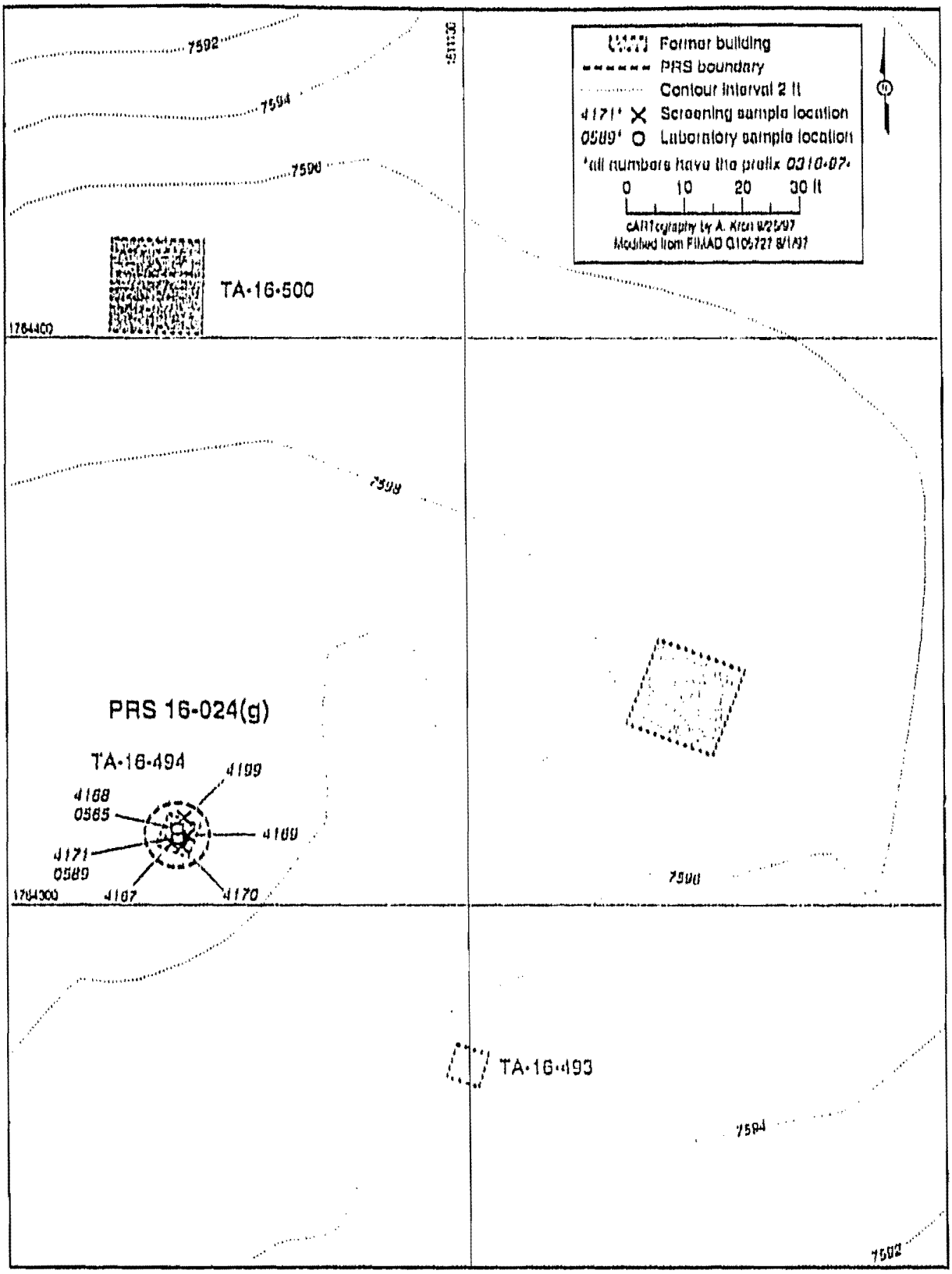


Fig. 5.4.4-1 Locations of PRS 16-024(g) samples.

(LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). Samples were analyzed for RDX and TNT using the D-Tech™ Immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050). The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. One sample screened positive for HE using the D-Tech™ kit (Table 5.4.4-1).

TABLE 5.4.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4167 southwest quadrant	16-4167	0 - 1	NA[a]	negative	background	< 0.5	< 0.5
0316-97-4168 northwest quadrant	16-4168	0 - 1	0316-97-0565	negative	background	< 0.5	< 0.5
0316-97-4169 northeast quadrant	16-4169	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4170 southeast quadrant	16-4170	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4171 center	16-4171	0 - 1	0316-97-0589	negative	background	0.5 - 1.5	< 0.5
0316-97-4199 door	16-4199	0 - 1	NA	negative	background	< 0.5	< 0.5

a. NA = Not analyzed.

Screening sample 0316-97-4171 contained the highest concentration of HE (0.5 to 1.5 mg/kg RDX) and was the center location. This sample was submitted to the laboratory for analysis. In the absence of other positive screening results, screening sample 0316-97-4168 was selected randomly and submitted to the laboratory for analysis. The random sample was selected by using a random-number generator to select a number one through four. These numbers corresponded with the northeast, northwest, southeast, and southwest quadrants. The northwest quadrant sample was selected (Table 5.4.4-1). The sample was analyzed for metals, SVOCs, and HE (Table 5.4.4-2).

TABLE 5.4.4-2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES
TAKEN AT PRS 16-024(g)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MATRIX	INORGANICS	SVOCS	HE
16-4168	0316-97-0565	0 - 1	soil	3440R	3438R	3439R
116-4171	0316-97-0589	0 - 1	soil	3440R	3438R	3439R

5.4.5 Evaluation of Inorganic Chemicals

No inorganic chemicals were present at levels greater than background UTLs at PRS 16-024(g). Baseline validation indicated no problems that affect the use of these inorganic data.

5.4.6 Evaluation of Radionuclides

Radionuclides were not analyzed for at PRS 16-024(g) because historical evidence indicated that radioactive material was not stored or used in this HE magazine. Additionally, field screening did not indicate the presence of radioactive constituents.

5.4.7 Evaluation of Organic Chemicals

No HE was detected in sample 0316-97-0589, despite indications of the presence of RDX in the associated field screening sample. The positive D-Tech™ result, which suggested that low levels of RDX were present, was not confirmed by the fixed laboratory analysis. The D-Tech™ kits have been shown to provide false positives due to interferences with humic materials. See Section 4.3.2 for further details.

No semivolatile organic chemicals were detected in sample 0316-97-0589 or 0316-97-0565. Baseline validation indicates no data quality problems associated with these analyses that affect the use of these organic data.

5.4.8 Risk-Based Screening Assessment

No screening assessment was performed because no chemicals were present at or above UTLs or EQLs at PRS 16-024(g).

5.4.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-024(g) because contamination was not detected at or above SALs.

5.4.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.4.11 Conclusions and Recommendations

Six screening samples and two laboratory samples were collected in and adjacent to the footprint of the former HE magazine TA-16-494. One laboratory sample was selected from the only screening sample with a positive HE screening result and the other was selected randomly. The samples contained no inorganic or organic contamination above detection limits.

The biased sampling and analysis strategy at this former magazine was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on information about the location, orientation, construction, use of the former building, and mode of decommissioning. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, two confirmatory laboratory samples are sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory samples were selected from screening samples based on field screening results, and were analyzed for all potential contaminants based on historical knowledge of operations in TA-16-494.

PRS 16-024(g) is recommended for human-health NFA based on NFA Criterion 5 because contamination is not present at this site at levels that present a potential risk to human health.

5.5 PRS 16-024(k)

This PRS is the site of the former HE magazine TA-16-57, located in the western portion of the GMX-2 area (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.5.1 History

PRS 16-024(k) is discussed in detail in Subsection 5.20 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

Little information is known regarding this HE magazine, however, a former site worker suggested that TA-16-57 was not extensively utilized (Martin 1993, 15-16-477). HE magazines were used to store packaged and finished HE products before and after processing. No HE processing was done in such magazines. The magazine had no sumps or plumbing. TA-16-57 was built in May 1946, and was abandoned in 1959. Before being burned in 1960, it was determined that the magazine was contaminated with HE (Engineering Department 1959, 15-16-256).

The potential contamination at this PRS was identified as metals, SVOCs, and HE.

5.5.2 Description

TA-16-57 was a magazine 6 ft long x 6 ft wide x 7 ft high of wooden-frame construction with a wood floor and with earthen barricades on three sides and on top. It was located on flat terrain south of TA-16-38.

5.5.3 Previous Investigation(s)

No previous investigations were conducted at this PRS.

5.5.4 Field Investigation

The goal of the Phase I investigation at PRS 16-024(k), as outlined in the approved RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect residual HE in the surface and near-surface soil at the site of the magazine footprint. The mode of decommissioning of the magazine and the fact that magazines were used for HE storage, but not for HE processing, suggest that residual contamination is unlikely at this PRS.

Addendum 1 (LANL 1994, 1160) specified screening soil samples, 0 to 1 ft depth intervals, from four locations and selecting one laboratory sample only if positive field screening results were obtained. The plan called for taking the screening samples within two of the four quadrants of the building, on the side of the footprint opposite the door, and one foot downgradient from the location of the door. The laboratory sample was to be selected from the screening samples using the following prioritized biasing scheme: (1) a sample with a positive HE spot test kit result; and (2) a sample with above two times background radiation readings. In response to an EPA NOD (EPA 1994, 15-16-644), one laboratory sample was collected(based on the above scheme), even if all field screening results were negative.

One deviation was made to the approved work plan. The screening samples were analyzed for RDX and TNT using the D-Tech™ Immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of 4 field screening samples were taken from 4 locations in and adjacent to the building footprint. The samples were collected from the 0 to 1 ft depth interval. The field screening samples were taken within two of the four quadrants of the building, on the side of the footprint opposite the door, and one foot downgradient from the location of the door (Fig. 5.5.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which had wooden floors, is hypothesized to be via either: (1) HE spills near door areas; or (2) leakage from cracks within wooden floors.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). Samples were analyzed for RDX and TNT using the D-Tech™ Immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050). The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

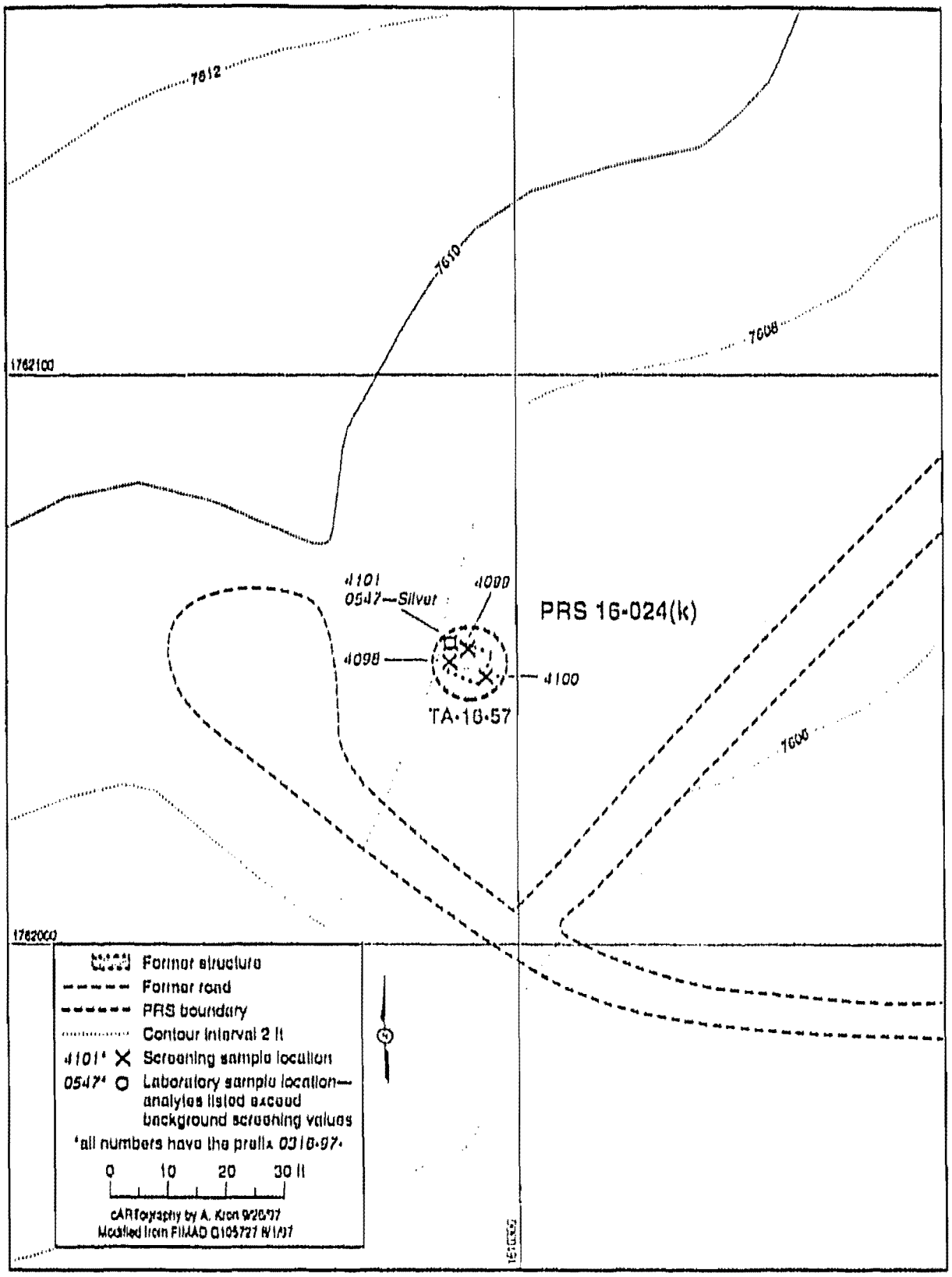


Fig. 5.5.4-1 Locations of PRS 16-024(k) samples.

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. No samples screened positive for HE using the D-Tech™ kit (Table 5.5.4-1).

TABLE 5.5.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4098 southwest quadrant	16-4098	0 - 1	NA[a]	negative	background	< 0.5	< 0.5
0316-97-4099 door	16-4099	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4100 southeast quadrant	16-4100	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4101 downgradient door	16-4101	0 - 1	0316-97-0547	negative	background	< 0.5	< 0.5

a. NA = Not analyzed.

All of the samples were non-detects for HE. Screening sample 0316-97-4101 was located one foot downgradient from the door and was submitted to the laboratory for analysis (Table 5.5.4-1). The sample was analyzed for metals, SVOCs, and HE (Table 5.5.4-2).

TABLE 5.5.4-2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES FOR PRS 16-024(k)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MATRIX	INORGANICS	SVOCS	HE
16-4101	0316-97-0547	0 - 1	soil	3419R	3417R	3418R

5.5.5 Evaluation of Inorganic Chemicals

Silver was reported at 0.59 mg/kg (below the EQL for silver). This result was originally reported as P-qualified. After inspection of the data it was qualified as estimated (J) because the duplicate analysis in this run was not within control limits, indicating possibly low precision; see Section 4.2 for discussion. Antimony was reported as estimated undetected (UJ) at 6.7 mg/kg because the spike recovery was low (52%). This result is accepted as undetected as discussed in Section 4.1.

The qualifiers shown in Table 5.5.5-1 have been assigned during baseline and focused data validation. The data are usable for site-specific decisions, as discussed in Section 4.1. Baseline validation revealed no other problems with the analyses that affect the use of these inorganic data.

TABLE 5.5.5-1
INORGANIC CHEMICALS WITH CONCENTRATIONS AT OR ABOVE BACKGROUND SCREENING VALUES FOR PRS 16-024(k)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	UTL MG/KG)	MEDIA	DEPTH (FT)
Antimony	0316-97-0547	6.7 (UJ)[b]	31	1	Soil	0-1
Silver	0316-97-0547	0.59(J)[c]	380	NC[a]	Soil	0-1

a. NC = not calculated
b. UJ = Analyte was not detected; the associated value is an estimate of the detection limit or quantitation limit.
c. J = Analyte was positively identified, but the result is estimated to be more uncertain than would normally be expected for that analysis.

5.5.6 Evaluation of Radionuclides

Radionuclides were not analyzed for at PRS 16-024(k) because historical evidence indicated that radioactive material was not stored or used in this HE magazine. Additionally, field screening did not indicate the presence of radioactive constituents.

5.5.7 Evaluation of Organic Chemicals

No organic chemicals were present at levels greater than detection limits in sample 0316-97-0547. Baseline validation indicated no problems that affect the use of these organic data.

5.5.8 Risk-Based Screening Assessment

Silver was reported at less than 0.5% of its SAL. Antimony was reported as undetected and is within the background concentrations for establishing an observed release as discussed in Section 4.1. No other chemicals were detected above EQLs or UTLs.

5.5.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-024(k) because inorganic and organic chemicals were below SALs.

5.5.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.5.11 Conclusions and Recommendations

Four screening samples and one laboratory sample were collected in and downgradient from the footprint of former HE magazine TA-16-57. All screening results were negative, so the laboratory sample was selected from the location downgradient from the door of the former bunker. Only silver was reported as estimated in this sample, at less than 1 mg/kg. No other inorganic chemicals were detected. No HE or other organic compounds were detected. The data show that no contaminants are present at this site at levels of concern to human health.

The biased sampling and analysis strategy at this former magazine was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on information about the location, orientation, construction, use, and mode of decommissioning of the former building. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, a single confirmatory laboratory sample is sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory sample was selected at the location of the door to the former HE magazine, because this would have been the area of greatest activity. It was analyzed for all potential contaminants based on historical knowledge of operations in TA-16-57.

PRS 16-024(k) is recommended for human-health NFA based on NFA Criterion 5 because contamination is not present at this site at levels that present a potential risk to human health.

5.6 PRS 16-024(m)

This PRS is the site of former HE magazine TA-16-66, located in the northeast portion of the GMX-2 area (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.6.1 History

PRS 16-024(m) is discussed in detail in Subsection 5.20 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

TA-16-66 was an HE magazine. HE magazines were used to store packaged HE and finished HE products before and after processing. No HE processing was done in such magazines. Little is known about this specific HE magazine, however, operations in magazines may have resulted in small spills of HE (Martin 1993, 15-16-477). The building had no sumps or plumbing. The

magazine was constructed in the mid 1940's, and abandoned in 1959. Before being burned in 1960, it was determined that the magazine was contaminated with HE (Engineering Department 1959, 15-16-256).

The potential contamination at this PRS was identified as metals, SVOCs, and HE.

5.6.2 Description

TA-16-66 was a 6 ft long x 6 ft wide x 7 ft high wooden-frame building with a wooden floor and with earthen barricades on three sides and on top. It was located on flat terrain northeast of TA-16-37.

5.6.3 Previous Investigation(s)

No previous investigations were conducted at this PRS.

5.6.4 Field Investigation

The goal of the Phase I investigation at PRS 16-024(m), as outlined in the approved RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect residual HE and other constituents in the surface and near-surface soil at the site of the former magazine. The mode of decommissioning of the magazine and the fact that magazines were used for HE storage, but not for HE processing suggest that residual contamination is unlikely at this PRS.

Addendum 1 (LANL 1994, 1160) specified screening soil samples, 0 to 1 ft depth intervals, from four locations and selecting one laboratory sample only if positive field screening results were obtained. The plan called for taking the screening samples within two of the four quadrants of the building, on the side of the footprint opposite the door, and one foot downgradient from the location of the door. The laboratory sample was to be selected from the screening samples using

the following prioritized biasing scheme: (1) a sample with a positive HE spot test kit result; and (2) a sample with above two times background radiation readings. In response to an EPA NOD (EPA 1994, 15-16-644), one laboratory sample was to be collected (based on the above scheme), even if all field screening results were negative.

One deviation was made to the approved work plan. The screening samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

The location of the former building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of 4 field screening samples were taken from 4 locations in and adjacent to the building footprint. The samples were collected from the 0 to 1 ft depth interval. The field screening samples were taken within two of the four quadrants of the building, on the side of the footprint opposite the door, and one foot downgradient from the location of the door (Fig. 5.6.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which had wooden floors, is hypothesized to be via either: (1) HE spills near door areas; or (2) leakage from cracks within wooden floors.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). The samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050). The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

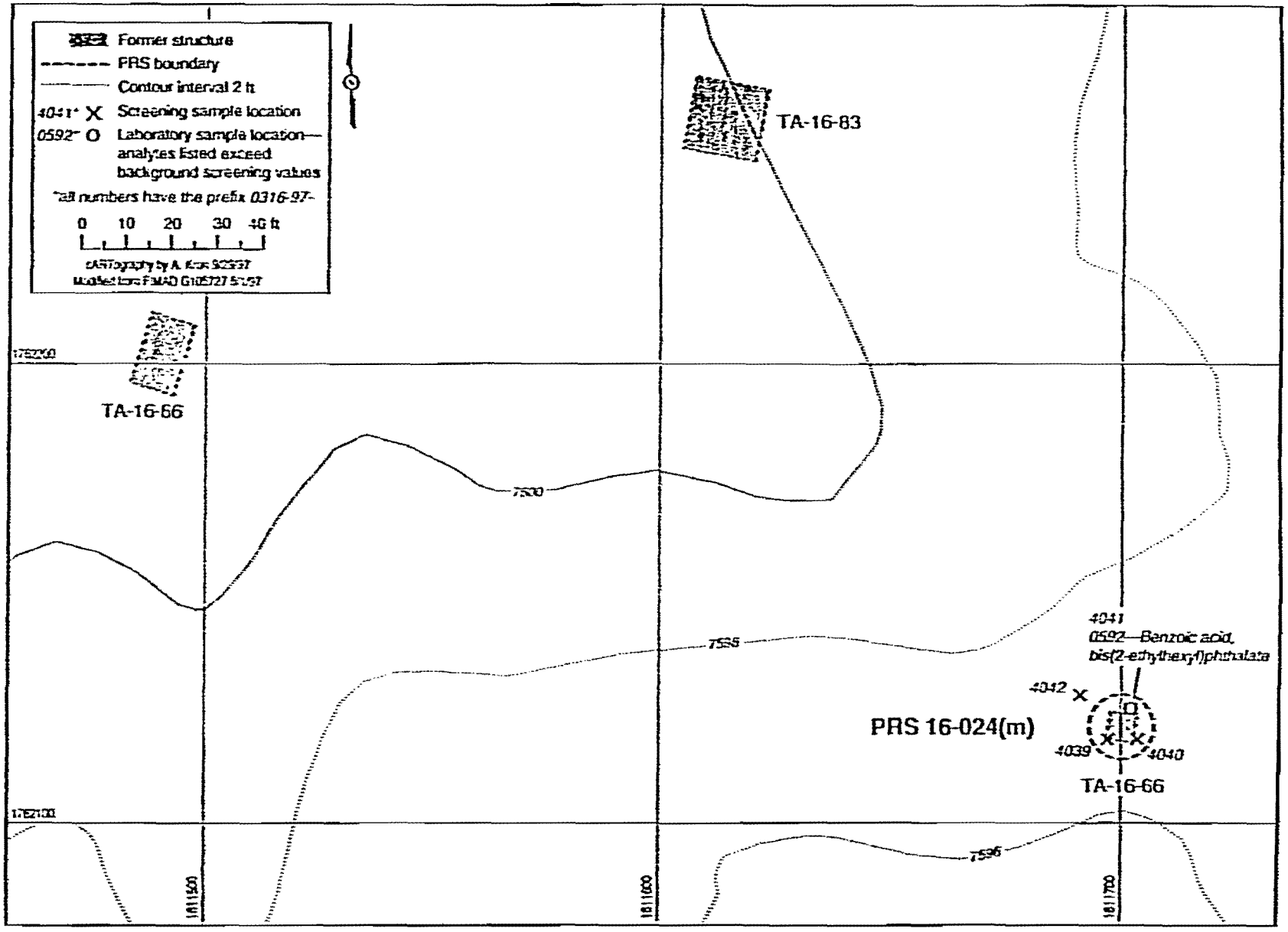


Fig. 5.6.4-1 Locations of PRS 16-024(m) samples.

All samples screened negative for HE using the HE spot test kit and contained background levels of radioactivity. One sample screened positive for HE using the D-Tech™ kit (Table 5.6.4-1).

TABLE 5.6.4-1
SUMMARY OF FIELD SCREENING RESULTS AT 0 TO 1 FT DEPTHS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4039 southwest quadrant	16-4039	0 - 1	NA[a]	negative	background	< 0.5	< 0.5
0316-97-4040 southeast quadrant	16-4040	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4041 door	16-4041	0 - 1	0316-97-0529	negative	background	0.5 - 1.5	< 0.5
0316-97-4042 downgradient door	16-4042	0 - 1	NA	negative	background	< 0.5	< 0.5

a. NA = Not analyzed.

Screening sample 0316-97-4041 contained the highest concentration of HE (0.5 to 1.5 mg/kg RDX). This sample was submitted to the laboratory for analysis (Table 5.6.4-1). The sample was analyzed for inorganic chemicals, SVOCs, and HE (Table 5.6.4-2).

TABLE 5.6.4-2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES TAKEN AT PRS 16-024(m)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MEDIA	INORGANICS	SVOCS	HE
16-4041	0316-97-0529	0 - 1	soil	3352R	3351R	3353R

5.6.5 Evaluation of Inorganic Chemicals

No inorganic constituents were detected above background in sample 0316-97-0529. Baseline validation indicated no problems that affect the use of these inorganic data.

5.6.6 Evaluation of Radionuclides

Radionuclides were not analyzed for at PRS 16-024(m) because historical evidence indicated that radioactive material was not stored or used in this HE magazine. Additionally, field screening did not indicate the presence of radioactive constituents.

5.6.7 Evaluation of Organic Chemicals

No HE was detected in sample 0316-97-0529, despite indications of the presence of RDX in the associated field screening sample. The positive D-Tech™ result, which suggested that low levels of RDX were present, was not confirmed by the fixed laboratory analysis. The D-Tech™ kits have been shown to provide false positives due to interferences with humic materials. See Section 4.3.2 for further details.

Trace amounts of two organic chemicals were present above instrument detection levels but below EQLs. These estimated levels were far below SALs and do not present a hazard at this site (Table 5.6.7-1). The J-qualifiers, assigned by the laboratory and unchanged by baseline data validation, indicate that the reported data are above the instrument detection level but below the EQL. Baseline validation revealed no problems with the organic analyses that affect the use of these organic data.

TABLE 5.6.7-1
DETECTED ORGANIC CHEMICALS FOR PRS 16-024(m)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	MEDIA	DEPTH (FT)
Benzoic Acid	0316-97-0529	0.095(J[a])	100000	Soil	0-1
Bis(2-ethylhexyl)phthalate	0316-97-0529	0.038(J)	32	Soil	0-1

a. J = Analyte was positively identified, but the result is estimated to be more uncertain than would normally be expected for that analysis.

5.6.8 Risk-Based Screening Assessment

Bis(2-ethylhexyl)phthalate, a plasticizer commonly found at low levels in environmental samples, was reported at less than 0.5% of its SAL. Benzoic acid was detected at less than one-millionth of its SAL. No other chemicals were detected above EQLs and UTLs.

5.6.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-024(m) because contamination was not detected at levels at or above SALs. Visual inspection of the data indicate that an MCE would yield a value far below the target level of 1.

5.6.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.6.11 Conclusions and Recommendations

Four screening samples and one laboratory sample were collected in and downgradient from the footprint of former HE magazine TA-16-66. The laboratory sample was selected from a screening sample with a positive HE result. No HE was detected in the laboratory sample. Only benzoic acid and bis(2-ethylhexyl) phthalate were detected in the laboratory sample. These compounds were detected at low levels below EQLs, and SALs. No other organic compounds were reported in this sample. No inorganic compounds were detected in this sample. The data show that no contaminants are present at this site at levels of concern to human health.

The biased sampling and analysis strategy at this former magazine was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on information about the location, orientation, construction, use of the former building, and mode of decommissioning. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, a single confirmatory laboratory sample is sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory sample was selected from screening samples based on field screening results, and was analyzed for all potential contaminants based on historical knowledge of operations in TA-16-66.

PRS 16-024(m) is recommended for human-health NFA based on NFA Criterion 5 because contamination is not present at this site at levels that present a potential risk to human health.

5.7 PRS 16-024(o)

This PRS is the site of the former HE magazine TA-16-67, located in the GMX-2 area (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.7.1 History

PRS 16-024(o) is discussed in detail in Subsection 5.20 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

TA-16-67 was an HE magazine built in April 1946. Little information is known regarding this HE magazine, however, it was suggested that operations in magazines were likely to have resulted in HE spills (Martin 1993, 15-16-477). HE magazines were used to store packaged HE and finished HE products before and after processing. No HE processing was done in such magazines. The

magazine had no sump or plumbing. Before being abandoned in 1959 and burned in 1960, it was determined that the magazine was contaminated with HE (Engineering Department 1959, 15-16-256).

The potential contamination at this PRS was identified as metals, SVOCs, and HE.

5.7.2 Description

TA-16-67 was a 6 ft long x 6 ft wide x 7 ft high wooden-frame building with a wooden floor and with earthen barricades on three sides and on top. It was located on flat terrain south of TA-16-37.

5.7.3 Previous Investigation(s)

No previous investigations were conducted at this PRS.

5.7.4 Field Investigation

The goal of the Phase I investigation at PRS 16-024(c), as outlined in the approved RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect residual HE in the surface and near-surface soil at the site of the magazine footprint. The mode of decommissioning of the magazine and the fact that magazines were used for HE storage, but not for HE processing suggest that residual contamination is unlikely at this PRS.

Addendum 1 (LANL 1994, 1160) specified screening soil samples, 0 to 1 ft depth intervals, from four locations and selecting one laboratory sample only if positive field screening results were obtained. The plan called for taking the screening samples within two of the four quadrants of the building, on the side of the footprint opposite the door, and one foot downgradient from the location of the door. The laboratory sample was to be selected from the screening samples using the following prioritized biasing scheme: (1) a sample with a positive HE spot test kit result; and (2)

a sample with above two times background radiation readings. In response to an EPA NOD (EPA 1994, 15-16-644), one laboratory sample was collected (based on the above scheme), even if all field screening results were negative.

Two deviations were made to the approved work plan.

- The screening samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.
- The soil samples were collected from 0 - 0.4 ft or 0 - 0.7 ft depths (rather than the required 1 ft depths) because the hand auger met refusal at the soil/tuff interface.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of 4 field screening samples were taken from 4 locations in and adjacent to the building footprint. The samples were collected from 0 to 0.4 or 0 to 0.7 ft depths. The field screening samples were taken within two of the four quadrants of the building, on the side of the footprint opposite the door, and one foot downgradient from the location of the door (Fig. 5.7.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which had wooden floors, is hypothesized to be via either: (1) HE spills near door areas; or (2) leakage from cracks within wooden floors.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). Samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050). The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

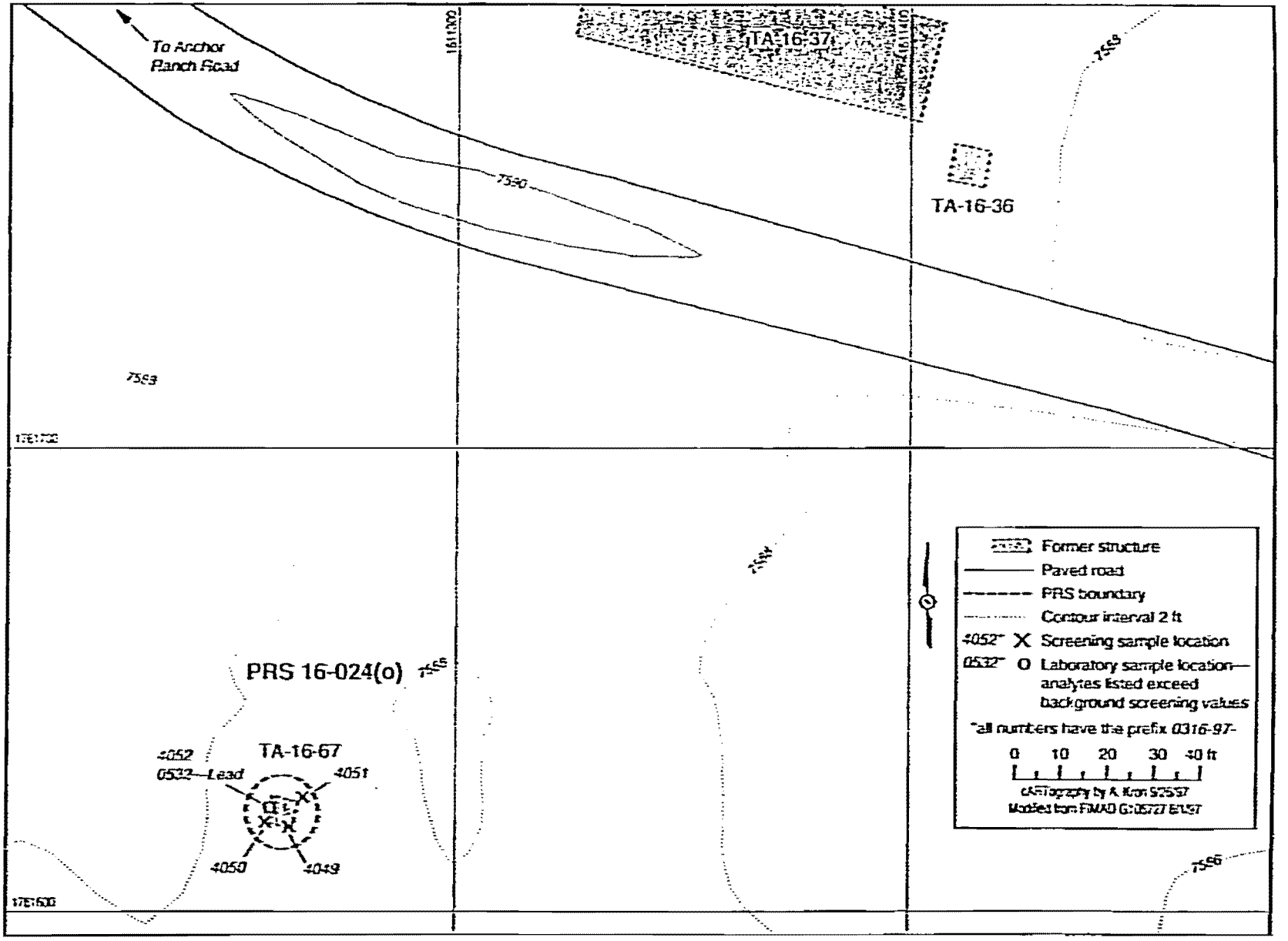


Fig. 5.7.4-1 Locations of PRS 16-024(o) samples.

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. One sample screened positive for HE using the D-Tech™ kit (Table 5.7.4-1).

TABLE 5.7.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4049 southeast quadrant	16-4049	0 - 0.7	NA[a]	negative	background	< 0.5	< 0.5
0316-97-4050 door	16-4050	0 - 0.7	NA	negative	background	< 0.5	< 0.5
0316-97-4051 northeast quadrant	16-4051	0 - 0.7	NA	negative	background	< 0.5	< 0.5
0316-97-4052 southwest quadrant	16-4052	0 - 0.4	0316-97-0532	negative	background	< 0.5	0.5 - 1.5

a. NA = Not analyzed.

Screening sample 0316-97-4052 contained the highest concentration of HE (0.5 to 1.5 mg/kg TNT) and was submitted to the laboratory for analysis (Table 5.7.4-1). The sample was analyzed for metals, SVOCs, and HE (Table 5.7.4-2).

TABLE 5.7.4-2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES TAKEN AT PRS 16-024(o)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MATRIX	INORGANICS	SVOCS	HE
16-4052	0316-97-0532	0 - 0.4	soil	3352R	3351R	3353R

5.7.5 Evaluation of Inorganic Chemicals

Lead was detected slightly above the background UTL in sample 0316-97-0532, although the concentration is within the range of the background data (Table 5.7.5-1). Baseline validation indicated no problems that affect the use of these inorganic data.

TABLE 5.7.5-1
INORGANIC CHEMICALS WITH CONCENTRATIONS AT OR ABOVE BACKGROUND SCREENING VALUES FOR PRS 16-024(o)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	UTL (MG/KG)	MEDIA	DEPTH (FT)
Lead	0316-97-0532	23.6	400	23.3	Soil	0-.42

5.7.6 Evaluation of Radionuclides

Radionuclides were not analyzed for at PRS 16-024(o) because historical evidence indicated that radioactive material was not stored or used in this HE magazine. Additionally, field screening did not indicate the presence of radioactive constituents.

5.7.7 Evaluation of Organic Chemicals

No HE was detected in sample 0316-97-0532, despite indications of the presence of TNT in the associated field screening sample. The positive D-Tech™ result, which suggested that low levels of TNT was present, was not confirmed by the fixed laboratory analysis. The D-Tech™ kits have been shown to provide false positives due to interferences with humic materials. See Section 4.3.2 for further details.

No other organic chemicals were detected in sample 0316-97-0532. Baseline validation indicates no data quality problems associated with these analyses that affect the use of these organic data.

5.7.8 Risk-Based Screening Assessment

Lead was reported at 1% above the background UTL at 6% of its SAL. No other chemicals were present at or above EQLs or UTLs at PRS 16-024(o).

5.7.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-024(o) because contamination was not detected above SALs.

5.7.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.7.11 Conclusions and Recommendations

Four screening samples and one laboratory sample were collected in and downgradient from the footprint of the former HE magazine TA-16-67. Selection of the laboratory sample was based on the only positive screening result. No HE or organic compounds were detected. Only lead was reported as detected, at less than 24 mg/kg.

The biased sampling and analysis strategy at this former magazine was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on information about the location, orientation, construction, use of the former building, and mode of decommissioning. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, a single confirmatory laboratory sample is sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory sample was selected from screening samples based on field screening results, and was analyzed for all potential contaminants based on historical knowledge of operations in TA-16-67.

PRS 16-024(o) is recommended for human-health NFA based on NFA Criterion 5 because contamination is not present at this site at levels that present a potential risk to human health.

5.8 PRS 16-024(p)

This PRS is the site of former HE magazine TA-16-70, located in the GMX-2 area (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.8.1 History

PRS 16-024(p) is discussed in detail in Subsection 5.20 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

TA-16-70 was an HE magazine built in April 1946. Little information is known regarding this HE magazine, however, it was suggested that operations in magazines were likely to have resulted in HE spills (Martin 1993, 15-16-477). HE magazines were used to store packaged HE and finished HE products before and after processing. No HE processing was done in such magazines. Before being abandoned in 1959 and burned in 1960, it was determined that the magazine was contaminated with HE (Engineering Department 1959, 15-16-256).

The potential contamination at this PRS was identified as metals, SVOCs, and HE.

5.8.2 Description

TA-16-70 was a 6 ft long x 6 ft wide x 7 ft high wooden-frame building and wooden floor with earthen barricades on three sides and on top. The magazine had no sumps or plumbing. It was located on flat terrain northeast of TA-16-49.

5.8.3 Previous Investigation(s)

No previous investigations were conducted at this PRS.

5.8.4 Field Investigation

The goal of the Phase I investigation at PRS 16-024(p), as outlined in the approved RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect residual HE in the surface and near-surface soil at the site of the magazine footprint. The mode of decommissioning of the magazine and the fact that magazines were used for HE storage, but not for HE processing suggest that residual contamination is unlikely at this PRS.

Addendum 1 (LANL 1994, 1160) specified screening soil samples, 0 to 1 ft depth intervals, from four locations and selecting one laboratory sample only if positive field screening results were obtained. The plan called for taking the screening samples within two of the four quadrants of the building, on the side of the footprint opposite the door, and one foot downgradient from the location of the door. The laboratory sample was to be selected from the screening samples using the following prioritized biasing scheme: (1) a sample with a positive HE spot test kit result; and (2) a sample with above two times background radiation readings. In response to an EPA NOD (EPA 1994, 15-16-644), one laboratory sample was collected (based on the above scheme), even if all field screening results were negative.

One deviation was made to the approved work plan. The screening samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of four field screening samples were taken from four locations in and adjacent to the building footprint. The samples were collected from the 0 to 1 ft depth interval. The field screening samples were taken within two of the four quadrants of the building, on the side of the footprint opposite the door, and one foot downgradient from the location of the door (Fig. 5.8.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which had wooden floors, is hypothesized to be via either: (1) HE spills near door areas; or (2) leakage from cracks within wooden floors.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). Samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050). The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. No samples screened positive for HE using the D-Tech™ kit (Table 5.8.4-1).

TABLE 5.8.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4059 northwest quadrant	16-4059	0 - 1	NA[a]	negative	background	< 0.5	< 0.5
0316-97-4060 northeast quadrant	16-4060	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4061 downgradient door	16-4061	0 - 1	0316-97-0535	negative	background	< 0.5	< 0.5
0316-97-4062 southeast quadrant	16-4062	0 - 1	NA	negative	background	< 0.5	< 0.5

a. NA = Not analyzed.

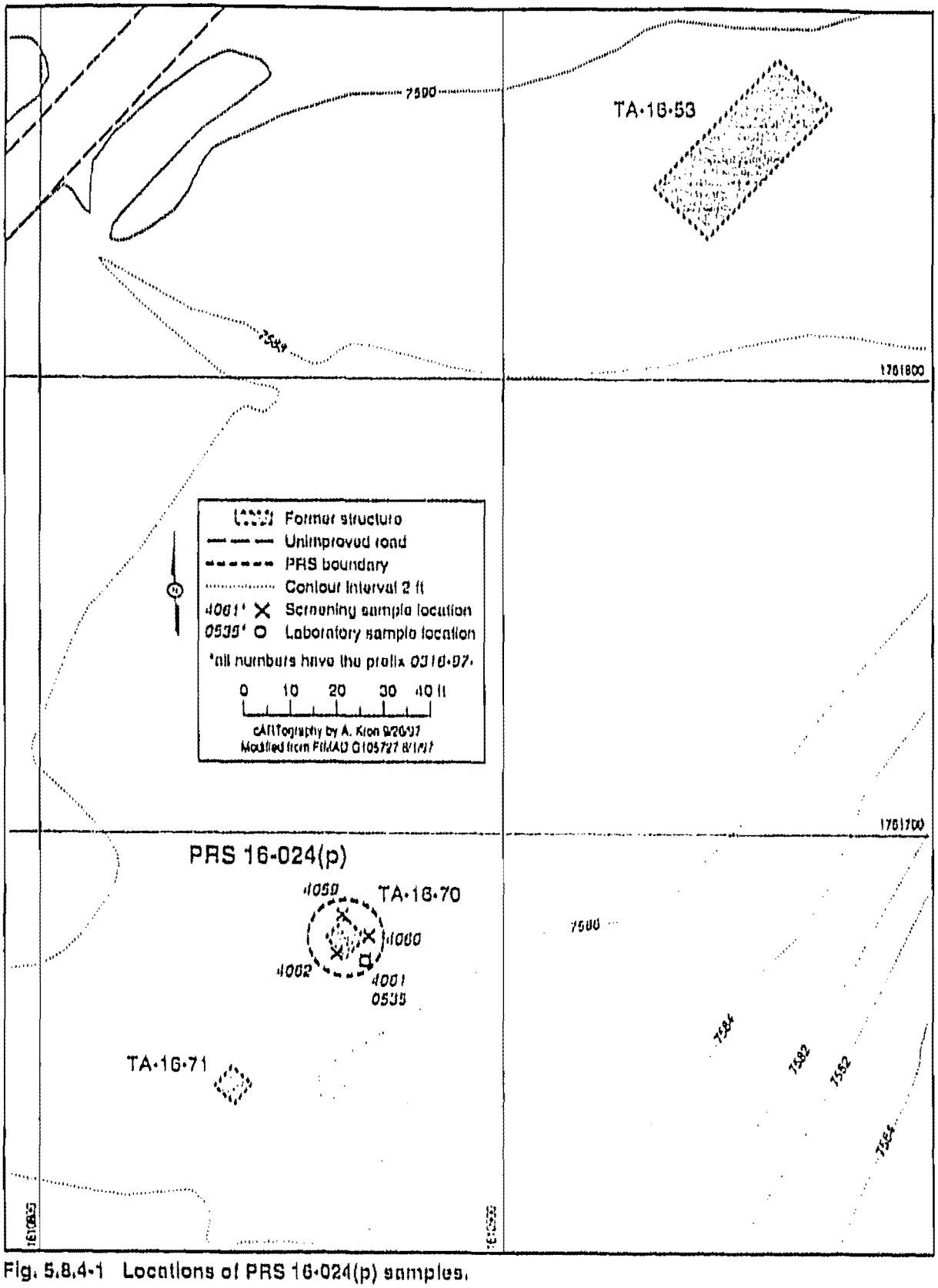


Fig. 5.8.4-1 Locations of PRS 16-024(p) samples.

All of the samples screened below detection for TNT and RDX. Screening sample 0316-97-4061 was located one foot downgradient from the door and was submitted to the laboratory for analysis (Table 5.8.4-1). The sample was analyzed for metals, SVOCs, and HE (Table 5.8.4-2).

TABLE 5.8.4-2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES TAKEN AT PRS 16-024(p)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MATRIX	INORGANICS	SVOCS	HE
16-4061	0316-97-0535	0 - 1	soil	3352R	3351R	3353R

5.8.5 Evaluation of Inorganic Chemicals

No inorganic chemicals were present at levels greater than background UTLs at PRS 16-024(p). Baseline validation indicated no problems that affect the use of these inorganic data.

5.8.6 Evaluation of Radionuclides

Radionuclides were not analyzed for at PRS 16-024(p) because historical evidence indicated that radioactive material was not stored or used in this HE magazine. Additionally, field screening did not indicate the presence of radioactive constituents.

5.8.7 Evaluation of Organic Chemicals

No organic chemicals were detected in sample 0316-97-0535. All semivolatile non-detects were qualified estimated undetected, but as discussed in Section 4.3.1 these were accepted as non detects following focused validation. Baseline validation indicated no problems that affect the use of these data.

5.8.8 Risk-Based Screening Assessment

No screening assessment was performed because chemicals were not present at levels at or above UTLs or EQLs at PRS 16-024(p).

5.8.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-024(p) because contamination was not detected at levels at or above SALs.

5.8.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.8.11 Conclusions and Recommendations

Four screening samples and one laboratory sample were collected in or adjacent to the footprint of the former HE magazine TA-16-70. In the absence of any positive screening results, the laboratory sample was collected downgradient from the former location of the door. No analytes were detected above background UTLs or EQLs and the data provide no evidence of a release of any contaminant to the environment at this site.

The biased sampling and analysis strategy at this former magazine was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on information about the location, orientation, construction, use of the former building, and mode of decommissioning. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, a single confirmatory laboratory sample is sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory sample was selected near the location of the door to the former HE magazine, because this would have been the area of greatest activity. It was analyzed for all potential contaminants based on historical knowledge of operations in TA-16-70.

PRS 16-024(p) is recommended for human-health NFA based on NFA Criterion 5 because contamination is not present at this site at levels that present a potential risk to human health.

5.9 PRS 16-024(q)

This PRS is the site of the former HE magazine TA-16-71 located in the GMX-2 area (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.9.1 History

PRS 16-024(q) is discussed in detail in Subsection 5.20 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

TA-16-71 was an HE magazine built in April 1946. Little information is known regarding this HE magazine, however, it was suggested that operations in magazines were likely to have resulted in HE spills (Martin 1993, 15-16-477). HE magazines were used to store packaged and finished HE products before and after processing. No HE processing was done in such magazines. The magazine contained no sumps or plumbing. Before being abandoned in 1959 and burned in 1960, it was determined that the magazine was contaminated with HE (Engineering Department 1959, 15-16-256).

The potential contamination at this PRS was identified as metals, SVOCs, and HE.

5.9.2 Description

TA-16-71 was a magazine 6 ft long x 6 ft wide x 7 ft high of wooden-frame construction with a wooden floor and with earthen barricades on three sides and on top. It was located on flat terrain northeast of TA-16-49.

5.9.3 Previous Investigation(s)

No previous field investigations were conducted at this PRS.

5.9.4 Field Investigation

The goal of the Phase I investigation at PRS 16-024(a), as outline in the approved Work Plan for Operable Unit 1082 (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect residual HE in the surface and near-surface soil at the site of the magazine footprint. The mode of decommissioning of the magazine and the fact that magazines were used for HE storage, but not for HE processing suggest that residual contamination is unlikely at this PRS.

Addendum 1 (LANL 1994, 1160) specified screening soil samples, 0 to 1 ft depth intervals, from four locations and selecting one laboratory sample only if positive field screening results were obtained. The plan called for taking the screening samples within two of the four quadrants of the building, on the side of the footprint opposite the door, and one foot downgradient from the location of the door. The laboratory sample was to be selected from the screening samples using the following prioritized biasing scheme: (1) a sample with a positive HE spot test kit result; and (2) a sample with above two times background radiation readings. In response to an EPA NOD (EPA 1994, 15-18-644), one laboratory sample was collected (based on the above scheme), even if all field screening results were negative.

One deviation was made to the approved work plan. The screening samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of 4 field screening samples were taken from 4 locations in and adjacent to the building footprint. The samples were collected from the 0 to 1 ft depth interval. The field screening samples were taken within two of the four quadrants of the building, on the side of the footprint opposite the door, and one foot downgradient from the location of the door (Fig. 5.9.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which had wooden floors, is hypothesized to be via either: (1) HE spills near door areas; or (2) leakage from cracks within wooden floors.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). Samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050). The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

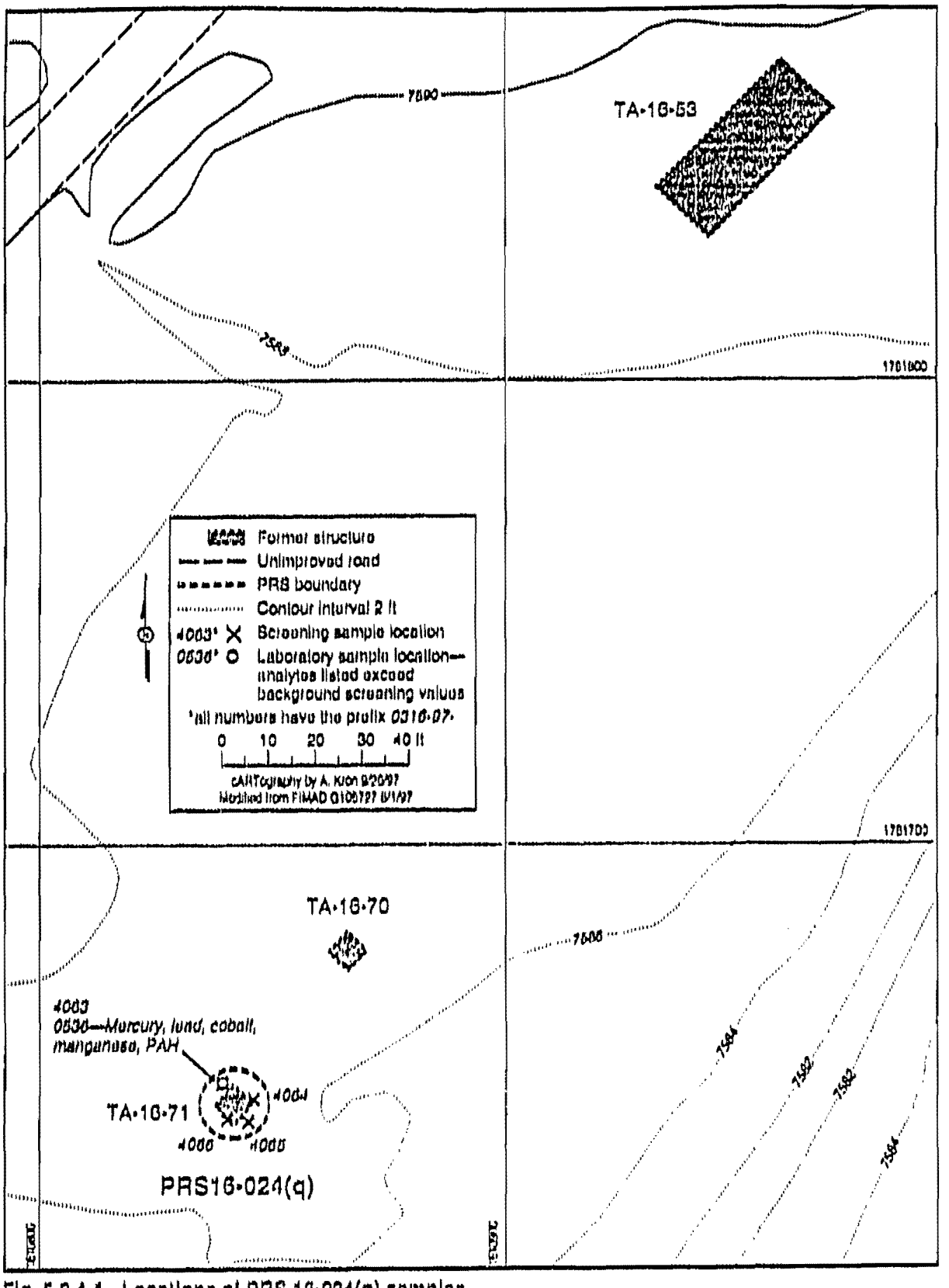


Fig. 5.9.4-1 Locations of PRS 16-024(q) samples.

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. No samples screened positive for HE using the D-Tech™ kit (Table 5.9.4-1).

TABLE 5.9.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4063 downgradient door	16-4063	0 - 1	0316-97-0536	negative	background	< 0.5	< 0.5
0316-97-4064 northeast quadrant	16-4064	0 - 1	NA[a]	negative	background	< 0.5	< 0.5
0316-97-4065 opposite door	16-4065	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4066 southeast quadrant	16-4066	0 - 1	NA	negative	background	< 0.5	< 0.5

a. NA = Not analyzed.

All of the samples screened below detection for TNT and RDX. Screening sample 0316-97-4063 was located downgradient from the former location of the door and was submitted to the laboratory for analysis (Table 5.9.4-1). The sample was analyzed for metals, SVOCs, and HE (Table 5.9.4-2).

TABLE 5.9.4-2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES
TAKEN AT PRS 16-024(q)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MATRIX	INORGANICS	SVOCS	HE
16-4063	0316-97-0536	0 - 1	soil	3352R	3351R	3353R

5.9.5 Evaluation of Inorganic Chemicals

Lead, cobalt and manganese were detected above background levels in sample 0316-97-0536 (Table 5.9.5-1). Mercury was reported at 0.11 mg/kg as estimated undetected (UJ). No other inorganic chemicals were detected above background UTLs. Baseline validation identified no problems that affect the use of these data.

TABLE 5.9.5-1
INORGANIC CHEMICALS WITH CONCENTRATIONS AT OR ABOVE BACKGROUND SCREENING VALUES FOR PRS 16-024(q)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	UTL (MG/KG)	MEDIA	DEPTH (FT)
Cobalt	0316-97-0536	19.5	4600	19.2	Soil	0-1
Lead	0316-97-0536	28.3	400	23.3	Soil	0-1
Manganese	0316-97-0536	1390	3200	714	Soil	0-1
Mercury	0316-97-0536	0.11(UJ[a])	23	0.1	Soil	0-1

a. UJ = Analyte was not detected; the associated value is an estimate of the detection limit or quantitation limit.

5.9.6 Evaluation of Radionuclides

Radionuclides were not analyzed for at PRS 16-024(q) because historical evidence indicated that radioactive material was not stored or used in this HE magazine. Additionally, field screening did not indicate the presence of radioactive constituents.

5.9.7 Evaluation of Organic Chemicals

Pyrene was detected at less than 0.1 mg/kg in sample 0316-97-0536 (Table 5.9.7-1). The sample was originally reported as PM (professional judgment needed) due to poor internal standard response, and it was requalified as estimated (J). No other organic chemicals were detected. Data validation indicated no data quality problems with the laboratory analyses of 0316-97-0536. There is no evidence for the release of organic constituents to the environment at this site.

TABLE 5.9.7-1
DETECTED ORGANIC CHEMICALS FOR PRS 16-024(Q)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	MEDIA	DEPTH (FT)
Pyrene	0316-97-0536	0.091(J[a])	1900	Soil	0-1

a. J = Analyte was positively identified, but the result is estimated to be more uncertain than would normally be expected for that analysis.

5.9.8 Risk-Based Screening Assessment

Four inorganic and one semivolatile organic chemical were detected above UTLs and EQLs. Manganese was present at 43% of its SAL and lead was present at 7% of its SAL in sample 0316-97-0536. All of the remaining chemicals were reported at less than 1% of their SALs. There is no risk to human health with a release of these chemicals at these levels. Visual examination of the data suggests an MCE would fall far below the target value of 1.0.

5.9.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-024(q) because contamination was not detected at levels at or above SALs.

5.9.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.9.11 Conclusions and Recommendations

Four screening samples and one laboratory sample were collected in and downgradient from the footprint of former HE magazine TA-16-71. All screening results were negative, so the laboratory sample was selected from the location downgradient from the former location of the door of the bunker. Mercury, lead, cobalt and manganese were detected but none above SALs. Pyrene was the only organic compound detected at less than 0.1 mg/kg.

The biased sampling and analysis strategy at this former magazine was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on information about the location, orientation, construction, use of the former building, and mode of decommissioning. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, a single confirmatory laboratory sample is sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory sample was selected near the location of the door to the former HE magazine, because this would have been the area of greatest activity. It was analyzed for all potential contaminants based on historical knowledge of operations in TA-16-71.

PRS 16-024(q) is recommended for human-health NFA based on NFA Criterion 5 because contamination is not present at this site at levels that present a potential risk to human health.

5.10 PRS 16-024(r)

This PRS is the site of the former HE magazine TA-16-68 located in the southern portion of the GMX-2 area (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.10.1 History

PRS 16-024(r) is discussed in detail in Subsection 5.20 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

TA-16-68 was an HE magazine located in GMX-2 area constructed in January 1945. Little information is known regarding this HE magazine, however, it was suggested that operations in magazines were likely to have resulted in HE spills (Martin 1993, 15-16-477). HE magazines were used to store packaged HE and finished HE products before and after processing. No HE processing was done in such magazines. The magazine contained no sumps or plumbing. It was abandoned in late winter 1959. Before being burned in 1960, it was determined that the magazine was contaminated with HE (Engineering Department 1959, 15-16-256).

The potential contamination at this PRS was identified as metals, SVOCs, and HE.

5.10.2 Description

TA-16-68 was 6 ft by 6 ft by 7 ft of wooden-frame construction with a wooden floor and with earthen barricades on three sides and on top. It was located southwest of TA-16-56, on flat terrain, with no nearby well-defined drainage.

5.10.3 Previous Investigation(s)

No previous field investigations were conducted at this PRS.

5.10.4 Field Investigation

The goal of the Phase I investigation at PRS 16-024(r), as outlined in the approved RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2)

mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect residual HE in the surface and near-surface soil at the site of the magazine footprint. The mode of decommissioning of the magazine and the fact that magazines were used for HE storage, but not for HE processing suggest that residual contamination is unlikely at this PRS.

Addendum 1 (LANL 1994, 1160) specified screening soil samples, 0 to 1 ft depth intervals, from four locations and selecting one laboratory sample only if positive field screening results were obtained. The plan called for taking the screening samples within two of the four quadrants of the building, on the side of the footprint opposite the door, and 1 foot downgradient from the location of the door. The laboratory sample was to be selected from the screening samples using the following prioritized biasing scheme: (1) a sample with a positive HE spot test kit result; and (2) a sample with above two times background radiation readings. In response to an EPA NOD (EPA 1994, 15-16-644), one laboratory sample was collected (based on the above scheme), even if all field screening results were negative.

One deviation was made to the approved work plan. The screening samples were analyzed for RDX and TNT using the D-Tech™ Immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of 4 field screening samples were taken from 4 locations in and adjacent to the building footprint. The samples were collected from the 0 to 1 ft depth interval. The field screening samples were taken within two of the four quadrants of the building, on the side of the footprint opposite the door, and 1 foot downgradient from the location of the door (Fig. 5.10.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which had wooden floors, is hypothesized to be via either: (1) HE spills near door areas; or (2) leakage from cracks within wooden floors.

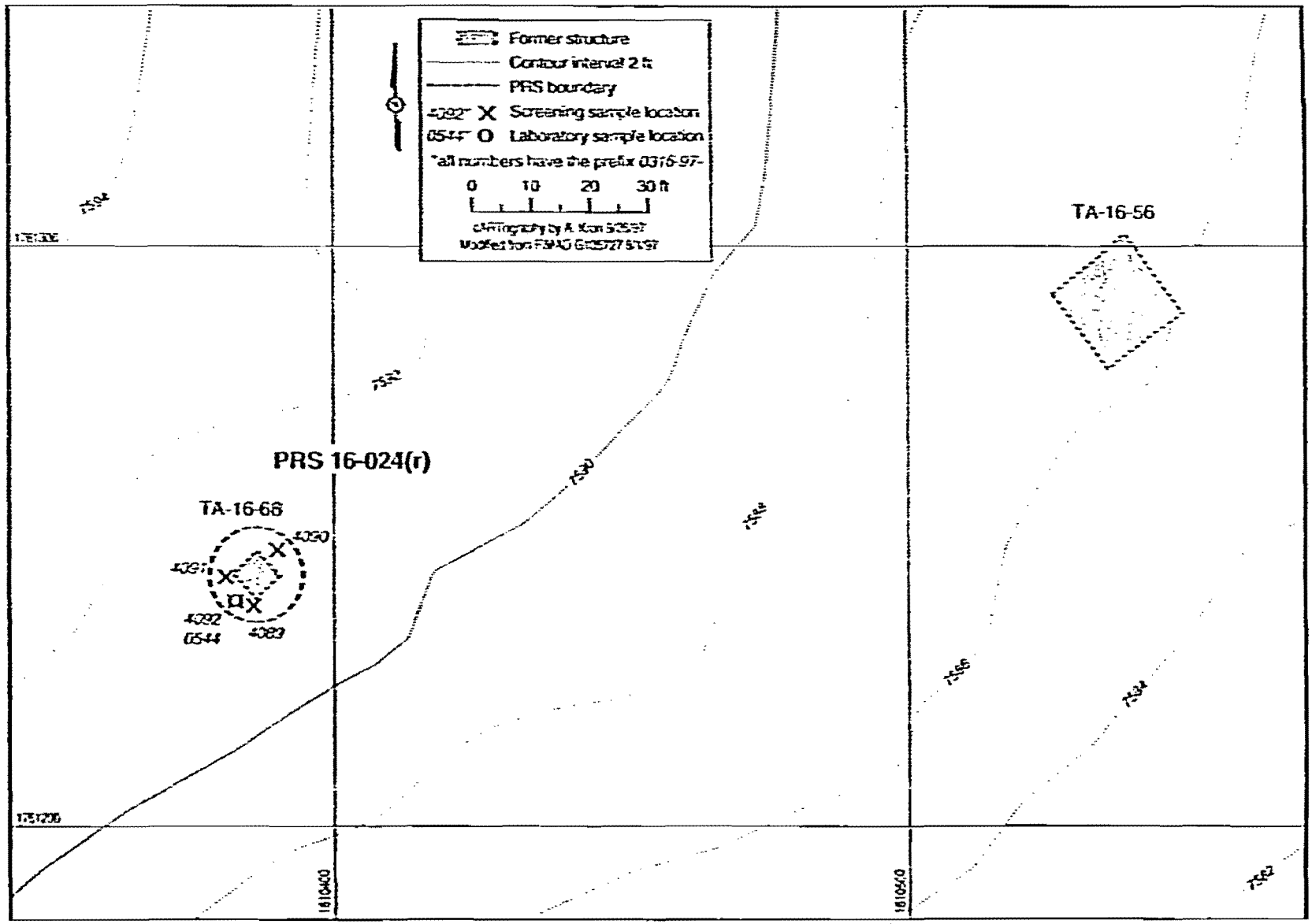


Fig. 5.10.4-1 Locations of PRS 16-024(r) samples.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-00.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). Samples were analyzed for RDX and TNT using the D-Tech™ Immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050). The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. Three samples screened positive for HE using the D-Tech™ kit (Table 5.10.4-1).

TABLE 5.10.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4089 southeast quadrant	16-4089	0 - 1	NA[a]	negative	background	0.5 - 1.5	< 0.5
0316-97-4090 opposite door	16-4090	0 - 1	NA	negative	background	0.5 - 1.5	< 0.5
0316-97-4091 southwest quadrant	16-4091	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4092 downgradient door	16-4092	0 - 1	0316-97-0544	negative	background	< 0.5	0.5 - 1.5

a. NA = Not analyzed.

Screening sample 0316-97-4092 contained an elevated concentration of TNT (0.5 to 1.5 mg/kg) and was downgradient from the former door location. This sample was submitted to the laboratory for analysis (Table 5.10.4-1). The sample was analyzed for metals, SVOCs, and HE (Table 5.10.4-2).

TABLE 5.10.4-2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES
TAKEN AT PRS 16-024(r)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MATRIX	INORGANICS	SVOCS	HE
16-4092	0316-97-0544	0 - 1	soil	3440R	3438R	3439R

5.10.5 Evaluation of Inorganic Chemicals

No inorganic chemicals were present at levels greater than UTL or SALs at PRS 16-024(r). Baseline validation indicated no problems that affect the use of these inorganic data.

5.10.6 Evaluation of Radionuclides

Radionuclides were not analyzed for at PRS 16-024(r) because historical evidence indicated that radioactive material was not stored or used in this HE magazine. Additionally, field screening did not indicate the presence of radioactive constituents.

5.10.7 Evaluation of Organic Chemicals

No HE was detected in sample 0316-97-0544, despite indications of the presence of TNT in the associated field screening sample. The positive D-Tech™ result, which suggested that low levels of TNT were present, was not confirmed by the fixed laboratory analysis. The D-Tech™ kits have been shown to provide false positives due to interferences with humic materials. See Section 4.3.2 for further details.

No organic chemicals were detected in sample 0316-97-0544. Baseline validation indicates no data quality problems associated with these analyses that affect the use of these organic data.

5.10.8 Risk-Based Screening Assessment

No screening assessment was performed because chemicals were not present at levels at or above UTLs or EQLs at PRS 16-024(r).

5.10.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-024(r) because contamination was not detected at or above SALs.

5.10.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.10.11 Conclusions and Recommendations

Four screening samples and one laboratory sample were collected in and adjacent to the footprint of the former HE magazine TA-16-60. One laboratory samples was selected from one of three screening samples that screened positive for HE. It was located downgradient from the door to the magazine. The sample contained no inorganic or organic contamination above detection limits and UTLs.

The biased sampling and analysis strategy at this former magazine was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on information about the location, orientation, construction, use of the former building, and mode of decommissioning. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, a single confirmatory laboratory sample is sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory sample was selected from screening samples based on field screening results, and was analyzed for all potential contaminants based on historical knowledge of operations in TA-16-60.

PRS 16-024(r) is recommended for human-health NFA based on NFA Criterion 5 because contamination is not present at this site at levels that present a potential risk to human health.

5.11 PRS 16-024(s)

This PRS is the former site of HE magazine TA-16-60, located at the south periphery of the decommissioned World War II area (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.11.1 History

PRS 16-024(s) is discussed in detail in Subsection 5.26 of the RFI Work Plan for Operable Unit 1082, Addendum 2 (LANL 1995, 1342).

TA-16-60 was a receiving magazine built in 1945 that was used for storage of finished HE product and packaged, raw HE. No HE processing was done at the magazine. The magazine had no sumps or plumbing. It was abandoned in 1959 and was removed in late 1950 due to its proximity to the TA-16-435 construction site.

The potential contamination at this PRS was identified as metals, SVOCs, and HE.

5.11.2 Description

TA-16-60 was 20 ft by 60 ft by 8.6 ft and had concrete floors and soil piled up against three sides of the building but not over the top. It was located inside the HE exclusion zone in a grass and tree-covered field that slopes southeast.

5.11.3 Previous Investigation(s)

No previous field investigations were conducted at this PRS.

5.11.4 Field Investigation

The goal of the Phase I investigation at PRS 16-024(s), as outlined in the approved RFI Work Plan for Operable Unit 1082, Addendum 2 (LANL 1995, 1342), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect residual HE contamination in heterogeneous surface and near-surface soil at the site of the building footprint. The mode of decommissioning of the magazine and the fact that magazines were used for HE storage, but not for HE processing, suggest that residual contamination is unlikely at this PRS.

Addendum 2 (LANL 1995, 1342) specified screening soil samples, 0 to 1 ft depth intervals, from five locations and selecting one laboratory sample based on field screening results. The plan called for taking the samples at the four quadrants of the building and adjacent to the location of the door. The laboratory sample was to be selected from the screening samples using the following prioritized biasing scheme: (1) a sample with a positive HE spot test kit result; (2) a sample with an above two times background radiation reading; and (3) a sample at the door location.

Two deviations were made from the work plan.

- The screening samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

- Screening samples were collected from 1 to 2 ft depth intervals (as well as the required 0 to 1 ft intervals) to confirm that the soil beneath this concrete floored building had not been disturbed during decommissioning. One screening sample was collected at 0 - 0.7 ft depth (rather than the required 1 ft depth). And the deeper interval sample (at 2 ft depth) at this same location was not collected because of hand auger refusal. At another location, the 2 ft depth interval sample was not collected because of hand auger refusal.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of eight field screening samples from five locations were taken in and adjacent to the building footprints. At three locations, samples were taken at 0 to 1 ft and 1 to 2 ft depth intervals. One sample was collected at location 16-4095 (sample 0316-97-4095) from the 0 to 0.7 ft depth interval. One sample was collected at location 16-4096 (sample 0316-97-4096) from the 0 to 1 ft depth interval. (Fig. 5.11.4-1). The two locations were not sampled to the total depth of 2 ft because the hand auger met refusal at solid material. The absence of these samples did not affect the screening decision because the material was undisturbed. According to the conceptual model, potential contaminants should not be present in the undisturbed material. These screening sample locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which had concrete floors, is hypothesized to be via either: (1) HE spills near door areas; or (2) leakage at the floor/wall joints.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels).

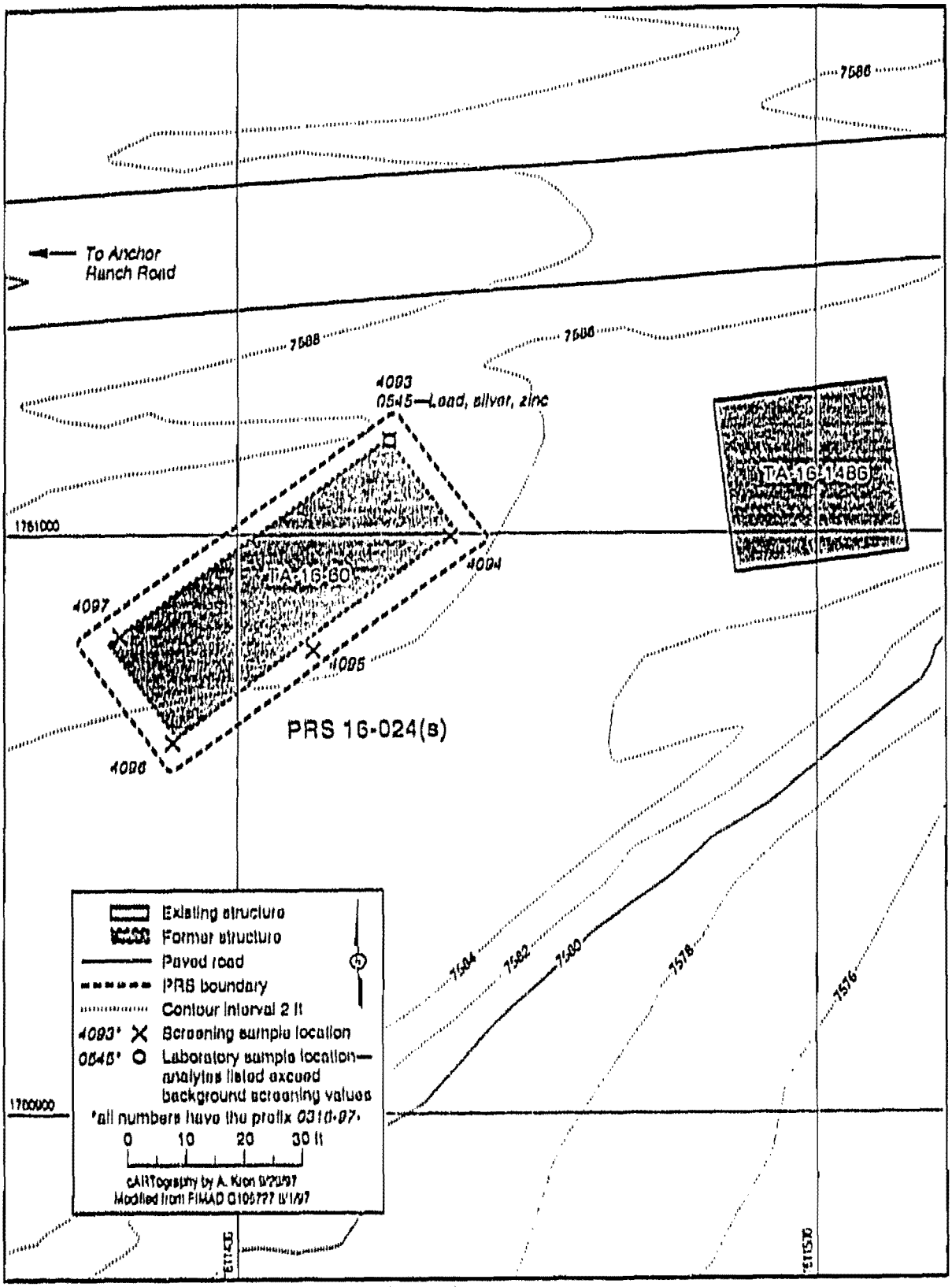


Fig. 5.11.4-1 Locations of PRS 16-024(s) samples.

Samples at 0 to 1 ft depth intervals were analyzed for RDX and TNT using the D•Tech™ immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050). The 0 to 1 ft intervals were selected for further characterization, rather than the 1 to 2 ft intervals, because the soil beneath the PRS structure is undisturbed, as confirmed by the soil descriptions in the sample collection logs. If contamination is present within the structure footprint, it is most likely present at shallow depths directly beneath the structure. The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. Two samples screened positive for HE using the D•Tech™ kit (Table 5.11.4-1).

TABLE 5.11.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D•TECH RDX (MG/KG)	D•TECH TNT (MG/KG)
0316-97-4093 northwest quadrant	16-4093	0 - 1	0316-97-0545	negative	background	4.5 - 6.0	0.5 - 1.5
0316-97-4094 northeast quadrant	16-4094	0 - 1	NA[a]	negative	background	0.5 - 1.5	< 0.5
0316-97-4095 door	16-4095	0 - 0.7	NA	negative	background	< 0.5	< 0.5
0316-97-4096 southeast quadrant	16-4096	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4097 southwest quadrant	16-4097	0 - 1	NA	negative	background	< 0.5	< 0.5

a. NA = Not analyzed.

Screening sample 0316-97-4093 contained the highest concentrations of RDX and TNT (4.5 to 6.0 mg/kg and 0.5 to 1.5 mg/kg). This sample was submitted to the laboratory for analysis (as laboratory sample 0316-97-0545). Additional samples were collected (in duplicate) from this same location at the deeper depth interval (1 to 2 ft) to confirm that HE was not found at depth. These samples were collected as QA/QC samples (0316-97-0598 and 0316-97-0599), and were submitted to the laboratory for analysis (Tables 5.11.4-1 and 5.11.4-2).

TABLE 5.11.4-2
SUMMARY OF FIELD SCREENING RESULTS
FOR QA/QC SAMPLES

LOCATION ID	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D•TECH RDX (MG/KG)	D•TECH TNT (MG/KG)	QA/QC SAMPLE
16-4093	0316-97-0599	negative	background	< 0.5	< 0.5	0316-97-0598

The laboratory samples were analyzed for metals SVOCs, and HE (Table 5.11.4-3).

TABLE 5.11.4-3
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES TAKEN AT PRS 16-024(s)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MEDIA	SVOC	HE	INORGANIC
16-4093	0316-97-0545	0-1	Soil	3417R	3418R	3419R
16-4093	0316-97-0598	1-2	Soil	3526R	3527R	3528R
16-4093	0316-97-0599	1-2	Soil	3526R	3527R	3528R

5.11.5 Evaluation of Inorganic Chemicals

Lead and zinc were reported in sample 0316-97-0545 above background UTLs but below SALs. Silver was reported as estimated (J) at 0.37 mg/kg, because the duplicate analysis in this run was not within control limits, indicating possibly low precision. Antimony was reported as estimated undetected (UJ) at 7.3 mg/kg in sample 0316-97-0545, because the matrix spike recovery was low (52%) (Table 5.11.5-1). This result is accepted as undetected, as discussed in Section 4.1. No inorganic chemicals were detected above UTLs in the field duplicate pair of samples 0316-97-0598 and 0316-97-0599. Baseline validation identified no other problems that affect the use of these data.

TABLE 5.11.5-1
INORGANIC CHEMICALS WITH CONCENTRATIONS AT OR ABOVE BACKGROUND SCREENING VALUES FOR PRS 16-024(s)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	UTL (MG/KG)	MEDIA	DEPTH (FT)
Antimony	0316-97-0545	7.3(UJ[b])	31	1	Soil	0-1
Lead	0316-97-0545	35.6	400	23.3	Soil	0-1
Silver	0316-97-0545	0.37(J[c])	380	NC[a]	Soil	0-1
Zinc	0316-97-0545	62.8	23000	50.8	Soil	0-1

a. NC = not calculated
b. UJ = Analyte was not detected; the associated value is an estimate of the detection limit or quantitation limit.
c. J = Analyte was positively identified, but the result is estimated to be more uncertain than would normally be expected for that analysis.

5.11.6 Evaluation of Radionuclides

Radionuclides were not analyzed for at PRS 16-024(s) because historical evidence indicated that radioactive material was not stored or used in this HE magazine. Additionally, field screening did not indicate the presence of radioactive constituents.

5.11.7 Evaluation of Organic Chemicals

No HE was detected in any sample, despite indications of the presence of TNT and RDX in the field screening sample associated with sample 0316-97-0545. The positive D-Tech™ result, which suggested that low levels of TNT and RDX were present, was not confirmed by fixed laboratory analysis. The D-Tech™ kits have been shown to provide false positives due to interferences with humic materials. See Section 4.3.2 for further details. Baseline validation identified no problems with the laboratory analyses.

No SVOCs were detected in any sample. All SVOC non-detects for sample 0316-97-0545 were qualified estimated undetected (UJ), but as discussed in Section 4.3.1, these were accepted as undetected following focused validation. Baseline validation indicated no other problems that affect the use of these data.

5.11.8 Risk-Based Screening Assessment

Lead was detected at less than 10% of its SAL, and zinc and silver at less than 1% of their SALs. Antimony was reported as undetected. A visual inspection of the data suggest an MCE would be far below the largest value of 1.0.

5.11.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-024(s) because contamination was not detected above SALs

5.11.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.11.11 Conclusions and Recommendations

Eight screening samples and three laboratory samples were collected in and downgradient from the footprint of former HE magazine TA-16-60. One laboratory sample was selected from the location with the highest screening results, but these results were not confirmed by laboratory analysis. The other laboratory samples were QA/QC duplicate splits collected at a depth of 1-2 ft at the same location. Lead and zinc were reported in the surface sample slightly above UTLs but well below SALs. No HE or organic compounds were detected. No inorganic or organic contamination was found above SALs and no COPCs were identified.

The biased sampling and analysis strategy at this former magazine was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on information about the location, orientation, construction, use of the former building, and mode of decommissioning,. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, sampling at one location was judged sufficient to indicate whether or not such contamination is present at levels of concern. Because of the high initial screening result, three laboratory samples were collected at this location. All samples were analyzed for all potential contaminants based on historical knowledge of operations in TA-16-60.

PRS 16-024(s) is recommended for human-health NFA based on NFA Criterion 5 because contamination is not present at this site at levels that present a potential risk to human health.

5.12 PRS 16-025(b2)

This PRS is the site of former casting building TA-16-52, located in the GMX-2 area (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.12.1 History

PRS 16-025(b2) is discussed in detail in Subsection 5.20 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

TA-16-52 was designed in the fall of 1944 as an experimental casting and machining building and served this function throughout its active lifetime (Martin 1993, 15-16-477). The structure had no sump adjacent to the building, only three sumps located approximately 75 ft to the southeast of the building and connected to the building. The locations of these sumps are currently

depressed sinkholes. The drain lines from these tanks exited into the main drainage to the east of the GMX-2 area. The sumps and drain lines are PRS 16-029(a2) and are addressed in the RFI Work Plan for Operable Unit 1082 Addendum 1 (LANL 1994, 1160).The building was abandoned in 1959 and decommissioned by burning in 1960. It was considered to be contaminated with HE before its decommissioning (Engineering Department 1959, 15-16-256).

The potential contamination at this PRS was identified as metals, SVOCs, and HE.

5.12.2 Description

TA-16-52 was located on level ground southeast of TA-16-49 in the southern portion of the GMX-2 area. It consisted of three sections, 15 ft long x 15 ft wide x 9 ft high, 10 ft-8 in. x 15 ft x 9 ft , and 23 ft x 15 ft x 9 ft. It also contained a steel reinforced concrete divider in its southern portion. This portion of the building was separated from the rest of the structure by an earthen barricade. The building was of wooden-frame construction with a concrete floor. The entire structure was surrounded by a large earthen barricade on the west, north, and south sides.

5.12.3 Previous Investigation(s)

No previous field investigations were conducted at this PRS.

5.12.4 Field Investigation

The goal of the Phase I investigation at PRS 16-025(b2), as outlined in the approved RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect HE contamination in heterogeneous surface and subsurface soil at the site of the building footprint. The mode of decommissioning of the building by burning suggests that residual contamination is unlikely at this PRS.

Addendum 1 (LANL 1994, 1160) specified screening soil samples, 0 to 1 ft depth intervals, from six locations and selecting two laboratory samples based on field screening results. The plan called for taking the samples at the four quadrants of the building, at the building center, and adjacent to the location of the door. The laboratory samples were to be selected from the screening samples using the following prioritized biasing scheme: (1) samples with positive HE spot test kit result; (2) samples with above two times background radiation reading; (3) a sample at the door location; and (4) a sample at the building center. In response to an EPA NOD (EPA 1994, 15-16-844), screening samples were collected from 1 to 2 ft depth intervals (as well as the required 0 to 1 ft intervals) to confirm that the soil beneath this concrete floored building had not been disturbed during decommissioning.

One deviation was made to the approved work plan. The screening samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of 12 field screening samples from 6 locations were taken in and adjacent to the building footprints. Two samples were collected from each location, at 0 to 1 ft and 1 to 2 ft depth intervals. The samples were collected near the corners of the four quadrants of the buildings, at the center, and at the door location (Fig. 5.12.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which had concrete floors, is hypothesized to be via either: (1) HE spills near door areas; or (2) leakage at the floors and floor/wall joints associated with floor washing.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). Samples at 0 to 1 ft depth intervals were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050). The 0 to 1 ft intervals were selected for further characterization, rather

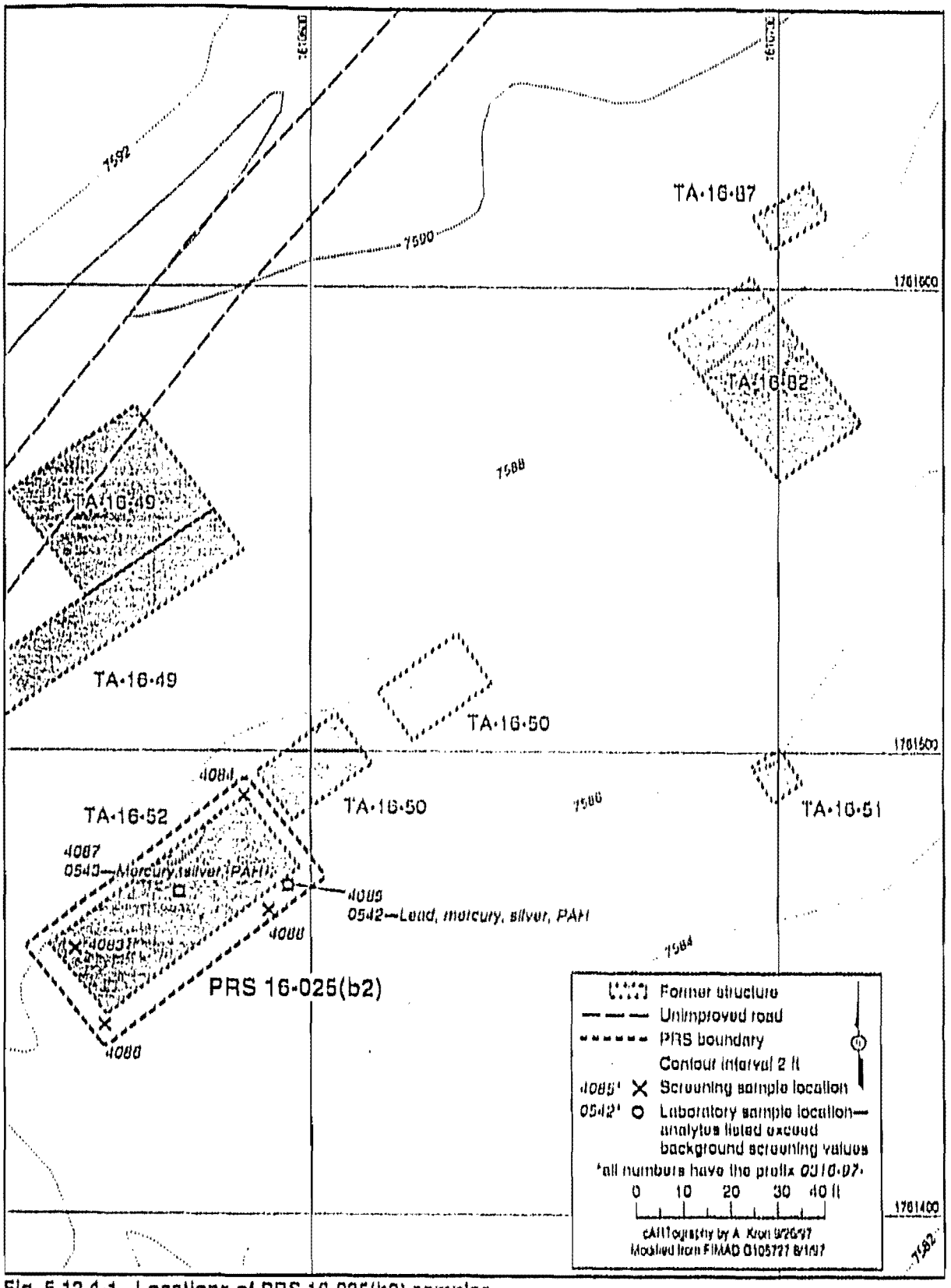


Fig. 5.12.4-1 Locations of PRS 16-025(b2) samples.

than the 1 to 2 ft intervals, because the soil beneath the PRS structure is undisturbed, as confirmed by the soil descriptions in the sample collection logs. If contamination is present within the structure footprint, it is most likely present at shallow depths directly beneath the structure. The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. Three samples screened positive for HE using the D-Tech™ kit (Table 5.12.4-1).

TABLE 5.12.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4083 southwest quadrant	16-4083	0 - 1	NA[a]	negative	background	< 0.5	0.5 - 1.5
0316-97-4084 northwest quadrant	16-4084	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4085 northeast quadrant	16-4085	0 - 1	0316-97-0542	negative	background	0.5 - 1.5	< 0.5
0316-97-4086 southeast quadrant	16-4086	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4087 center	16-4087	0 - 1	0316-97-0543	negative	background	< 0.5	0.5 - 1.5
0316-97-4088 door	16-4088	0 - 1	NA	negative	background	< 0.5	< 0.5

a. NA = Not analyzed.

Screening sample 0316-97-4087 contained an elevated concentration of TNT (0.5 to 1.5 mg/kg) and was the center location. This sample was submitted to the laboratory for analysis. Screening sample 0316-97-4085 was one of the remaining two samples which contained an elevated concentration of HE (0.5 to 1.5 mg/kg RDX) and was selected randomly. The random sample was selected by using a random-number generator to select a number one or two. The two numbers corresponded to the northeast and southwest quadrants (the quadrants containing samples with elevated HE). The northeast quadrant sample was selected. This sample was submitted to the laboratory for analysis (Table 5.12.4-1). The laboratory samples were analyzed for metals, SVOCs, and HE (Table 5.12.4-2).

TABLE 5.12.4-2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES
TAKEN AT PRS 16-025(b2)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MATRIX	SVOC	HE	INORGANIC
16-4085	0316-97-0542	0-1	Soil	3457R	3458R	3459R
16-4087	0316-97-0543	0-1	Soil	3457R	3458R	3459R

5.12.5 Evaluation of Inorganic Chemicals

Lead was detected above background UTLs. Antimony was undetected by the laboratory at 6.7 mg/kg and 7.5 mg/kg (Table 5.12.5-1). The data were qualified as estimated undetected (UJ) because the matrix spike recoveries were below the acceptable level (52 %). These results are accepted as non detects, as discussed in Section 4.1. Mercury was detected in both samples above background levels. As discussed in Section 4.1, the data of Ferenbaugh et al (1990, 0099) are being used to make background evaluations for mercury for data reported below the UTL of 0.1 mg/kg.) Silver was detected at 1.5 mg/kg, above the instrument detection limits but below the reporting limits (lab qualifier of B). The data was reevaluated as estimated (J).

Baseline validation revealed no other problems with the inorganic analyses that affect their use in this report.

TABLE 5.12.5-1
INORGANIC CHEMICALS WITH CONCENTRATIONS AT OR ABOVE
BACKGROUND SCREENING VALUES FOR PRS 16-025(b2)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	SAL UNITS	UTL (MG/KG)	MEDIA	DEPTH (FT)
Antimony	0316-97-0542	6.7(UJ[a])	31	MG/KG	1	Soil	0-1
Antimony	0316-97-0543	7.5(UJ)	31	MG/KG	1	Soil	0-1
Lead	0316-97-0542	27.9	400	MG/KG	23.3	Soil	0-1
Mercury	0316-97-0542	0.17(J[b])	23	MG/KG	NC[c]	Soil	0-1
Mercury	0316-97-0543	0.6(J)	23	MG/KG	NC	Soil	0-1
Silver	0316-97-0542	1.5(J)	380	MG/KG	NC	Soil	0-1
Silver	0316-97-0543	1.5(J)	380	MG/KG	NC	Soil	0-1

a. UJ = Analyte was not detected; the associated value is an estimate of the detection limit or quantitation limit.
b. J = Analyte was positively identified, but the result is estimated to be more uncertain than would normally be expected for that analysis.
c. NC = not calculated

5.12.6 Evaluation of Radionuclides

Radionuclides were not analyzed for at PRS 16-025(b2) because historical evidence indicated that radioactive material was not stored or used in the casting building. Additionally, field screening did not indicate the presence of radioactive constituents.

5.12.7 Evaluation of Organic Chemicals

PAHs were detected in samples 0316-97-0542 and 0316-97-0543 at low concentrations (Table 5.12.7-1). These data were PM-qualified (professional judgment needed) during baseline validation because the samples missed the extraction holding time by two days. Recent EPA findings indicate that minor deviations from the extraction holding times have little effect on sample results for soil samples; see discussion in Section 4.3.1. All data are considered usable; detected results were requalified as estimated (J) and estimated undetected results (UJ).

No HE was detected in sample 0316-97-0542 and 0316-97-0543, despite indications of the presence of TNT and RDX in the associated field screening sample. The positive D-Tech™ result, which suggested that low levels of TNT and RDX were present, was not confirmed by the fixed laboratory analysis. The D-Tech™ kits have been shown to provide false positives due to interferences with humic materials. See Section 4.3.2 for further details.

The qualifiers shown in Table 5.12.7-1 have been assigned during focused data validation.

TABLE 5.12.7-1
DETECTED ORGANIC CHEMICALS FOR PRS 16-025(b2)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	MEDIA	DEPTH (FT)
Benzo(a)anthracene	0316-97-0543	0.036(J[a])	0.61	Soil	0-1
Benzo(b)fluoranthene	0316-97-0543	0.05(J)	0.61	Soil	0-1
Benzo(k)fluoranthene	0316-97-0543	0.042(J)	6.1	Soil	0-1
Chrysene	0316-97-0543	0.047(J)	61	Soil	0-1
Fluoranthene	0316-97-0542	0.034(J)	2600	Soil	0-1
Fluoranthene	0316-97-0543	0.054(J)	2600	Soil	0-1
Pyrene	0316-97-0542	0.055(J)	1900	Soil	0-1
Pyrene	0316-97-0543	0.053(J)	1900	Soil	0-1

a. J = Analyte was positively identified, but the result is estimated to be more uncertain than would normally be expected for that analysis.

5.12.8 Risk-Based Screening Assessment

Detected inorganics are present at less than 10% of SALs. Detected organic chemicals are present only at low levels (less than 1 mg/kg).

Four inorganic and five organic chemicals were carried forward from the background comparison and organic constituent evaluation. Analytes are divided into two classes, noncarcinogens and carcinogens, for the screening assessment depending on which toxicological effect forms the basis of their SAL. This separation is required to evaluate possible additive effects within each class of chemical.

An MCE calculation was performed using the sum of the maximum concentrations at this PRS. The MCE calculations are presented in Table 5.12.8-1. The MCE results for noncarcinogens and carcinogens are 0.4 and 0.2, respectively. The MCE value for both classes is less than unity; therefore, a potential human health risk based on additive effects is not identified for this class of chemical.

TABLE 5.12.8-1
MCE CALCULATION FOR PRS 16-025(b2)

	MAXIMUM CONCENTRATION	SAL	
ANALYTE	MG/KG	MG/KG	NORMALIZED VALUE
Noncarcinogenic Effects			
Antimony	8	31	0.25806
Lead	28	400	0.07000
Mercury	0.6	23	0.02609
Silver	2	380	0.00526
Fluoranthene	0.05	2600	0.00002
Pyrene	0.06	1900	0.00003
TOTAL			0.4
Carcinogenic Effects			
Benzo(a)anthracene	0.04	0.61	0.06557
Benzo(b)fluoranthene	0.05	0.61	0.08197
Benzo(k)fluoranthene	0.04	6.1	0.00656
Chrysene	0.05	61	0.00082
TOTAL			0.2

5.12.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-025(b2) because contamination was not detected at levels at or above SALs.

5.12.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.12.11 Conclusions and Recommendations

Twelve screening samples and two laboratory samples were collected in and adjacent to the footprint of the former casting building TA-16-52. The laboratory samples were selected from screening samples with positive HE screening results. No HE was detected in the laboratory samples. Trace amounts of inorganics and organic compounds were reported above detection but at levels far below SALs. The data show that no contaminants are present at this site at levels of concern to human health.

The biased sampling and analysis strategy at this former casting building was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on information about the location, orientation, construction, use of the former building, and mode of decommissioning. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, two confirmatory laboratory samples are sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory samples were based on field screening results, and were analyzed for all potential contaminants based on historical knowledge of operations in TA-16-52.

PRS 16-025(b2) is recommended for human-health NFA because contamination is not present at this site at levels that present a potential risk to human health.

5.13 PRS 16-025(d)

This PRS is the site of former equipment and control building TA-16-94, located in the GMX-3 area (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.13.1 History

PRS 16-025(d) is discussed in detail in Subsection 5.19 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

TA-16-94 was an equipment and control building for machining buildings TA-16-95, TA-16-96, TA-16-97, and TA-16-98. It was the center building of the North/South/East/West machining line. It is possible, but unlikely, that some HE was used in the building. The building had no sump or plumbing. TA-16-94 was built in 1948, abandoned in 1959 and destroyed in 1960 by intentional burning. Surveys completed before the destruction of the building suggest it was free of HE contamination (Engineering Department 1956, 15-16-256).

The potential contamination at this PRS was identified as metals, SVOCs, and HE.

5.13.2 Description

TA-16-94 was on relatively level ground with a slight slope to the northeast. The exact dimensions of the building are unknown. Based on photographs, it is estimated to be 30 ft by 30 ft with a 10 ft by 10 ft extension on the west side. The building was of wooden-frame construction on a concrete platform.

5.13.3 Previous Investigation(s)

No previous investigations were conducted at this PRS.

5.13.4 Field Investigation

The goal of the Phase I investigation at PRS 16-025(d), as outlined in the approved RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect residual HE in the surface and near-surface soil at the site of the building footprint. The mode of

decommissioning of the building by burning suggests that residual contamination is unlikely at this PRS.

Addendum 1 (LANL 1994, 1160) specified screening soil samples, 0 to 1 ft depth intervals, from four locations and selecting one laboratory sample if a positive field screening reading is obtained. The plan called for taking the samples at the four quadrants of the building. The laboratory sample was to be selected from the screening samples using the following prioritized biasing scheme: (1) a sample with a positive HE spot test kit result; and (2) a sample with an above two times background radiation reading. In response to an EPA NOD (EPA 1994, 15-16-644), screening samples were collected from 1 to 2 ft depth intervals (as well as the required 0 to 1 ft intervals) to confirm that the soil beneath this concrete floored building had not been disturbed during decommissioning, and one laboratory sample was collected, (based on the above scheme), even if all field screening results were negative.

One deviation was made to the approved work plan. The screening samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of eight field screening samples were taken from four locations in the building footprint. Two samples were collected from each location, at 0 to 1 ft and 1 to 2 ft depth intervals. The samples were collected near the corners of the four quadrants of the building (Fig. 5.13.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which had concrete floors, is hypothesized to be via leakage at the floor/wall joints.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels).

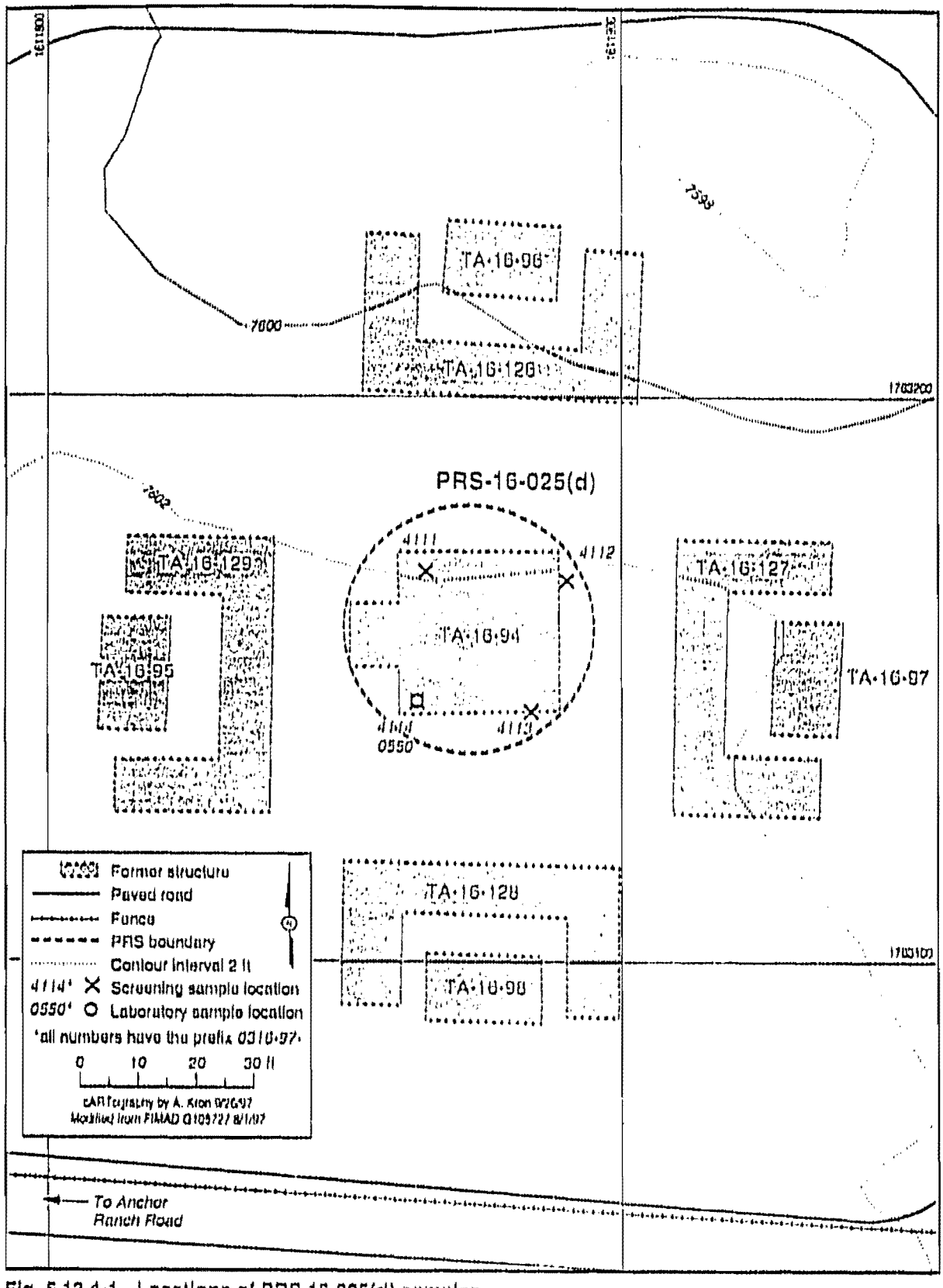


Fig. 5.13.4-1 Locations of PRS 16-025(d) samples.

Samples at 0 to 1 ft depth intervals were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050). The 0 to 1 ft intervals were selected for further characterization, rather than the 1 to 2 ft intervals, because the soil beneath the PRS structure is undisturbed, as confirmed by the soil descriptions in the sample collection logs. If contamination is present within the structure footprint, it is most likely present at shallow depths directly beneath the structure. The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. One sample screened positive for HE using the D-Tech™ kit (Table 5.13.4-1).

TABLE 5.13.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4111 northwest quadrant	16-4111	0 - 1	NA[a]	negative	background	< 0.5	< 0.5
0316-97-4112 northeast quadrant	16-4112	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4113 southeast quadrant	16-4113	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4114 southwest quadrant	16-4114	0 - 1	0316-97-0550	negative	background	0.5 - 1.5	< 0.5

a. NA = Not analyzed.

Screening sample 0316-97-4114 contained the highest concentration of HE (0.5 to 1.5 mg/kg RDX) and was submitted to the laboratory for analysis (Table 5.13.4-1). The sample was analyzed for metals, SVOCs, and HE (Table 5.13.4-2).

TABLE 5.13.4-2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES FOR PRS 16-025(d)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MATRIX	INORGANICS	SVOCS	HE
16-4114	0316-97-0550	0 - 1	soil	3443R	3441R	3442R

5.13.5 Evaluation of Inorganic Chemicals

No inorganic chemicals were present at levels greater than UTL in sample 0316-97-0550. Baseline validation indicates no data quality problems associated with the analyses that affect the use of the results.

5.13.6 Evaluation of Radionuclides

Radionuclides were not analyzed for at PRS 16-025(d) because historical evidence indicated that radioactive material was not stored or used in the equipment and control building. Additionally, field screening did not indicate the presence of radioactive constituents.

5.13.7 Evaluation of Organic Chemicals

No organic chemicals were detected in sample 0316-97-0550, despite indications of the presence of RDX in the associated field screening sample. The positive D-Tech™ result, which suggested that low levels of RDX were present, was not confirmed by the fixed laboratory analysis. The D-Tech™ kits have been shown to provide false positives due to interferences with humic materials. See Section 4.3.2 for further details.

Baseline validation indicates no data quality problems associated with these analyses that affect the use of the organic data.

5.13.8 Risk-Based Screening Assessment

No chemicals were present at levels at or above UTLs or EQLs at PRS 16-025(d).

5.13.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-025(d) because contamination was not detected at levels at or above SALs.

5.13.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.13.11 Conclusions and Recommendations

Eight screening samples and one laboratory sample were collected in and adjacent to the footprint of the former equipment and control building TA-16-94. One laboratory sample was selected from the only sample with a positive HE screening result. The sample contained no inorganic or organic contamination above detection limits and UTLs. The data show that no contaminants are present at this site at levels of concern to human health.

The biased sampling and analysis strategy at this former equipment and control building was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on information about the location, orientation, construction, use of the former building, and mode of decommissioning. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, a single confirmatory laboratory sample is sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory sample was selected from screening samples based on field screening results, and was analyzed for all potential contaminants based on historical knowledge of operations in TA-16-94.

PRS 16-025(d) is recommended for human-health NFA because contamination is not present at this site at levels that present a potential risk to human health.

5.14 PRS 16-025(g)

This PRS is the site of former machining building TA-16-95, located in the GMX-3 area (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.14.1 History

PRS 16-025(g) is discussed in detail in Subsection 5.16 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

TA-16-95 was an HE machining building which was the western building of the North/South/East/West machining line, built in November 1948. The building had a sump PRS 16-029(m) which is addressed in the RFI Work Plan for Operable Unit 1082 Addendum 1(LANL 1994, 1160). The building was designated as HE contaminated in a 1959 HE survey (Engineering Department 1959, 16-16-256) and was subsequently abandoned. It was destroyed by intentional burning in 1960.

The potential contamination at this PRS was identified as metals, SVOCs, and HE.

5.14.2 Description

The building was located east of the 306-Line on flat terrain with a slight drop in elevation to the northeast. The building was 20 ft long x 12 ft wide with a 20 ft x 6 ft porch, and was of wooden-frame construction on concrete floors. It had a U-shaped and wooden-walled earthen barricade

separating it from a central utility building, TA-16-94. Some drainage probably flowed into a gully on the east side of the building. The building series was surrounded by access roads that roughly formed a square border.

5.14.3 Previous Investigation(s)

No previous investigations were conducted at this PRS.

5.14.4 Field Investigation

The goal of the Phase I investigation at PRS 16-025(g), as outlined in the approved Addendum 1 (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect surface and near-surface HE contamination of nonhomogeneous soil at the site of the building footprint. The mode of decommissioning of the building by burning suggests that residual contamination is unlikely at this PRS.

Addendum 1 (LANL 1994, 1160) specified screening soil samples, 0 to 1 ft depth intervals, from six locations and selecting two laboratory samples based on screening results. The plan called for taking the samples at the four quadrants of the building, in the building center, and adjacent to the location of the door. The laboratory samples were to be selected from the screening samples using the following prioritized biasing scheme: (1) samples with positive HE spot test kit results; (2) samples with above two times background radiation reading; (3) a sample at the building door; (4) a sample at building center; and (5) random samples. In response to an EPA NOD (EPA 1994, 15-16-644), screening samples were collected from 1 to 2 ft depth intervals (as well as the required 0 to 1 ft intervals) to confirm that the soil beneath this concrete floored building had not been disturbed during decommissioning, and three laboratory samples were collected (based on the above scheme) rather than two laboratory samples.

One deviation was made to the approved work plan. The samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of 12 field screening samples were taken from 6 locations in and adjacent to the building footprint. Two samples were collected from each location, at 0 to 1 ft and 1 to 2 ft depth intervals. The samples were collected near the corners of the four quadrants of the building, in the building center, and adjacent to the location of the door (Fig. 5.14.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which had concrete floors, is hypothesized to be via either: (1) HE spills near door areas; or (2) leakage at the floor and floor/wall joints.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). Samples at 0 to 1 ft depth intervals were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050). The 0 to 1 ft intervals were selected for further characterization, rather than the 1 to 2 ft intervals, because the soil beneath the PRS structure is undisturbed, as confirmed by the soil descriptions in the sample collection logs. If contamination is present within the structure footprint, it is most likely present at shallow depths directly beneath the structure. The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

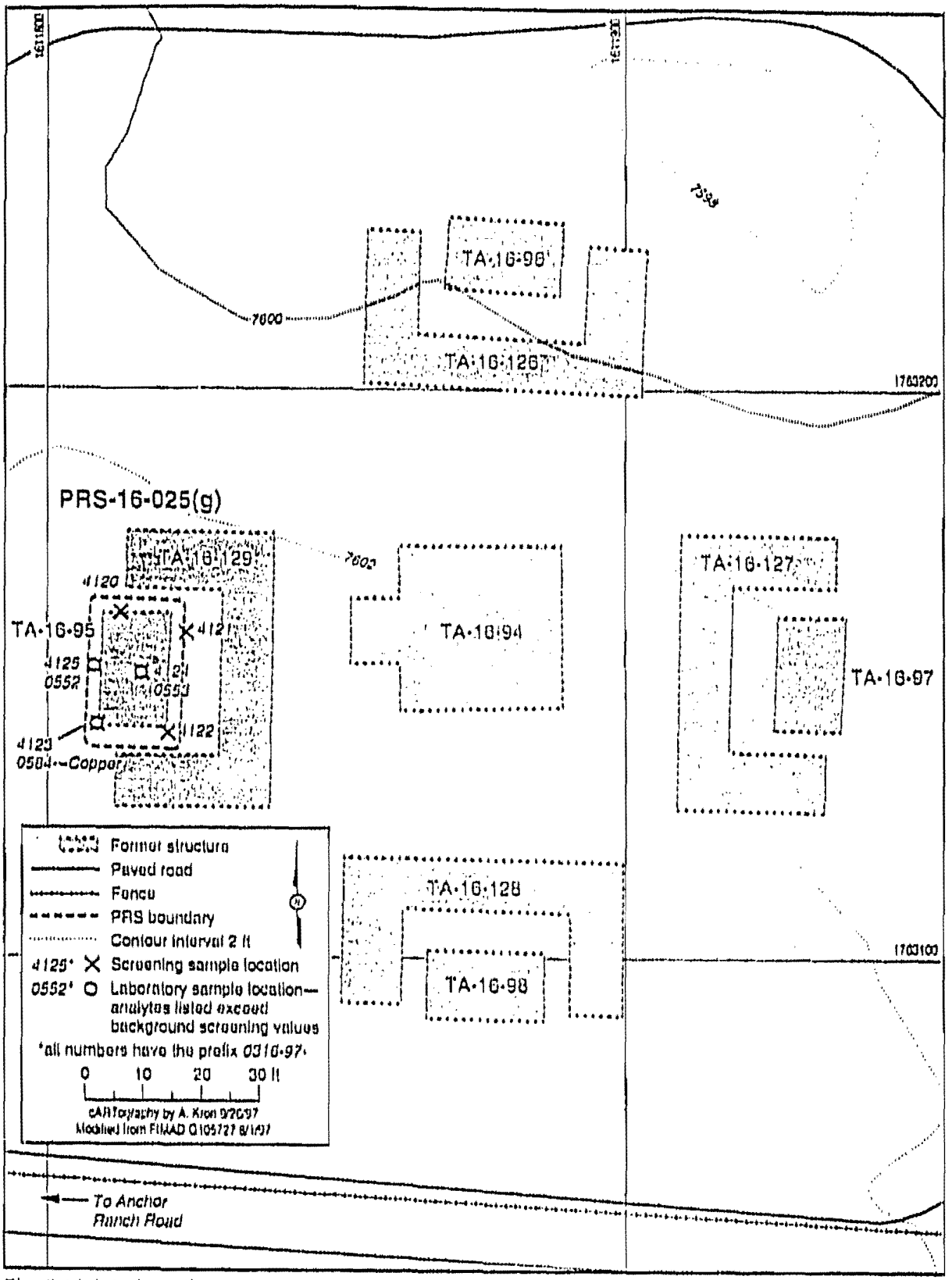


Fig. 5.14.4-1 Locations of PRS 16-025(g) samples.

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. One sample screened positive for HE using the D-Tech™ kit (Table 5.14.4-1).

TABLE 5.14.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4120 northwest quadrant	16-4120	0 - 1	NA[a]	negative	background	< 0.5	< 0.5
0316-97-4121 northeast quadrant	16-4121	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4122 southeast quadrant	16-4122	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4123 southwest quadrant	16-4123	0 - 1	0316-97-0584	negative	background	< 0.5	< 0.5
0316-97-4124 center	16-4124	0 - 1	0316-97-0553	negative	background	< 0.5	< 0.5
0316-97-4125 door	16-4125	0 - 1	0316-97-0552	negative	background	< 0.5	0.5 - 1.5

a. NA = Not analyzed.

Screening sample 0316-97-4125 contained the highest concentration of TNT (0.5 to 1.5 mg/kg) and was the door location. This sample was submitted to the laboratory for analysis. The other samples submitted to the laboratory, 0316-97-4124 and 0316-97-4123, were below detection for TNT and RDX and were selected from the center and a random location, respectively. The random sample was selected by using a random-number generator to select a number one through four. These numbers corresponded with the northeast, northwest, southeast, and southwest quadrants. The southwest quadrant sample was selected (Table 5.14.4-1). The samples were analyzed for metals, SVOCs, and HE (Table 5.14.4-2).

TABLE 5.14.4-2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES FOR PRS 16-025(g)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MATRIX	SVOC	HE	INORGANIC
16-4125	0316-97-0552	0-1	Soil	3441R	3442R	3443R
16-4124	0316-97-0553	0-1	Soil	3441R	3442R	3443R
16-4123	0316-97-0584	0-1	Soil	3441R	3442R	3443R

5.14.5 Evaluation of Inorganic Chemicals

Copper was detected slightly above the background UTL but below the SAL. Baseline validation revealed no problems with the inorganic analyses (Table 5.14.5-1).

TABLE 5.14.5-1
INORGANIC CHEMICALS WITH CONCENTRATIONS AT OR ABOVE BACKGROUND SCREENING VALUES FOR PRS 16-025(g)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	UTL (MG/KG)	MEDIA	DEPTH (FT)
Copper	0316-97-0584	16.6	2800	15.5	Soil	0-1

5.14.6 Evaluation of Radionuclides

Radionuclides were not analyzed for at PRS 16-025(g) because historical evidence indicated that radioactive material was not stored or used in the machining building. Additionally, field screening did not indicate the presence of radioactive constituents.

5.14.7 Evaluation of Organic Chemicals

No HE was detected in any laboratory sample, despite indications of the presence of TNT in the field screening sample associated with sample 0316-97-0552. The positive D-Tech™ result, which suggested that low levels of TNT were present, was not confirmed by the fixed laboratory analysis. The D-Tech™ kits have been shown to provide false positives due to interferences with humic materials. See Section 4.3.2 for further details.

No organic chemicals were detected in any laboratory sample. Baseline validation indicates no data quality problems associated with these analyses. The data indicate no evidence for a release of organic constituents at the site.

5.14.8 Risk-Based Screening Assessment

Copper was detected slightly above the background UTL, at less than 1% of its SAL. No other chemical was reported above detection limits and UTLs in any laboratory sample.

5.14.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-025(g) because contamination was not detected at levels at or above SALs.

5.14.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.14.11 Conclusions and Recommendations

Twelve screening samples and three laboratory samples were collected in and adjacent to the footprint of the former machining building TA-16-95. Laboratory samples were selected from the only sample with a positive HE screening result, the center location, and a random location. No inorganic or organic contamination was present in the samples above detection limits. The data show that no contaminants are present at this site at levels of concern to human health.

The biased sampling and analysis strategy at this former machining building was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on information about the location, orientation, construction, use of the former building, and mode of decommissioning. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, three confirmatory laboratory samples are sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory samples were selected from screening samples based on the site specific prioritization scheme and were analyzed for all potential contaminants based on historical knowledge of operations in TA-16-95.

PRS 16-025(g) is recommended for human-health NFA based on NFA Criterion 5 because contamination is not present at this site at levels that present a potential risk to human health.

ER96-0525-A-1

5.15 PRS 16-025(h)

This PRS is the site of former machining building TA-16-90, located in the GMX-3 area (Fig. 5.0-1). It is recommended for human-health because contamination is not present at levels that present a potential risk to human health.

5.15.1 History

PRS 16-025(h) is discussed in detail in Subsection 5.18 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

TA-16-96 was an HE machining building that was the northern building in the North/South/East/West machining line. The building was constructed in 1948 and used for HE machining until the TA-16-260 machining building was completed in the early 1950s. The building had a sump, PRS 16-029(n), that is addressed in the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160). The building was designated as HE contaminated in a 1959 HE survey (Engineering Department 1959, 15-16-256) and was subsequently abandoned. It was destroyed by intentional burning in 1960.

The potential contamination at this PRS was identified as metals, SVOCs, and HE.

5.15.2 Description

The building was located east of the 30s-Line on flat terrain with a slight drop in elevation to the northeast. The building was 20 ft long x 12 ft wide with a 20 ft x 6 ft porch, and of wooden-frame construction on a concrete floor. It had a U-shaped and wooden-walled earthen barricade separating it from a central utility building, TA-16-94. Some drainage probably flowed into a culvert under the northern end of the easternmost road into a gully. This building series was surrounded by access roads that roughly formed a square boarder.

5.15.3 Previous Investigation(s)

No previous investigations were conducted at this PRS.

5.15.4 Field Investigation

The goal of the Phase I investigation at PRS 16-025(h), as outlined in the approved Addendum 1 (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is

hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect surface and near-surface HE contamination of nonhomogeneous soil at the site of the building footprint. The mode of decommissioning of the building by burning suggests that residual contamination is unlikely at this PRS.

Addendum 1 (LANL 1994, 1160) specified screening soil samples, 0 to 1 ft depth interval, from six locations and selecting two laboratory samples based on screening results. The plan called for taking the samples at the four quadrants of the building, in the building center, and adjacent to the location of the door. The laboratory samples were to be selected from the screening samples using the following prioritized biasing scheme: (1) samples with positive HE spot test kit results; (2) samples with above-two-times background radiation readings; (3) a sample at the building door; (4) a sample at the building center; and (5) random sampling. In response to an EPA NOD (EPA 1994, 15-16-644), screening samples were collected from 1 to 2 ft depth intervals (as well as the required 0 to 1 ft intervals) to confirm that the soil beneath this concrete floored building had not been disturbed during decommissioning, and three laboratory samples were collected (based on the above scheme) rather than two laboratory samples.

Two deviations were made from the work plan.

- The screening samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

- At one location, the soil/tuff/interface was located at 0.5 ft depth, therefore a soil sample was collected to 0.5 ft depth (rather than the required 1 ft depth) and the deeper interval sample (to 2 ft depth) was not collected because the hand auger met refusal. At another location, the deeper screening sample was collected to 1.2 ft (rather than the required 2 ft depths) because the hand auger met refusal at the soil/tuff interface.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an

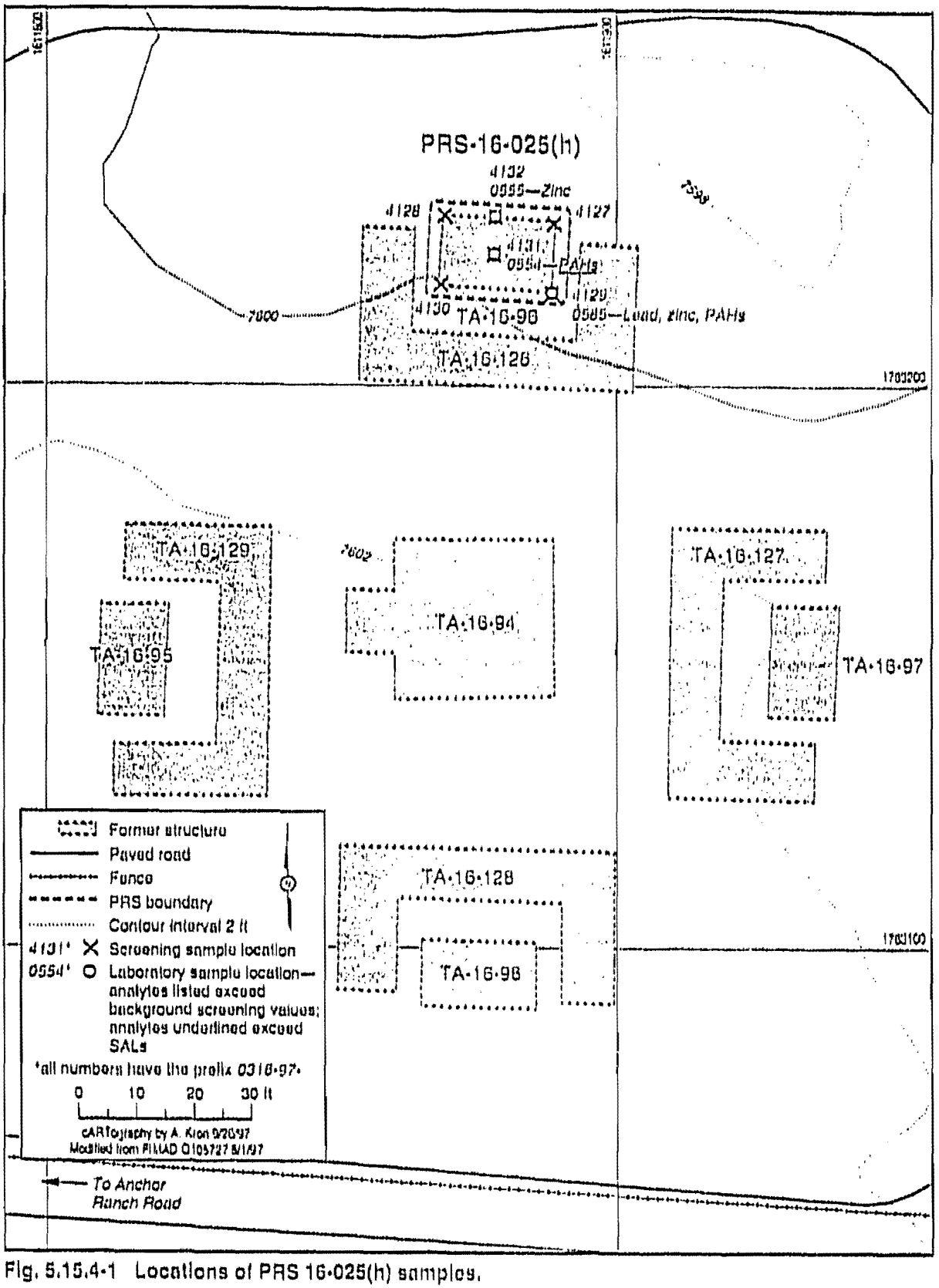


Fig. 5.15.4-1 Locations of PRS 16-025(h) samples.

estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of 11 field screening samples were taken from 6 locations in and adjacent to the building footprint. Two samples were collected from five locations, at 0 to 1 ft and 1 to 2 ft depth intervals. One sample was collected at one location where soil/tuff interface was encountered. The absence of one screening sample did not affect the screening decision because the material was undisturbed. According to the conceptual model, potential contamination should not be present in the undisturbed material. The field screening samples were taken near the corners of the four quadrants of the building, in the building center, and adjacent to the location of the door (Fig. 5.15.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which had concrete floors, is hypothesized to be via either: (1) HE spills near door areas; or (2) leakage at the floor/wall joints.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). Samples at 0 to 1 ft depth intervals were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050). The 0 to 1 ft intervals were selected for further characterization, rather than the 1 to 2 ft intervals, because the soil beneath the PRS structure is undisturbed, as confirmed by the soil descriptions in the sample collection logs. If contamination is present within the structure footprint, it is most likely present at shallow depths directly beneath the structure. The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. One sample screened positive for HE using the D-Tech™ kit (Table 5.15.4-1).

TABLE 5.15.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4127 northeast quadrant	16-4127	0 - 1	NA[a]	negative	background	< 0.5	< 0.5
0316-97-4128 northwest quadrant	16-4128	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4129 southeast quadrant	16-4129	0 - 1	0316-97-0585	negative	background	0.5 - 1.5	0.5 - 1.5
0316-97-4130 southwest quadrant	16-4130	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4131 center	16-4131	0 - 1	0316-97-0554	negative	background	< 0.5	< 0.5
0316-97-4132 door	16-4132	0 - 0.5	0316-97-0555	negative	background	< 0.5	< 0.5

a. NA = Not analyzed.

Screening sample 0316-97-4129 contained the highest concentrations of TNT and RDX (0.5 to 1.5 mg/kg for each analyte) and was submitted to the laboratory for analysis. The other two samples which were submitted to the laboratory (0316-97-4131 and 0316-97-4132) were the samples from the door and center locations, respectively (Table 5.15.4-1). Samples were analyzed for metals, SVOCs, and HE (Table 5.15.4-2).

TABLE 5.15.4-2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES TAKEN AT PRS 16-026(h)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MATRIX	INORGANICS	SVOCS	HE
16-4129	0316-97-0585	0 - 1	soil	3403R	3401R	3402R
16-4131	0316-97-0554	0 - 1	soil	3403R	3401R	3402R
16-4132	0316-97-0555	0 - 0.5	soil	3403R	3401R	3402R

5.15.5 Evaluation of Inorganic Chemicals

Lead and zinc were detected at levels slightly above background UTLs (Table 5.15.5-1). The antimony results were rejected as unusable because of calibration problems, as discussed in Section 4.1. Baseline validation indicated no other problems that affect the use of these inorganic data.

TABLE 5.15.5-1
INORGANIC CHEMICALS WITH CONCENTRATIONS AT OR ABOVE BACKGROUND SCREENING VALUES FOR PRS 16-025(h)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	UTL (MG/KG)	MEDIA	DEPTH (FT)
Lead	0316-97-0585	38	400	23.3	Soil	0-1
Zinc	0316-97-0555	54	23000	50.8	Soil	0-.5
Zinc	0316-97-0585	78	23000	50.8	Soil	0-1

5.15.6 Evaluation of Radionuclides

Radionuclides were not analyzed for at PRS 16-025(h) because historical evidence indicated that radioactive material was not stored or used the HE machining building. Additionally, field screening did not indicate the presence of radioactive constituents.

5.15.7 Evaluation of Organic Chemicals

No HE was detected in any laboratory sample, despite indications of the presence of TNT and RDX in the field screening sample associated with sample 0316-97-0585. The positive D-Tech™ result, which suggested that low levels of TNT and RDX were present, was not confirmed by the fixed laboratory analysis. The D-Tech™ kits have been shown to provide false positives due to interferences with humic materials. See Section 4.3.2 for further details. Baseline validation identified no problems with the laboratory analyses.

Ten PAH compounds were detected in samples 0316-97-0554 and 0316-97-0585 at or below 0.2 mg/kg including benzo(a)pyrene at a level greater than SAL. The levels reported in Table 5.15.7-1 are reported as estimated (J) by the analytical laboratory because they are below the EQLs for these chemicals. Results from sample 0316-97-0555 were originally reported as JPM (professional judgment required). The detected compounds were requalified as estimated (J).

No other organic chemicals were detected in samples 0316-97-0554, 0316-97-0555, or 0316-97-0585. Baseline validation indicates no data quality problems associated with these analyses.

TABLE 5.15.7-1
DETECTED ORGANIC CHEMICALS FOR PRS 16-025(h)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	MEDIA	DEPTH (FT)
Benzo(a)anthracene	0316-97-0554	0.072	0.61	Soil	0-1
Benzo(a)anthracene	0316-97-0585	0.072	0.61	Soil	0-1
Benzo(a)pyrene	0316-97-0554	0.08	0.061	Soil	0-1
Benzo(b)fluoranthene	0316-97-0554	0.2	0.61	Soil	0-1
Benzo(b)fluoranthene	0316-97-0585	0.079	0.61	Soil	0-1
Benzo(g,h,i)perylene	0316-97-0554	0.081	NC[a]	Soil	0-1
Benzo(k)fluoranthene	0316-97-0554	0.064	6.1	Soil	0-1
Chrysene	0316-97-0554	0.12	61	Soil	0-1
Fluoranthene	0316-97-0554	0.16	2600	Soil	0-1
Fluoranthene	0316-97-0585	0.039	2600	Soil	0-1
Indeno(1,2,3-cd)pyrene	0316-97-0554	0.085	0.61	Soil	0-1
Phenanthrene	0316-97-0554	0.098	NC	Soil	0-1
Pyrene	0316-97-0554	0.18	1900	Soil	0-1
Pyrene	0316-97-0585	0.036	1900	Soil	0-1

a. NC = not calculated

5.15.8 Risk-Based Screening Assessment

Lead was reported at less than 10% of its SAL in one sample, and zinc at less than 0.5% of its SAL in two. Antimony results were reported as unusable. No other inorganic chemicals were observed above background UTLs.

These two inorganic chemicals and ten organic PAH chemicals were carried forward from the background comparison and organic constituent evaluation. Analytes are divided into two classes, noncarcinogens and carcinogens, for the screening assessment, depending on which toxicological effect forms the basis of their SAL. This separation is required to evaluate possible additive effects within each class of chemical.

An MCE calculation was performed using the sum of the maximum concentrations of constituents present at levels less than SALs at this PRS (Table 5.15.8-1). The MCE calculations are presented in Table 5.15.8-1. The MCE results for noncarcinogens and carcinogens are 0.1 and 0.7, respectively. The MCE value for both classes are less than unity; therefore, a potential human health risk based on additive effects is not identified for these classes of chemical.

Although benzo(g,h,i)perylene and phenanthrene have no SALs, these PAH compounds are present at low concentrations which are orders of magnitude below SALs for similar compounds.

The evaluation of these PAH compounds is considered to be complete based on the evaluation of PAHs with the available SALs. Refer to Section 5.0.1 for a further discussion of PAH compounds without SALs.

The concentrations of the PAH compounds, including benzo(a)pyrene (which is present slightly above the SAL) are less than the EPA Region 9 PRGs for industrial soils. These concentrations correspond to carcinogenic risk levels below 10^{-6} under an industrial scenario.

TABLE 5.15.8-1
MCE CALCULATION FOR PRS 16-025(h)

	MAXIMUM CONCENTRATION	SAL	
ANALYTE	MG/KG	MG/KG	NORMALIZED VALUE
Noncarcinogenic Effects			
Lead	38	400	0.09500
zinc	78	23000	0.00339
Fluoranthene	0.2	2600	0.00008
Pyrene	0.2	1900	0.00011
TOTAL			0.1
Carcinogenic Effects			
Benzo(a)anthracene	0.1	0.61	0.16393
Indeno(1,2,3-cd)pyrene	0.1	0.61	0.16393
Benzo(b)fluoranthene	0.2	0.61	0.32787
Benzo(k)fluoranthene	0.1	6.1	0.01639
Chrysene	0.1	61	0.00164
TOTAL			0.7

The most likely explanation for the observation of PAHs in these soil samples is that they represent nonspecific contamination associated with general industrial sites. The "Toxicological Profile for Polycyclic Aromatic Hydrocarbons (PAHs)" by the Agency of Toxic Substances and Disease Registry shows that soil concentrations of PAHs in urban/industrial areas commonly range in the tens to hundreds of mg/kg. The source of these constituents includes combustion products from organic materials and fossil fuels and runoff from asphalt and roofing tar.

Process knowledge and history of operations associated with PRS 16-025(h) suggest that PAHs were not used in processes in this area. Asphalt is a common source of PAHs at industrial areas. The site is in close proximity to several former access roads. The sampling locations receive storm-water runoff from these asphalt roads. In addition, buried asphalt was noted in the field at depths of 6 to 9 inches at the locations of sample 0316-97-0554 and 0316-97-0585. Field notes indicate that asphalt may have been present in the samples.

5.15.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-025(h) because contamination associated with a release from the PRS was not detected above levels of concern.

5.15.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.15.11 Conclusions and Recommendations

Eleven screening samples and three laboratory samples were collected within and near the footprint of former building TA-16-96. One of the laboratory samples was selected based on the only positive screening results obtained. No HE was reported in the laboratory samples. Lead and zinc were detected above background UTL levels but far below levels of concern to human health. The detected organic constituents are low-level PAHs frequently associated with asphalt and industrial operations and field notes indicated that buried asphalt was present at this site and may have been in the collected samples. The samples were collected approximately thirty ft from an old road, and asphalt is visible on the ground surface. Knowledge of operations suggests that PAHs were not used in processes at this site. No other chemicals were present at levels of concern at PRS 16-025(h). The data show that no released contaminants are present at this site at levels of concern to human health.

The biased sampling and analysis strategy at this former machining building was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on information about the location, orientation, construction, use of the former building, and mode of decommissioning. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, three laboratory samples are sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory samples were selected from screening samples according to a site specific prioritization scheme and included the only sample with positive HE screening results. All samples were analyzed for all potential contaminants based on historical knowledge of operations in TA-16-96.

PRS 16-025(h) is recommended for human-health NFA based on NFA Criterion 5 because contamination is not present at this site at levels that present a potential risk to human health.

5.16 PRS 16-025(j)

This PRS is the site of former HE machining building TA-16-98, located in the GMX-3 area (Fig. 5.0-1). It is recommended for human-health NFA based on NFA Criterion 5 because no contaminants were detected above SALs.

5.16.1 History

PRS 025(j) is discussed in detail in Subsection 5.18 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

TA-16-98 was an HE machining building that was the south building in the North/South/East/West machining line built in November 1948. The building stored containers for disposal of pieces of HE at the burning ground. It had a sump, PRS 16-029(p), which is addressed in the RFI Work Plan for Operable Unit 1082 Addendum 1 (LANL 1994, 1160). The building was decommissioned as a machining building and converted into a coffee and smoking room. It was abandoned in December 1959, and was destroyed by intentional burning in 1960 (Engineering Department 1959, 15-16-256).

The potential contamination at this PRS was identified as metals, SVOCs, and HE.

5.16.2 Description

This building was 20 ft long x 12 ft wide with a 20 ft x 6 ft porch, and of wooden-frame construction on a concrete floor. The North/South/East/West buildings were surrounded by access roads that roughly formed a square border. The building had a U-shaped wooden-walled earthen barricade. It was located east of the 30s-Line on flat terrain that has a slight drop in elevation to the northeast.

5.16.3 Previous Investigation(s)

No previous investigations were conducted at this PRS.

5.16.4 Field Investigation

The goal of the Phase I investigation at PRS 16-025(j), as outlined in the approved Addendum 1 to the RFI Work Plan (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of Addendum 1. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations, or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil, or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect surface and near-surface HE contamination of nonhomogeneous soil at the site of the building footprint. The mode of decommissioning of the building by burning suggests that residual contamination is unlikely at this PRS.

Addendum 1 (LANL 1994, 1160) specified screening soil samples, taken at 0 to 1 ft depth intervals, from five locations and selecting one laboratory sample based on screening results. The plan called for taking the samples at the four quadrants of the building and adjacent to the location of the door. The laboratory sample was to be selected from the screening samples using the following prioritized biasing scheme: (1) a sample with positive HE spot test kit result, (2) a sample with a radiation reading two times above background; and (3) a sample at the building door. In response to an Environmental Protection Agency (EPA) notice of deficiency (NOD) (EPA 1994, 15-15-644.), screening samples were collected from 1 to 2 ft depth intervals (as well as the required 0 to 1 ft intervals) to confirm that the soil beneath this concrete floored building had not been disturbed during decommissioning, and three laboratory samples were collected (based on the above scheme) rather than one laboratory sample.

One deviation was made from Addendum 1. The screening samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

The building was accurately surveyed using a Trimble™ GPS total station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an

estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of 10 field screening samples were taken from 5 locations in the building footprint. Two samples were collected from each location, at 0 to 1 ft and 1 to 2 ft depth intervals. The samples were collected near the corners of the four quadrants of the building and adjacent to the location of the door (Fig. 5.16.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which had concrete floors, is hypothesized to be via either: (1) HE spills near door areas, or (2) leakage at the floor/wall joints.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). Samples at 0 to 1 ft depth intervals were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050). The 0 to 1 ft intervals were selected for further characterization, rather than the 1 to 2 ft intervals, because the soil beneath the PRS structure is undisturbed, as confirmed by the soil descriptions in the sample collection logs. If contamination is present within the structure footprint, it is most likely present at shallow depths directly beneath the structure. The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

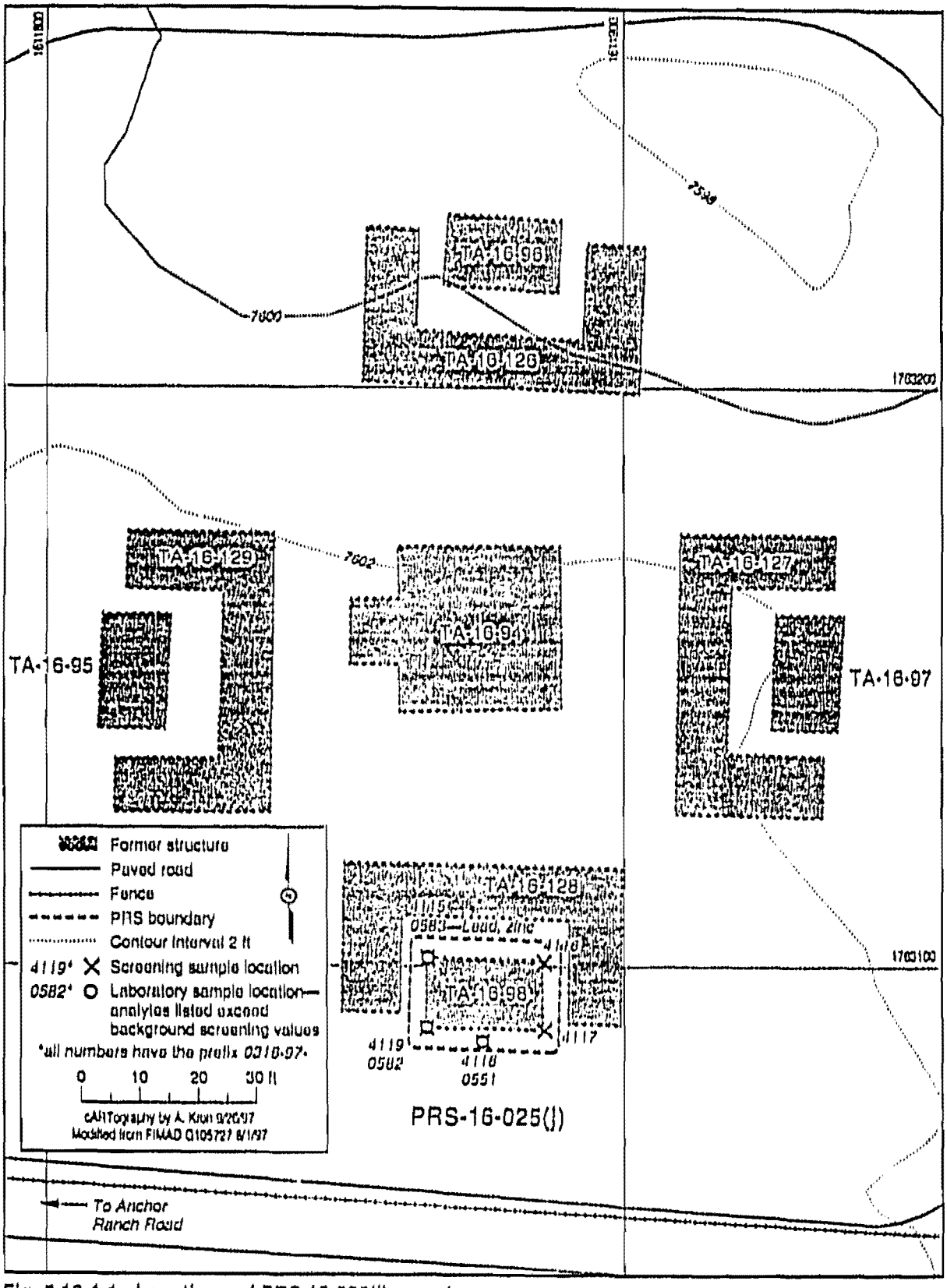


Fig. 5.16.4-1 Locations of PRS 16-025(j) samples.

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. No samples screened positive for HE using the D-Tech™ kit (Table 5.16.4-1).

TABLE 5.16.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4115 northwest quadrant	16-4115	0 - 1	0316-97-0583	negative	background	< 0.5	< 0.5
0316-97-4116 northeast quadrant	16-4116	0 - 1	NA[a]	negative	background	< 0.5	< 0.5
0316-97-4117 southeast quadrant	16-4117	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4118 door	16-4118	0 - 1	0316-97-0551	negative	background	< 0.5	< 0.5
0316-97-4119 southwest quadrant	16-4119	0 - 1	0316-97-0582	negative	background	< 0.5	< 0.5

a. NA = Not analyzed.

All of the samples screened below detection for RDX and TNT. Screening sample 0316-97-4118 was located adjacent to the former door and was submitted to the laboratory for analysis. The other two laboratory samples were selected randomly. The random samples were selected by using a random-number generator to select numbers one through four. These numbers corresponded with the northeast, northwest, southeast, and southwest quadrants. The northwest and southwest quadrant samples were selected(Table 5.16.4-1). Samples were analyzed for metals, SVOCs, and HE (Table 5.16.4-2).

TABLE 5.16.4-2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES FOR PRS 16-025(j)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MEDIA	SVOC	HE	INORGANIC
16-4118	0316-97-0551	0-1	Soil	3441R	3442R	3443R
16-4119	0316-97-0582	0-1	Soil	3441R	3442R	3443R
16-4115	0316-97-0583	0-1	Soil	3441R	3442R	3443R

5.16.5 Evaluation of Inorganic Chemicals

Lead and zinc were detected above background UTL (Table 5.16.5-1). Baseline validation revealed no problems with the inorganic analyses that affect the use of the data.

TABLE 5.16.5-1
INORGANIC CHEMICALS WITH CONCENTRATIONS AT OR ABOVE BACKGROUND SCREENING VALUES FOR PRS 16-025(j)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	UTL (MG/KG)	MEDIA	DEPTH (FT)
Lead	0316-97-0583	67	400	23.3	Soil	0-1
Zinc	0316-97-0583	260	23000	50.8	Soil	0-1

5.16.6 Evaluation of Radionuclides

Radionuclides were not analyzed for at PRS 16-025(j) because historical evidence indicated that radioactive material was not stored or used in the machining building. Additionally, field screening did not indicate the presence of radioactive constituents.

5.16.7 Evaluation of Organic Chemicals

No organic chemicals were detected above EQLs. Baseline validation indicated no data quality problems associated with these analyses.

5.16.8 Risk-Based Screening Assessment

Lead and zinc were detected in one sample at less than 20% and 2% of their SALs, respectively. No other chemicals were reported above detection limits and UTLs. Visual examination of the data suggests that an MCE would yield a value far below the target value of 1.0.

5.16.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-025(j) because contamination was not detected at levels at or above SALs.

5.16.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.16.11 Conclusions and Recommendations

Ten screening samples and three laboratory samples were collected in and adjacent to the footprint of the former machining building TA-16-98. In the absence of positive screening results,

laboratory samples were collected from the door location and randomly. No inorganic or organic contamination was detected at levels at or above SALs. The data show that no contaminants are present at this site at levels of concern to human health.

The biased sampling and analysis strategy at this former machining building was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on information about the location, orientation, construction, use of the former building, and mode of decommissioning. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, three laboratory samples are sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory samples were selected from the door to the former building, because this would have been the area of greatest activity and randomly (where there were no other biasing criteria). The samples were analyzed for all potential contaminants based on historical knowledge of operations in TA-16-93.

PRS 16-025(j) is recommended for human-health NFA based on NFA Criterion 5 because contamination is not present at this site at levels that present a potential risk to human health.

5.17 PRS 16-025(k)

This PRS is the site of HE inspection building TA-16-25, located in the GMX-3 area (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.17.1 History

PRS 16-025(k) is discussed in detail in Subsection 5.18 of RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

The building, TA-16-25, was constructed in February 1944 without a sump as part of the 20s-Line. TA-16-25 initially served as an HE powder inspection room (Ackerman 1945, 15-16-509; Martin 1993, 15-16-477). HE powder was spread on tables for the removal of foreign objects such as nails in preparation for casting (Martin 1993, 15-16-477). An early S-Site drawing suggested that a drain line exited TA-16-25 from its southeast corner and emptied into a pond nearby. The drain line and pond associated with this building is PRS 16-029(r), which is addressed in Addendum 1 to the OU 1082 Work Plan (LANL 1994, 1160). The building was abandoned in 1959 and was shown to be HE contaminated before intentional burning in March 1968.

The potential contamination at this PRS was identified as metals, SVOCs, and HE.

5.17.2 Description

TA-16-25 was a wooden-frame building (20 ft long x 30 ft wide x 15 ft high) with a concrete foundation and floor, plus an addition (6 ft long x 10 ft wide x 15 ft high). This PRS was located on level ground.

5.17.3 Previous Investigation(s)

No previous investigations were conducted at this PRS.

5.17.4 Field Investigation

The goal of the Phase I investigation at PRS 16-025(k), as outline in the approved Addendum 1 (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect surface and near-surface HE contamination of nonhomogeneous soil at the site of the building footprint. The mode of decommissioning of the building by burning suggests that residual contamination is unlikely at this PRS.

Addendum 1 (LANL 1994, 1160) specified screening soil samples, 0 to 1 ft depth intervals, from five locations and selecting one laboratory sample based on screening results. The plan called for taking the samples at the four quadrants of the building and adjacent to the location of a door. The laboratory sample was to be selected from the screening samples using the following prioritized biasing scheme: (1) a sample with positive HE spot test kit result; (2) a sample with above two times background radiation reading; and (3) a sample at building door. In response to an EPA NOD (EPA 1994, 15-16-644), screening samples were collected from 1 to 2 ft depth intervals (as well as the required 0 to 1 ft intervals) to confirm that the soil beneath this concrete-floored building had not been disturbed during decommissioning, and three laboratory samples were collected (based on the above scheme) rather than one laboratory sample.

Two deviations were made from the work plan.

- A sixth screening location was selected at the second door location, because door locations are likely places for spills to have occurred or for material to have been swept out of the structures.
- The screening samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of 12 field screening samples were taken from 6 locations in the building footprint. Two samples were collected from each location, at 0 to 1 ft and 1 to 2 ft depth intervals. The field screening samples were taken near the corners of the four quadrants of the building and adjacent to the location of two doors (Fig. 5.17.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which had concrete floors, is hypothesized to be via either: (1) HE spills near door areas; or (2) leakage at the floor/wall joints.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). Samples at 0 to 1 ft depth intervals were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050). The 0 to 1 ft intervals were selected for further characterization, rather than the 1 to 2 ft intervals, because the soil beneath the PRS structure is undisturbed, as confirmed by the soil descriptions in the sample collection logs. If contamination is present within the structure footprint, it is most likely present at shallow depths directly beneath the structure. The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

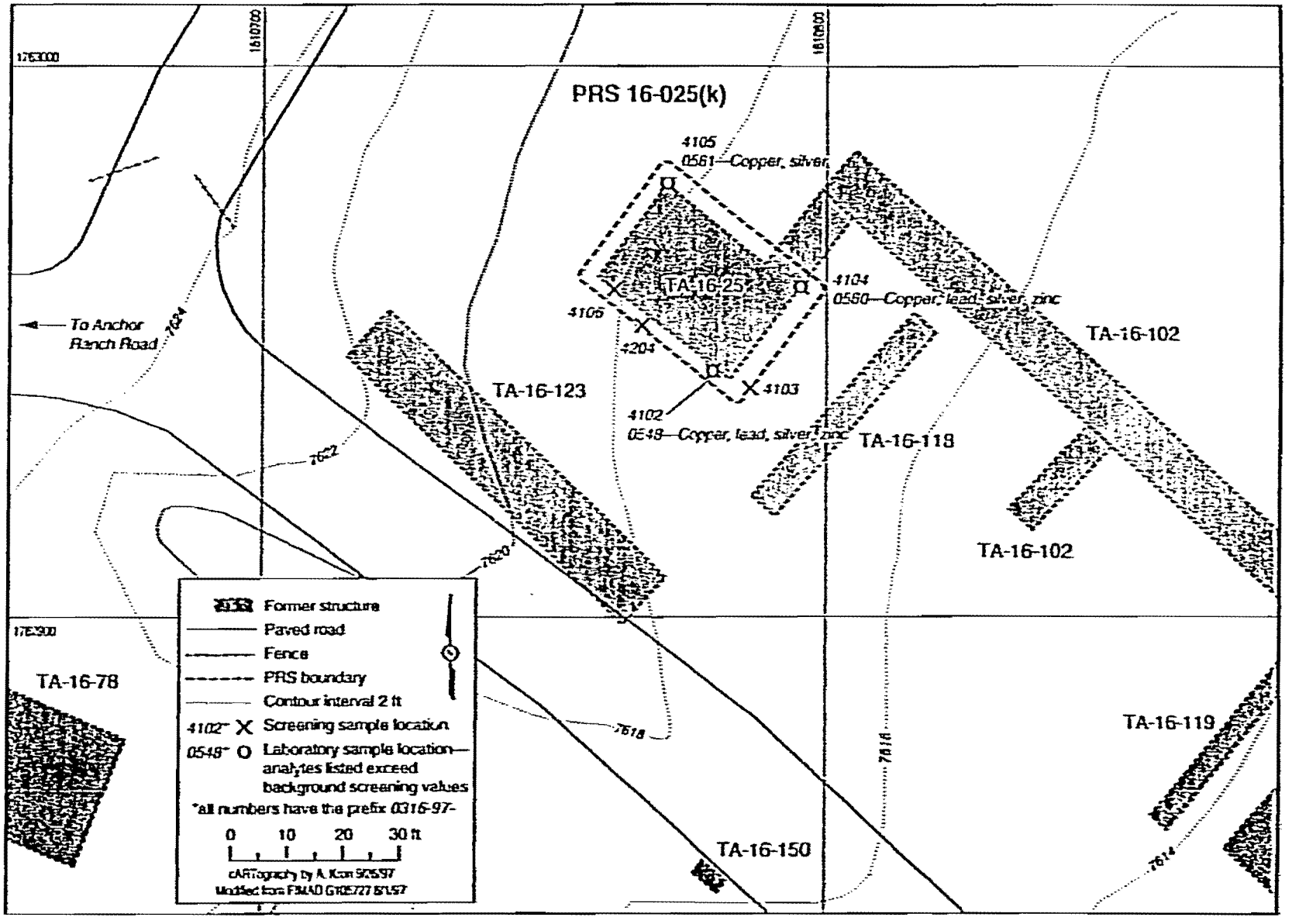


Fig. 5.17.4-1 Locations of PRS 16-025(k) samples.

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. Four samples screened positive for HE using the D-Tech™ kit (Table 5.17.4-1).

TABLE 5.17.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4102 door	16-4102	0 - 1	0316-97-0548	negative	background	0.5 - 1.5	0.5 - 1.5
0316-97-4103 southeast quadrant	16-4103	0 - 1	NA[a]	negative	background	< 0.5	< 0.5
0316-97-4104 northeast quadrant	16-4104	0 - 1	0316-97-0580	negative	background	0.5 - 1.5	< 0.5
0316-97-4105 northwest quadrant	16-4105	0 - 1	0316-97-0581	negative	background	0.5 - 1.5	< 0.5
0316-97-4106 southwest quadrant	16-4106	0 - 1	NA	negative	background	< 0.5	0.5 - 1.5
0316-97-4204 door	16-4204	0 - 1	NA	negative	background	< 0.5	< 0.5

a. NA = Not analyzed.

Sample 0316-97-4102 screened positive for RDX and TNT and was the door location. This sample was submitted for laboratory analysis. Samples 0316-97-4104 and 0316-97-4105 screened positive for RDX and were submitted for laboratory analysis (Table 5.17.4-1) Samples were analyzed for metals, SVOCs, and HE (Table 5.17.4-2).

TABLE 5.17.4-2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES FOR PRS 16-025(k)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MEDIA	SVOC	HE	INORGANIC
16-4102	0316-97-0548	0-1	Soil	3457R	3458R	3459R
16-4104	0316-97-0580	0-1	Soil	3457R	3458R	3459R
16-4105	0316-97-0581	0-1	Soil	3457R	3458R	3459R

5.17.5 Evaluation of Inorganic Chemicals

Lead was detected in two samples above the background UTL. Copper and zinc were reported at concentrations above the UTLs (Table 5.17.5-1). These data were originally P-qualified (professional judgment required) because the duplicate recoveries were below the acceptable limits of 20 %. The data was requalified as estimated (J) because they are adequate for comparison to SALs that are much larger than the reported values. Antimony was reported as undetected by the laboratory at 6.7 to 7.3 mg/kg. The data were qualified as estimated undetected (UJ) because the matrix spike recoveries were below the acceptable level (52 %), but are accepted as non detects as discussed in Section 4.1. Silver was detected at 0.87 mg/kg, 0.95 mg/kg, and 1.1 mg/kg, above the instrument detection limits but below the reporting limits (lab qualifier B). The data were reevaluated as estimated (J). Baseline validation revealed no other problems with the inorganic analyses that affect the use of these data.

TABLE 5.17.5-1
INORGANIC CHEMICALS WITH CONCENTRATIONS AT OR ABOVE BACKGROUND SCREENING VALUES FOR PRS 16-025(k)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	UTL (MG/KG)	MEDIA	DEPTH (FT)
Antimony	0316-97-0548	7.3(UJ[b])	31	1	Soil	0-1
Antimony	0316-97-0580	7.3(UJ)	31	1	Soil	0-1
Antimony	0316-97-0581	6.7(UJ)	31	1	Soil	0-1
Copper	0316-97-0548	96.8(J[c])	2800	15.5	Soil	0-1
Copper	0316-97-0580	150(J)	2800	15.5	Soil	0-1
Copper	0316-97-0581	18.6(J)	2800	15.5	Soil	0-1
Lead	0316-97-0548	43.1	400	23.3	Soil	0-1
Lead	0316-97-0580	33.1	400	23.3	Soil	0-1
Silver	0316-97-0548	1.1(J)	380	NC[a]	Soil	0-1
Silver	0316-97-0580	0.95(J)	380	NC	Soil	0-1
Silver	0316-97-0581	0.87(J)	380	NC	Soil	0-1
Zinc	0316-97-0548	91.3(J)	23000	50.8	Soil	0-1
Zinc	0316-97-0580	61.4(J)	23000	50.8	Soil	0-1

a. NC = not calculated
b. UJ = Analyte was not detected; the associated value is an estimate of the detection limit or quantitation limit.
c. J = Analyte was positively identified, but the result is estimated to be more uncertain than would normally be expected for that analysis.

5.17.6 Evaluation of Radionuclides

Radionuclides were not analyzed for at PRS 16-025(k) because historical evidence indicated that radioactive material was not stored or used in the HE inspection building. Additionally, field screening did not indicate the presence of radioactive constituents.

5.17.7 Evaluation of Organic Chemicals

No organic compounds were detected in samples 0316-97-0548, 0316-97-0580, and 0316-97-0581. This data was PM-qualified (professional judgment needed) because the samples missed the extraction holding time by one day. Recent EPA findings indicate that minor deviations from the extraction holding times have little effect on sample results for soil samples; see the discussion in Section 4.3.1. All data are considered usable and were reevaluated as estimated undetected (UJ).

No HE was detected in samples 0316-97-0548, 0316-97-0580, and 0316-97-0581, despite indications of the presence of TNT and RDX in the associated field screening samples. The positive D-Tech™ results, which suggested that low levels of TNT and RDX were present, were not confirmed by the fixed laboratory analysis. The D-Tech™ kits have been shown to provide false positives due to interferences with humic materials. See Section 4.3.2 for further details.

Baseline validation revealed no other problems with the organic analyses that affect the use of the data.

5.17.8 Risk-Based Screening Assessment

Lead was reported at 11% of its SAL and copper at 5.4% of its SAL. Other inorganic chemicals present above UTLs were at less than 1% of SALs. No organic chemicals were detected, and no chemicals were present at levels at or above SALs at PRS 16-025(k). Visual examination of the data suggest that an MCE screening evaluation would yield a value far below the target level of 1.0.

5.17.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-025(k) because contamination was not detected at levels at or above SALs.

5.17.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.17.11 Conclusions and Recommendations

Twelve screening samples and three laboratory samples were collected in and adjacent to the footprint of the former HE inspection building TA-16-25. The laboratory samples were selected from the four screening samples with positive HE results. No HE was detected in the laboratory samples. Inorganic chemicals were found above UTLs, but below SALs. The data show that no contaminants are present at this site at levels of concern to human health.

The biased sampling and analysis strategy at this former HE inspecting building was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on information about the location, orientation, construction, use of the former building, and mode of decommissioning. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, three laboratory samples are sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory samples were selected from screening samples based on field screening results, and were analyzed for all potential contaminants based on historical knowledge of operations in TA-16-25.

PRS 16-025(k) is recommended for human-health NFA based on NFA Criterion 5 because contamination is not present at this site at levels that present a potential risk to human health.

5.18 PRS 16-025(m)

This PRS is the site of former radiography source hutment TA-16-495, locate at T-Site (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.18.1 History

PRS 16-025(m) is discussed in detail in Subsection 5.24 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

TA-16-495 was constructed in July 1947. The building was used as an x-ray or gamma-ray radiography facility. It was a source building which contained either radium-226 or cobalt-60 gamma sources (Martin and Hickmott 1993, 15-16-500; Martin and Hickmott 1993, 15-16-514). It did not have a pit in the building center like the other source buildings. The building contained no sumps or plumbing. Before being abandoned in 1959 and burned in 1960, the building was found to be contaminated with HE (Engineering Department 1959, 15-16-256) and uranium-238 (Buckland 1957, 15-16-243).

The potential contamination at this PRS was identified as metals, SVOCs, HE, and radionuclides.

5.18.2 Description

TA-16-499 was a 16 ft by 16 ft by 9 ft wooden-frame construction building with a concrete floor. The building was located on level ground.

5.18.3 Previous Investigation(s)

No previous field investigations were conducted at this PRS.

5.18.4 Field Investigation

The goal of the Phase I investigation at PRS 16-025(m), as outlined in the approved Addendum 1 (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of

potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect residual radionuclides and HE in the surface and near-surface soil at the site of the building footprint. The mode of decommissioning of the building by burning suggests that residual contamination is unlikely at this PRS.

Addendum 1 (LANL 1994, 1160) specified screening soil samples, 0 to 1 ft depth intervals, from five locations and selecting two laboratory samples based on screening results. The plan called for taking the samples at the four quadrants of the building and at the building center. The laboratory samples were to be selected from the screening samples using the following prioritized biasing scheme: (1) samples with positive HE spot test kit result; (2) samples with above two times background radiation reading; (3) a sample from the center of the building; and (4) a sample from a random location. In response to an EPA NOD (EPA 1994, 15-16-644), the screening samples were collected from 1 to 2 ft depth intervals (as well as the required 0 to 1 ft intervals) to confirm that the soil beneath this concrete-floored building had not been disturbed during decommissioning.

Two deviations were made from the work plan:

- The laboratory samples were analyzed for specific radioactive constituents of concern (radium-226, cobalt-60, strontium-90) rather than by beta spectroscopy. This change was made because the analytical laboratories do not have a method for beta spectroscopy. They analyze for the specific radionuclides of concern.

- The screening samples were analyzed for RDX and TNT using the D-Tech™ Immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of 10 field screening samples were taken from 5 locations in the building footprint. Two samples were collected from each location, at 0 to 1 ft and 1 to 2 ft depth intervals. The samples were collected near the corners of the four quadrants of the building and the building center (Fig.

5.18.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which had concrete floors, is hypothesized to be via either: (1) HE or radioactive spills; or (2) leakage at the floor and floor/wall joints.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). Samples at 0 to 1 ft depth intervals were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050). The 0 to 1 ft intervals were selected for further characterization, rather than the 1 to 2 ft intervals, because the soil beneath the PRS structure is undisturbed, as confirmed by the soil descriptions in the sample collection logs. If contamination is present within the structure footprint, it is most likely present at shallow depths directly beneath the structure. The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. One sample screened positive for HE using the D-Tech™ kit (Table 5.18.4-1).

TABLE 5.18.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4177 southwest quadrant	16-4177	0 - 1	NA[a]	negative	background	< 0.5	< 0.5
0316-97-4178 northwest quadrant	16-4178	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4179 northeast quadrant	16-4179	0 - 1	0316-97-0568	negative	background	0.5 - 1.5	< 0.5
0316-97-4180 southeast quadrant	16-4180	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4181 center	16-4181	0 - 1	0316-97-0569	negative	background	< 0.5	< 0.5

a. NA = Not analyzed.

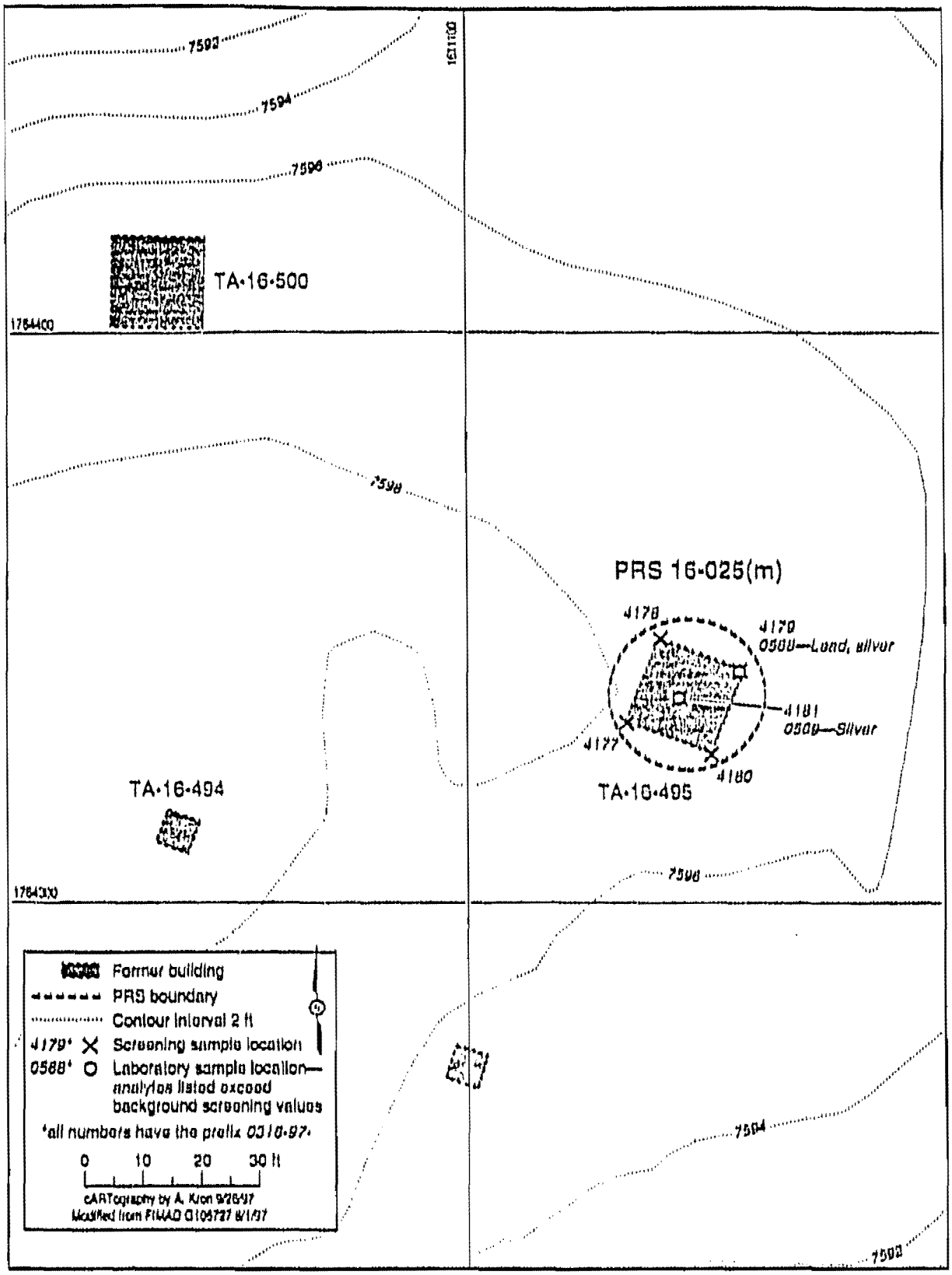


Fig. 5.18.4-1 Locations of PRS 16-025(m) samples.

Screening sample 0316-97-4179 contained the highest concentration of HE (0.5 to 1.5 mg/kg RDX), and screening sample 0316-97-4181 was located at the center of the former structure. These two samples were submitted to the laboratory for analysis (Table 5.18.4-1). The samples were analyzed for metals, SVOCs, HE, isotopic uranium, radium-226, cobalt-60, strontium-90, and gamma spectroscopy (Table 5.18.4-2).

TABLE 5.18.4-2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES
TAKEN AT PRS 16-025(m)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MEDIA	SVOC	HE	INORGANIC	RADIONUCLIDES
16-4179	0316-97-0568	0-1	Soil	3417R	3418R	3419R	3420R
16-4181	0316-97-0569	0-1	Soil	3417R	3418R	3419R	3420R

5.18.5 Evaluation of Inorganic Chemicals

Lead was detected above background UTLs. Antimony in the two samples was undetected by the laboratory at 6.8 mg/kg and 9.5 mg/kg. The antimony data were qualified as estimated undetected (UJ) because the matrix spike recoveries were below the acceptable level of 75%, but these results are accepted as non detects as discussed in Section 4.1. Silver is reported by the laboratory at 3.6 mg/kg and 0.8 mg/kg. The data is estimated (J) because the duplicate recoveries were above the acceptable value. Baseline validation revealed no other problems with the inorganic analyses that affect the use of the data

TABLE 5.18.5-1
INORGANIC CHEMICALS WITH CONCENTRATIONS AT OR ABOVE
BACKGROUND SCREENING VALUES FOR PRS 16-025(m)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	UTL (MG/KG)	MEDIA	DEPTH (FT)
Antimony	0316-97-0568	6.8(UJ[a])	31	1	Soil	0-1
Antimony	0316-97-0569	9.5(UJ)	31	1	Soil	0-1
Lead	0316-97-0568	33.9	400	23.3	Soil	0-1
Silver	0316-97-0568	3.6(J[b])	380	NC[c]	Soil	0-1
Silver	0316-97-0569	0.8(J)	380	NC	Soil	0-1

a. UJ = Analyte was not detected; the associated value is an estimate of the detection limit or quantitation limit.
b. J = Analyte was positively identified, but the result is estimated to be more uncertain than would normally be expected for that analysis.
c. NC = not calculated

5.18.6 Evaluation of Radionuclides

Cesium-137 and lanthanum-140 were detected above the MDAs for sample 0316-97-0568, but at less than two times the associated measurement uncertainty. Thus these observations are statistically indistinguishable from zero, and considered to be non detects. No other radionuclides of interest (see Section 4.2 for a list of these) were detected above MDAs and background levels, and baseline validation indicates no data quality problems associated with these analyses.

5.18.7 Evaluation of Organic Chemicals

No HE was detected in sample 0316-97-0568, despite indications of the presence of TNT in the associated field screening sample. The positive D-Tech™ result, which suggested that low levels of TNT were present, was not confirmed by the fixed laboratory analysis. The D-Tech™ kits have been shown to provide false positives due to interferences with humic materials. See Section 4.3.2 for further details.

No organic chemicals were detected at or above EQLs or SALs. Baseline validation indicates no data quality problems associated with these analyses. The data present no evidence for a release of inorganic constituents at the site.

5.18.8 Risk-Based Screening Assessment

Lead was detected at concentrations above the background UTL at less than 10% the SAL, while silver was estimated at less than 1% of SAL. Antimony was reported as undetected. No chemicals were present at levels at or above SALs at PRS 16-025(m). Visual examination of the data suggests that an MCE evaluation would yield a value far below the target level of 1.0.

5.18.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-025(m) because contamination was not detected at levels at or above SALs.

5.18.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.18.11 Conclusions and Recommendations

Ten screening samples and two laboratory samples were collected in and adjacent to the footprint of the former radiography building TA-16-495. One laboratory sample was selected from the only screening sample with a positive HE result. The other laboratory sample was selected from the center location. No inorganic or organic contamination was found at levels at or above SALs. The data show that no contaminants are present at this site at levels of concern to human health.

The biased sampling and analysis strategy at this former radiography source hutment was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on information about the location, orientation, construction, use of the former building, and mode of decommissioning. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, two laboratory samples are sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory samples were selected from screening samples according to a site specific prioritization scheme, including field screening results, and were analyzed for all potential contaminants based on historical knowledge of operations in TA-16-495.

PRS 16-025(m) is recommended for human-health NFA based on NFA Criterion 5 because contamination is not present at this site at levels that present a potential risk to human health.

5.19 PRS 16-025(n)

This PRS is the site of former source hutment TA-16-499, located at T-Site (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.19.1 History

PRS 16-025(n) is discussed in detail in Subsection 5.24 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

TA-16-499 was constructed in March 1945. The source hutment was used for gamma-ray radiography of baratol lenses and other dense weapon parts. It was located along the northern margin of T-Site. The structure was used for radium-226 sources (Martin 1993, 15-16-477) and for cobalt-60 sources (Martin and Hickmott 1993, 15-16-500). The building contained no sumps or plumbing. Before being abandoned in 1959 and burned in 1960, the building was found to be

contaminated with HE. A shelf was contaminated with alpha radiation when it was surveyed before being burned (Engineering Department 1959, 15-16-256).

The potential contamination at this PRS was identified as metals, SVOCs, HE, and radionuclides.

5.19.2 Description

TA-16-500 was a 16 ft by 16 ft by 9 ft wooden-frame construction building with a concrete floor and a pit in the center 2 ft long by 4 ft wide by 2 ft 6 in deep. It was located on level ground.

5.19.3 Previous Investigation(s)

No previous field investigations were conducted at this PRS.

5.19.4 Field Investigation

The goal of the Phase I investigation at PRS 16-025(n), as outlined in the approved Addendum 1 (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect residual radionuclides and HE in the surface and near-surface soil at the site of the building footprint. The mode of decommissioning of the building by burning suggests that residual contamination is unlikely at this PRS.

Addendum 1 (LANL 1994, 1160) specified screening soil samples, 0 to 1 ft depth intervals, from five locations and selecting two laboratory samples based on screening results. The plan called for taking the samples at the four quadrants of the building and at the building center. The laboratory samples were to be selected from the screening samples using the following prioritized biasing scheme: (1) samples with positive HE spot test kit results; (2) samples with above two times background radiation readings; (3) a sample from the position of the lead-lined pit in the center of the building; and (4) a sample from a random location. In response to an EPA NOD (EPA 1994, 15-16-644), the screening samples were collected from 1 to 2 ft depth intervals (as well as the

required 0 to 1 ft intervals) to confirm that the soil beneath this concrete floored building had not been disturbed during decommissioning.

Two deviations were made from the work plan:

- The laboratory samples were analyzed for specific radioactive constituents of concern (radium-226, cobalt-60, strontium-90) rather than by beta spectroscopy. This change was made because the analytical laboratories do not have a method for beta spectroscopy. They analyze for the specific radionuclides of concern.
- The screening samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of 10 field screening samples were taken from five locations in and adjacent to the building footprint. Two samples were collected from each location, at 0 to 1 ft and 1 to 2 ft depth intervals. The samples were collected near the corners of the four quadrants of the building and the building center (Fig. 5.19.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which had concrete floors, is hypothesized to be via either: (1) HE or radioactive spills near the center of the building at the source pit; or (2) leakage at the floor/wall joints.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). Samples at 0 to 1 ft depth intervals were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050). The 0 to 1 ft intervals were selected for further characterization, rather than the 1 to 2 ft intervals, because the soil beneath the PRS structure was observed to be undisturbed, as noted in the soil descriptions

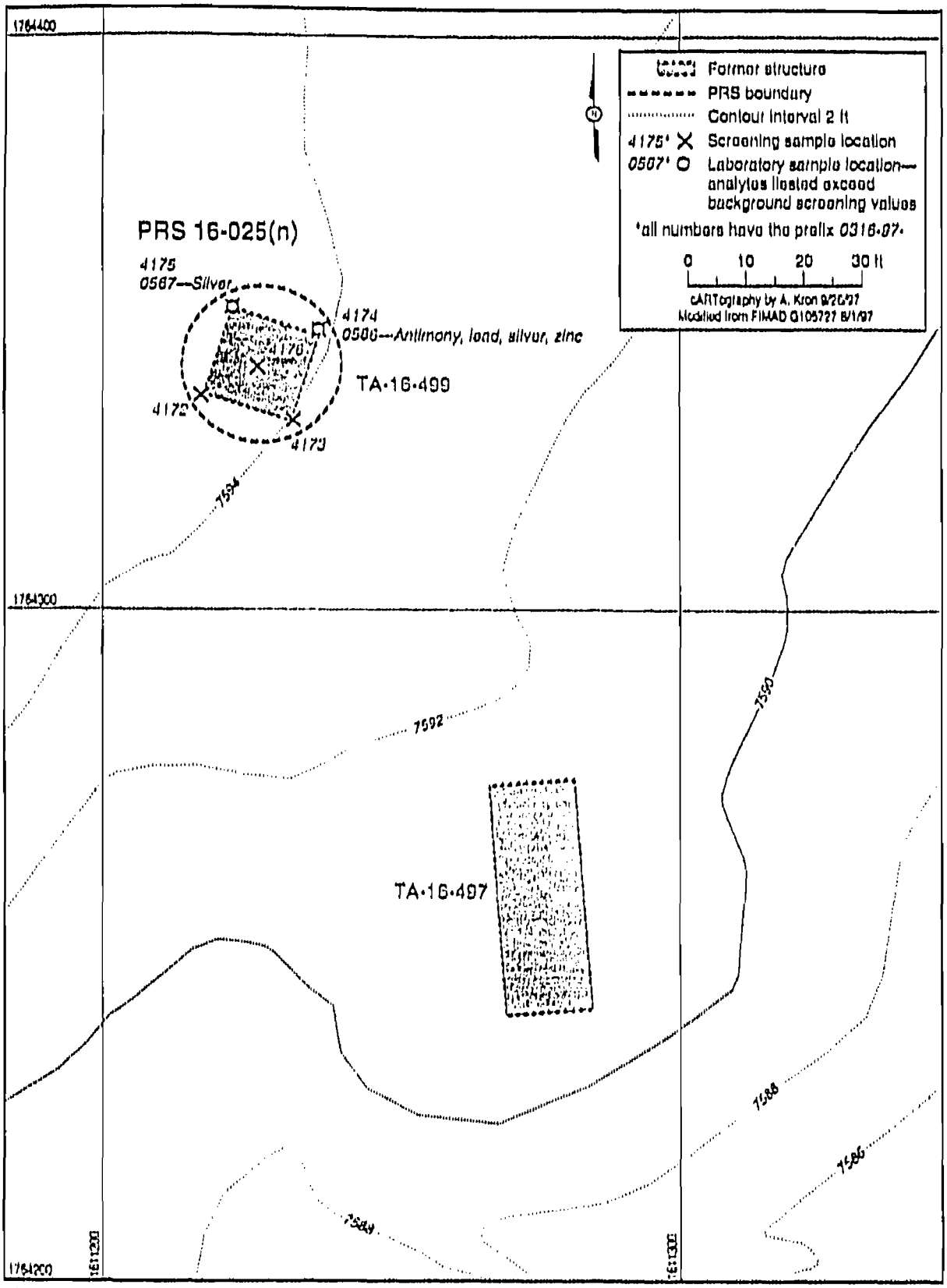


Fig. 5.19.4-1 Locations of PRS 16-025(n) samples.

In the sample collection logs. If contamination is present within the structure footprint, it is most likely present at shallow depths beneath the structure. The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. Four samples screened positive for HE using the D-Tech™ kit (Table 5.19.4-1).

TABLE 5.19.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4172 southwest quadrant	16-4172	0 - 1	NA[a]	negative	background	< 0.5	0.5 - 1.5
0316-97-4173 southeast quadrant	16-4173	0 - 1	NA	negative	background	< 0.5	0.5 - 1.5
0316-97-4174 northeast quadrant	16-4174	0 - 1	0316-97-0566	negative	background	0.5 - 1.5	0.5 - 1.5
0316-97-4175 northwest quadrant	16-4175	0 - 1	0316-97-0567	negative	background	0.5 - 1.5	< 0.5
0316-97-4176 center	16-4176	0 - 1	NA	negative	background	< 0.5	< 0.5

a. NA = Not analyzed.

Screening sample 0316-97-4174 contained elevated concentrations of RDX and TNT (0.5 to 1.5 mg/kg for each analyte). This sample was submitted to the laboratory for analysis. Screening sample 0316-97-4175 was one of three remaining samples which contained an elevated concentration of HE (0.5 to 1.5 mg/kg RDX) and was selected randomly. The random sample was chosen by using a random-number generator to select a number one through three. These numbers corresponded to the northeast, northwest, and southwest quadrants (the quadrant samples containing HE). The northeast quadrant sample was selected. This sample was submitted to the laboratory for analysis (Table 5.19.4-1). The sample was analyzed for metals, SVOCs, HE, isotopic uranium, radium-226, cobalt-60, strontium-90, and gamma spectroscopy (Table 5.19.4-2).

TABLE 5.19.4-2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES
TAKEN AT PRS 16-025(n)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MEDIA	SVOC	HE	INORGANIC	RADIONUCLIDES
16-4174	0316-97-0566	0-1	Soil	3417R	3418R	3419R	3420R
16-4175	0316-97-0567	0-1	Soil	3417R	3418R	3419R	3420R

5.19.5 Evaluation of Inorganic Chemicals

Lead and zinc were detected above background UTLs. Antimony was reported in sample 0316-97-0566 at 14.2 mg/kg. This value is qualified as estimated with a low bias due to poor matrix spike recovery. Antimony was undetected in sample 0316-97-0567 at 5.9 mg/kg (Table 5.19.5-1). The latter result was qualified estimated undetected (UJ) by baseline data validation because the matrix spike recovery was 52.5%. However, this is accepted as a non detect as discussed in Section 4.1. Silver is reported in the two samples at 0.84 mg/kg and 0.88 mg/kg. The data is estimated (J) because the duplicate recoveries were above the acceptable value. Baseline validation revealed no other problems with the inorganic analyses that affect the use of the data.

TABLE 5.19.5-1
INORGANIC CHEMICALS WITH CONCENTRATIONS AT OR ABOVE BACKGROUND SCREENING VALUES FOR PRS 16-025(n)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	UTL (MG/KG)	MEDIA	DEPTH (FT)
Antimony	0316-97-0566	14.2(J[b])	31	1	Soil	0-1
Antimony	0316-97-0567	5.9(UJ[c])	31	1	Soil	0-1
Lead	0316-97-0566	64.3	400	23.3	Soil	0-1
Silver	0316-97-0566	0.84(J)	380	NC[a]	Soil	0-1
Silver	0316-97-0567	0.88(J)	380	NC	Soil	0-1
Zinc	0316-97-0566	87.6	23000	50.8	Soil	0-1

a. NC = not calculated
b. J = Analyte was positively identified, but the result is estimated to be more uncertain than would normally be expected for that analysis.
c. UJ = Analyte was not detected; the associated value is an estimate of the detection limit or quantitation limit.

5.19.6 Evaluation of Radionuclides

Cesium-137, lanthanum-140 and neptunium-237 were detected above the MDAs for sample 0316-97-0523, but at less than two times the associated measurement uncertainty. Thus these observations are statistically indistinguishable from zero, and considered to be non detects. No other radionuclides of interest (see Section 4.2 for a list of these) were detected above MDAs and background levels, and baseline validation indicates no data quality problems associated with these analyses.

5.19.7 Evaluation of Organic Chemicals

No organic chemicals were detected in samples 0316-97-0566 and 0316-97-0567, despite indications of the presence of TNT and RDX in the associated field screening samples. The

positive D-Tech™ results, which suggested that low levels of TNT and RDX were present, were not confirmed by the fixed laboratory analysis. The D-Tech™ kits have been shown to provide false positives due to interferences with humic materials. See Section 4.3.2 for further details.

Baseline validation indicates no data quality problems associated with these analyses that affect the use of these data.

5.19.8 Risk-Based Screening Assessment

Antimony was reported at 46% of its SAL in one sample, and this result may have been biased low by as much as a factor of two. Lead was reported at about 16% of SAL in the same sample. Other detected inorganics were present at less than 1% of SAL. No chemicals were present at levels at or above SALs at PRS 16-025(n), and even allowing for the possible negative bias in the antimony result the data indicate that there is little likelihood that contaminants are present at levels that present a potential risk to human health.

Four inorganic chemicals were carried forward from the background comparison evaluation. Analytes are divided into two classes, noncarcinogens and carcinogens, for the screening assessment depending on which toxicological effect forms the basis of their SAL. This separation is required to evaluate possible additive effects within each class of chemical. The MCE evaluation for PRS 16-025(n) was not performed for carcinogenic effects because no chemicals in this class were present above background levels.

An MCE calculation was performed using the sum of the maximum concentrations at this PRS. The MCE calculations are presented in Table 5.19.8-1. The MCE result for noncarcinogens is 0.61.

TABLE 5.19.8-1
MCE CALCULATION FOR PRS 16-025(n)

	MAXIMUM CONCENTRATION	SAL	
ANALYTE	MG/KG	MG/KG	NORMALIZED VALUE
Noncarcinogenic Effects			
Antimony	14	31	0.45161
Lead	64	400	0.16000
Silver	0.9	380	0.00237
Zinc	88	23000	0.00383
TOTAL			0.61

5.19.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-025(n) because contamination was not detected at levels at or above SALs.

5.19.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.19.11 Conclusions and Recommendations

Ten screening samples and two laboratory samples were collected in and adjacent to the footprint of the former source hutment TA-16-499. The laboratory samples were selected from screening samples with positive HE results. No HE was detected. Antimony, lead, silver, and zinc were detected above background UTLs but below SALs. No inorganic or organic contamination was found at levels at or above SALs. The data show that no contaminants are present at this site at levels of concern to human health.

The biased sampling and analysis strategy at this former source hutment was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on information about the location, orientation, construction, use of the former building, and mode of decommissioning. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, two laboratory samples are sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory samples were selected based on field screening results, and were analyzed for all potential contaminants based on historical knowledge of operations in TA-16-499.

PRS 16-025(n) is recommended for human-health NFA based on NFA Criterion 5 because contamination is not present at this site at levels that present a potential risk to human health.

5.20 PRS 16-025(o)

This PRS is the site of former source hutment TA-16-500, located at T-Site (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.20.1 History

PRS 16-025(o) is discussed in detail in Subsection 5.24 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

TA-16-500 was built in March 1945. The source hutment was used for gamma-ray radiography of baratol lenses and other dense weapon parts. It was located along the northern margin of T-Site. The structure was used for radium-226 sources (Martin 1993, 15-16-477) and for cobalt-60 sources (Martin and Hickmott 1993, 15-16-500). It is highly likely that a radioactive lanthanum source was used in the building (Buckland 1966, 15-6-136). The building contained no sumps or plumbing. The hutment was abandoned in December 1959. Before being burned in 1960, the building was found to be contaminated with HE (Engineering Department 1959, 15-16-256).

The potential contamination at this PRS was identified as metals, SVOCs, HE, and radionuclides.

5.20.2 Description

TA-16-500 was a 16 ft by 16 ft by 9 ft building of wooden-frame construction with a concrete floor and a pit in the center 2 ft long by 4 ft wide by 2 ft 6 in. deep. It was located on level ground.

5.20.3 Previous Investigation(s)

No previous field investigations were conducted at this PRS.

5.20.4 Field Investigation

The goal of the Phase I investigation at PRS 16-025(o), as outlined in the approved Addendum 1 (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no

historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect residual radionuclides and HE in the surface and near-surface soil at the site of the building footprint. The mode of decommissioning of the building by burning suggests that residual contamination is unlikely at this PRS.

Addendum 1 (LANL 1994, 1160) specified screening soil samples, 0 to 1 ft depth, from five locations and selecting two laboratory samples based on screening results. The plan called for taking the samples at the four quadrants of the building and at the building center. The laboratory samples were to be selected from the screening samples using the following prioritized biasing scheme: (1) samples with positive HE spot test kit results; (2) samples with above two times background radiation readings; (3) a sample from the position of the lead-lined pit in the center of the building; and (4) a sample from a random location. In response to an EPA NOD (EPA 1994, 15-16-644), the screening samples were collected from 1 to 2 ft depth intervals (as well as the required 0 to 1 ft intervals) to confirm that the soil beneath this concrete floored building had not been disturbed during decommissioning.

Two deviations were made from the work plan:

- The laboratory samples were analyzed for specific radioactive constituents of concern (radium-226, cobalt-60, strontium-90) rather than by beta spectroscopy. This change was made because the analytical laboratories do not have a method for beta spectroscopy. They analyze for the specific radionuclides of concern.

- The screening samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of 10 field screening samples were taken from 5 locations in and adjacent to the building footprint. Two samples were collected from each location, at 0 to 1 ft and 1 to 2 ft depth intervals. The samples were collected near the corners of the four quadrants of the building and the

building center (Fig. 5.20.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which had concrete floors, is hypothesized to be via either: (1) HE or radioactive spills near the central pit; or (2) leakage at the floor/wall joints.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). Samples at 0 to 1 ft depth intervals were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit (EPA SW-846 Methods 4051 And 4050). The 0 to 1 ft intervals were selected for further characterization, rather than the 1 to 2 ft intervals, because the soil beneath the PRS structure was found to be undisturbed, as noted in the soil descriptions in the sample collection logs. If contamination is present within the structure footprint, it is most likely present at shallow depths directly beneath the structure. The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. Three samples screened positive for HE using the D-Tech™ kit (Table 5.20.4-1).

TABLE 5.20.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4182 southeast quadrant	16-4182	0 - 1	NA[a]	negative	background	< 0.5	< 0.5
0316-97-4183 northeast quadrant	16-4183	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4184 northwest quadrant	16-4184	0 - 1	0316-97-0570	negative	background	< 0.5	0.5 - 1.5
0316-97-4185 southwest quadrant	16-4185	0 - 1	NA	negative	background	0.5 - 1.5	< 0.5
0316-97-4186 center	16-4186	0 - 1	0316-97-0571	negative	background	< 0.5	0.5 - 1.5

a. NA = Not analyzed.

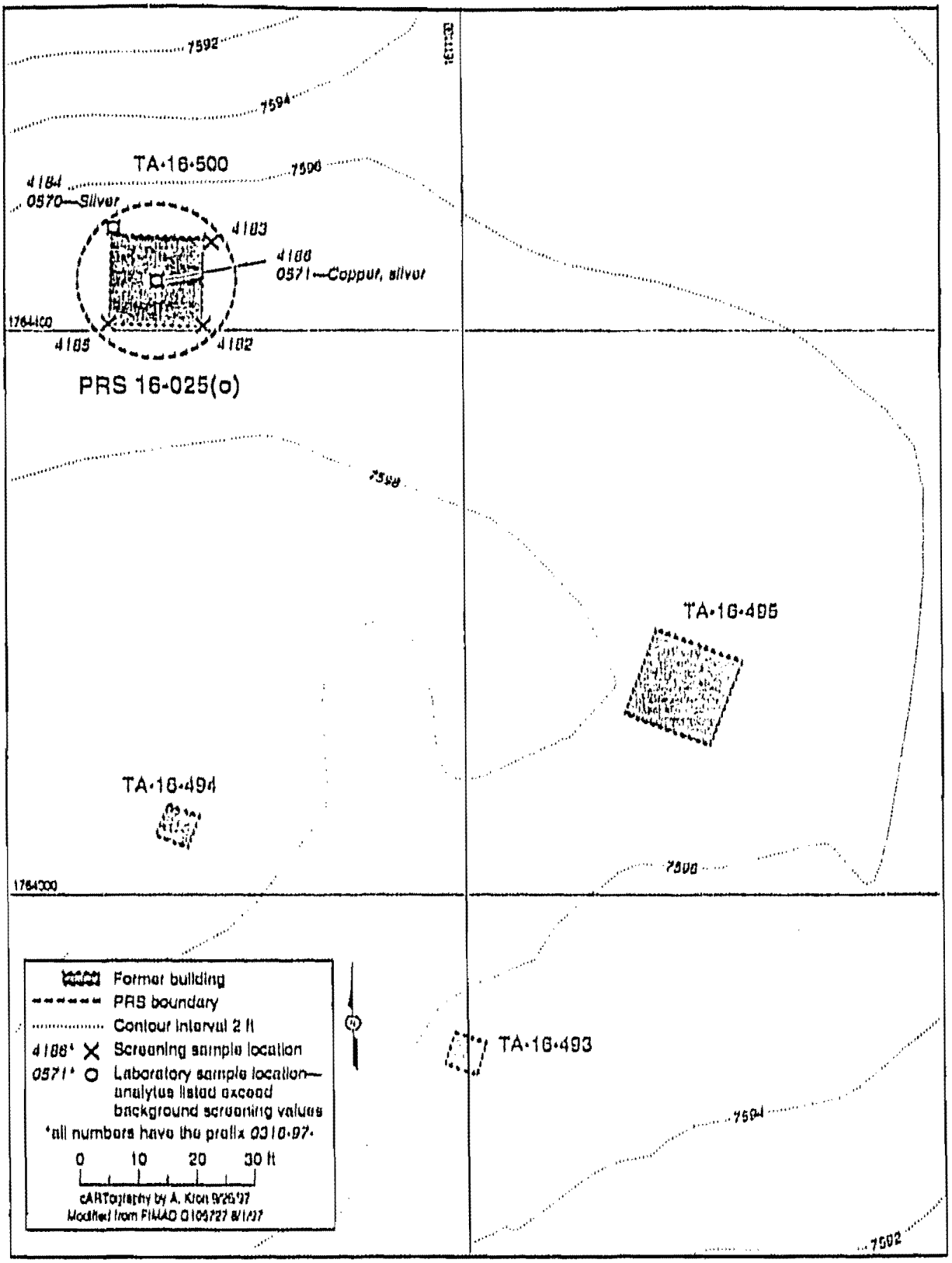


Fig. 5.20.4-1 Locations of PRS 16-025(o) samples.

Screening sample 0316-97-4186 was one of three samples which contained an elevated concentration of HE (0.5 to 1.5 mg/kg TNT) and was located in the center of the former structure. This sample was submitted to the laboratory for analysis. Screening sample 0316-97-4184 was one of two remaining samples which contained an elevated concentration of HE (0.5 to 1.5 mg/kg TNT) and was selected randomly as a laboratory sample (0316-97-0570). The random sample was selected by using a random-number generator to select a number one or two. These numbers corresponded to the northwest and southwest quadrants (the quadrant locations containing HE). The northwest quadrant sample was selected. This sample was submitted to the laboratory for analysis (Table 5.20.4-1). The sample was analyzed for metals, SVOCs, HE, isotopic uranium, radium-226, cobalt-60, strontium-90, and gamma spectroscopy (Table 5.20.4-2).

TABLE 5.20.4-2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES
TAKEN AT PRS 16-025(c)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MEDIA	SVOC	HE	INORGANIC	RADIONUCLIDES
16-4184	0316-97-0570	0-1	Soil	3417R	3418R	3419R	3420R
16-4186	0316-97-0571	0-1	Soil	3417R	3418R	3419R	3420R

5.20.5 Evaluation of Inorganic Chemicals

Copper was detected above background UTLs. Antimony in the two samples was undetected by the laboratory at 5.8 mg/kg and 6.2 mg/kg (Table 5.20.5-1). The data were qualified estimated undetected (UJ) because the matrix spike recoveries were below the acceptable level (52 %). These results are accepted as non-detects, as discussed in Section 4.1. Silver was reported in the two samples at 0.5 mg/kg and 0.75 mg/kg. The data were qualified as estimated (J) because the duplicate recoveries were above the acceptable value.

Baseline validation revealed no other problems with the inorganic analyses that affect the use of the data.

TABLE 5.20.5-1
INORGANIC CHEMICALS WITH CONCENTRATIONS AT OR ABOVE BACKGROUND SCREENING VALUES FOR PRS 16-025(o)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	UTL (MG/KG)	MEDIA	DEPTH (FT)
Antimony	0316-97-0570	5.8(UJ)	31	1	Soil	0-1
Antimony	0316-97-0571	6.2(UJ)	31	1	Soil	0-1
Copper	0316-97-0571	21.9	2800	15.5	Soil	0-1
Silver	0316-97-0570	0.5(J)	380	NC[a]	Soil	0-1
Silver	0316-97-0571	0.75(J)	380	NC	Soil	0-1

a. NC = not calculated
b. UJ = Analyte was not detected; the associated value is an estimate of the detection limit or quantitation limit.
c. J = Analyte was positively identified, but the result is estimated to be more uncertain than would normally be expected for that analysis.

5.20.6 Evaluation of Radionuclides

Cesium-137 was reported at 0.48 pCi/g in sample 0316-97-0571. Cesium-137 is a fallout radionuclide (i.e., a moderately long-lived radionuclide produced by atmospheric testing) which continues to be present in surface soils world-wide, including those of the Pajarito Plateau, at levels up to 1 to 1.5 pCi/g. Its presence at less than 0.48 pCi/g in a 0-1 ft soil sample is therefore ascribed to world-wide fallout. No other radionuclides of interest (see Section 4.2 for a list of these) were detected above MDAs and background levels, and baseline validation indicates no data quality problems associated with these analyses.

5.20.7 Evaluation of Organic Chemicals

No organic chemicals were detected in samples 0316-97-0570 and 0316-97-0571, despite indications of the presence of TNT in the associated field screening samples. The positive D-Tech™ results, which suggested that low levels of TNT were present, were not confirmed by the fixed laboratory analysis. The D-Tech™ kits have been shown to provide false positives due to interferences with humic materials. See Section 4.3.2 for further details.

Baseline validation indicates no data quality problems associated with these analyses that affect the use of these data.

5.20.8 Risk-Based Screening Assessment

Copper and silver were reported at less than 0.5% of their SALs. Antimony was reported as undetected. No chemicals were present at levels at or above SALs at PRS 16-025(o). Visual inspection of the data suggest that an MCE calculation would yield a value far below the target level of 1.0.

5.20.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-025(o) because contamination was not detected at levels at or above SALs.

5.20.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.20.11 Conclusions and Recommendations

Ten screening samples and two laboratory samples were collected in and adjacent to the footprint of the former source hutment TA-16-500. The laboratory samples were selected from screening samples with positive HE results. No inorganic or organic contamination was found at or above SALs. The data show that no contaminants are present at this site at levels of concern to human health.

The biased sampling and analysis strategy at this former source hutment was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on the information about the location, orientation, construction, use and mode of decommissioning of the former building. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, two laboratory samples are sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory samples were selected based on field screening results, and were analyzed for all potential contaminants based on historical knowledge of operations in TA-16-500.

PRS 16-025(o) is recommended for human-health NFA based on NFA Criterion 5 because contamination is not present at this site at levels that present a potential risk to human health.

5.21 PRS 16-025(y)

This PRS is the site of the former barium nitrate grinding facility TA-16-55, located in the GMX-2 area (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.21.1 History

PRS 16-025(y) is discussed in detail in Subsection 5.20 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

TA-16-55 was the first barium nitrate grinding facility at S-Site, constructed in March 1945. It contained a micropulverizer that was used for grinding barium nitrate. It served this function from March 1945 until TA-16-54 was constructed later in 1945 (Truslow 1973, 15-16-264). A former site worker stated that the building was later used for a number of purposes including lead storage (Martin 1993, 15-16-477). When the building was surveyed in 1959 it was noted as being a storage building containing "blocks of paraffin, jars of toluene, and unlabeled cans" (Schulte 1959, 15-16-263). The sumps were east of the building and exited to a drain line that presumably flowed into the main drainage of World War II era S-site, less than 100 ft from TA-16-55. The sumps, PRS 16-029(a2), are addressed in Addendum 1 (LANL 1994, 1160). This building was abandoned on December 18, 1959. Before burning in February 1960, it was determined that TA-16-55 was contaminated with HE.

The potential contamination at this PRS was identified as metals, SVOCs, and HE.

5.21.2 Description

TA-16-55 was located south of TA-16-45 on a relatively flat site. It consisted of three structures, a large process building (20 ft wide x 40 ft long x 1 ft high) connected to a smaller equipment room (7 ft wide x 11 ft long x 8 ft high) and a small storage room (10 ft wide x 1 ft long x 8 ft high). The structure was of wooden-frame construction with a concrete floor.

5.21.3 Previous Investigation(s)

No previous field investigations were conducted at this PRS.

5.21.4 Field Investigation

The goal of the Phase I investigation at PRS 16-025(y), as outlined in the approved RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial

land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect barium and HE in the surface and near-surface soil at the site of the building footprint. The mode of decommissioning of the building by burning suggests that residual contamination is unlikely at this PRS.

Addendum 1 (LANL 1994, 1160) specified screening soil samples, 0 to 1 ft depth, from five locations and selecting one laboratory sample based on screening results. The plan called for taking the screening samples at the corners of three quadrants of the building (excluding NW), at the building center, and adjacent to the location of the door. The laboratory sample was to be selected from the screening samples using the following prioritized biasing scheme: (1) a sample with elevated barium concentrations; (2) a sample with positive HE spot test kit results; (3) a sample with above two times background radiation readings; (4) a sample adjacent to the location of the door; and (5) a sample at the building center. In response to the EPA NOD (EPA 1994, 15-16-644), screening samples were collected from 1 to 2 ft depth intervals (as well as the required 0 to 1 ft intervals) to confirm that the soil beneath this concrete floored building had not been disturbed during decommissioning, and two laboratory samples were collected (based on the above scheme) rather than one sample.

One deviation was made to work plan. The samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

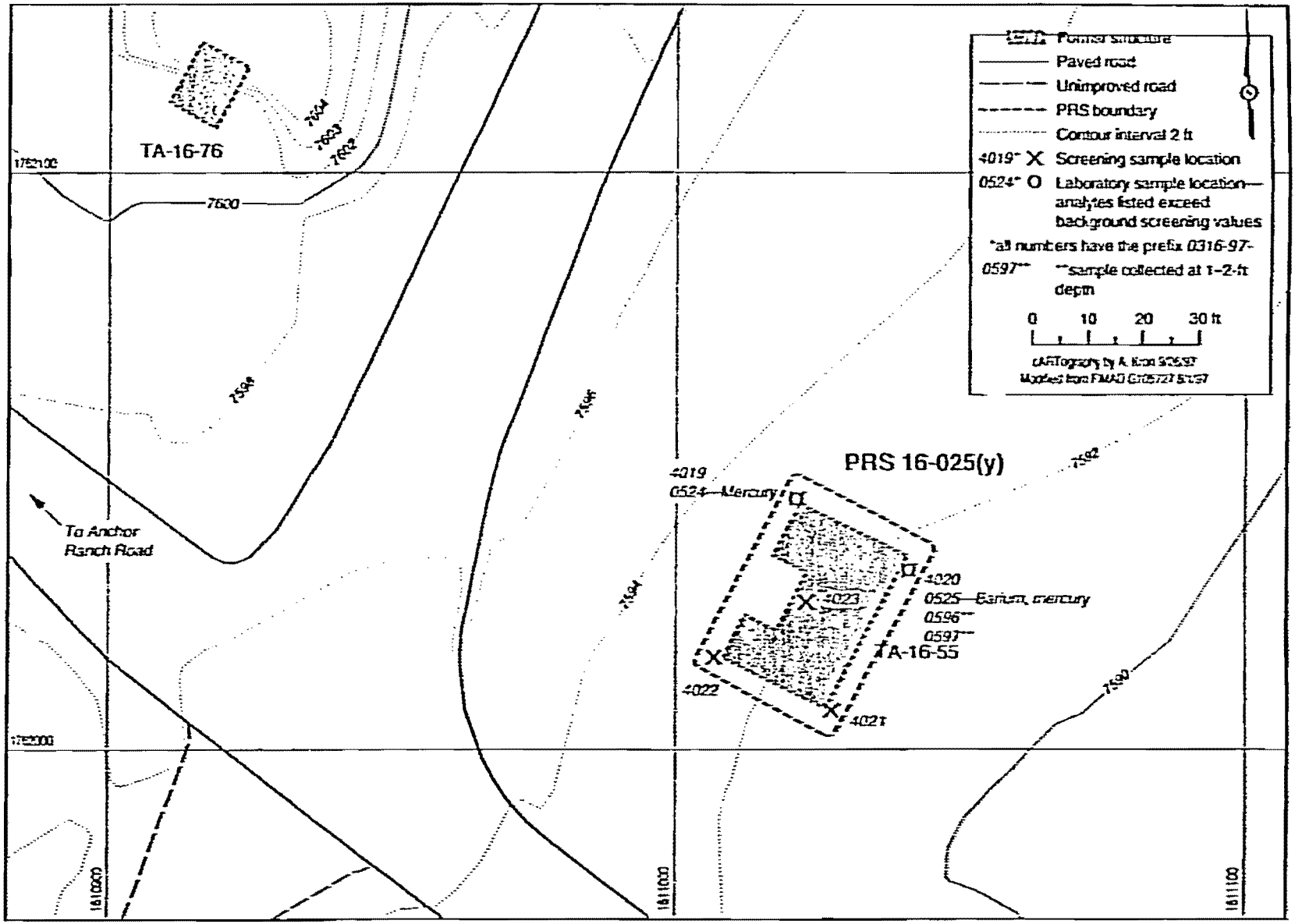


Fig. 5.21.4-1 Locations of PRS 16-025(y) locations.

A total of ten field screening samples were taken from five locations in and adjacent to the building footprint. Two samples were collected from each location, at 0 to 1 ft and 1 to 2 ft depth intervals. The samples were collected near the corners of the three quadrants of the building (excluding NW), at the building center, and adjacent to the location of the door (Fig. 5.21.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which had concrete floors, is hypothesized to be via either: (1) HE or barium nitrate spills near door areas; or (2) leakage at the floor and floor/wall joints.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). Samples at 0 to 1 ft depth intervals were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050) and metals using the Tracor Northern Spectrace 9000 XRF (LANL-ER-SOP-10.06). The 0 to 1 ft intervals were selected for further characterization, rather than the 1 to 2 ft intervals, because the soil beneath the PRS structure is undisturbed, as confirmed by the soil descriptions in the sample collection logs. If contamination is present within the structure footprint, it is most likely present at shallow depths directly beneath the structure. The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. All samples screened positive for HE using the D-Tech™ kit and were within two times background for barium using the XRF (Table 5.21.4-1).

TABLE 5.21.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOC. ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	XRF BA (MG/KG)	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4019 door	16-4019	0 - 1	0316-97-0524	negative	bkg.	447 ± 24	0.5 - 1.5	< 0.5
0316-97-4020 northeast quadrant	16-4020	0 - 1	0316-97-0525	negative	bkg.	551 ± 26	4.5 - 6	< 0.5
0316-97-4021 southeast quadrant	16-4021	0 - 1	NA[a]	negative	bkg.	847 ± 36	0.5 - 1.5	< 0.5
0316-97-4022 southwest quadrant	16-4022	0 - 1	NA	negative	bkg.	443 ± 24	0.5 - 1.5	< 0.5
0316-97-4023 center	16-4023	0 - 1	NA	negative	bkg.	822 ± 32	0.5 - 1.5	< 0.5

a. NA = Not analyzed.

All of the samples screened within two times background for barium. The background UTL for barium is 314 mg/kg, however the background for barium using the XRF is approximately 500 mg/kg. (The screening barium values above are reported as concentrations plus or minus two standard deviations). Because barium concentrations did not exceed two times XRF background, they were not used to bias laboratory samples. The laboratory samples were selected from screening locations with HE hits. Screening sample 0316-97-4020 contained the highest concentration of HE (4.5 to 6 mg/kg RDX). Screening sample 0316-97-4019 contained an elevated RDX concentration (0.5 to 1.5 mg/kg) and was located adjacent to the former location of the door. These two samples were submitted to the laboratory for analysis.

Samples 0316-97-0596 and 0316-97-0597 were collected as QA/QC duplicate splits. These samples were taken at 1 to 2 ft depth interval at the same location as sample 0316-97-4020. These samples were collected to confirm that HE was not present at depths. They were submitted to the laboratory for analysis (Table 5.21.4-3).

TABLE 5.21.4-2
SUMMARY OF FIELD SCREENING RESULTS
FOR QA/QC SAMPLES

LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	XRF BA (MG/KG)	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)	QA/QC SAMPLE
16-4020	1 - 2	0316-97-0596	negative	bkg.	424 ± 24	< 0.5	< 0.5	0316-97-0597

The samples were analyzed for metals, SVOCs, and HE. (Table 5.21.4-3).

TABLE 5.21.4-3
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES TAKEN AT PRS 16-025(y)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MATRIX	INORGANICS	SVOCS	HE
16-4019	0316-97-0524	0 - 1	soil	3334R	3333R	3335R
16-4020	0316-97-0525	0 - 1	soil	3334R	3333R	3335R
16-4020	0316-97-0596	1 - 2	soil	3528R	3526R	3527R
16-4020	0316-97-0597	1 - 2	soil	3528R	3526R	3527R

5.21.5 Evaluation of Inorganic Chemicals

Barium was reported above background levels in all screening samples from this site (Table 5.21.5-1). However, the screening method (XRF) detects all barium in the sample material, not only that leachable by the sample digestion method (SW-846 method 3050) used in the preparation of the sample for laboratory analysis by ICPES, so the XRF results are not directly comparable to the data on which the background UTL calculation was based. Barium was detected at 12% above the background UTL but below the associated field screening result in sample 0316-97-0525. In the remaining samples, barium was well within the background range at 180 to 205 mg/kg. Mercury was estimated in both surface samples at 0.03 mg/kg, the upper limit of the results reported by Feronbaugh et al. (1990, 0099). Baseline and focused validation identified no problems with these inorganic analyses.

TABLE 5.21.5-1
INORGANIC CHEMICALS WITH CONCENTRATIONS AT OR ABOVE BACKGROUND SCREENING VALUES FOR PRS 16-025(y)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	UTL (MG/KG)	MEDIA	DEPTH (FT)
Barium	0316-97-0525	353	5600	315	Soil	0-1
Mercury	0316-97-0524	0.03(J[b])	23	NC[a]	Soil	0-1
Mercury	0316-97-0525	0.03(J)	23	NC	Soil	0-1

a. NC = not calculated.
b. J = Analyte was positively identified, but the result is estimated to be more uncertain than would normally be expected for that analysis.

5.21.6 Evaluation of Radionuclides

Radionuclides were not analyzed for at PRS 16-025(y) because historical evidence indicated that radioactive material was not stored or used in the barium nitrate grinding facility. Additionally, field screening did not indicate the presence of radioactive constituents.

5.21.7 Evaluation of Organic Chemicals

No HE was detected in any sample, despite indications of the presence of RDX in the associated field screening samples, including a field screening result of 4.5 to 6 mg/kg for the field screening sample associated with sample 0316-97-0525. The positive D-Tech™ results were not confirmed by the fixed laboratory analyses of three samples from this location. Baseline validation identified no problems with the laboratory analyses.

No semivolatile organic chemicals were detected in any sample. All semivolatile non detects for sample 0316-97-0525 were qualified UJ, but as discussed in Section 4.3.1 these were accepted as non detects following focused validation. Baseline validation indicated no other problems that affect the use of these data.

5.21.8 Risk-Based Screening Assessment

Barium was reported at less than 10% of its SAL in one sample, and mercury was estimated at less than 0.5% of its SAL in two. No chemicals were present at levels above SALs at PRS 16-025(y).

5.21.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-025(y) because there were no constituents above SALs or UTLs and MCE screening would yield a value far below the target limit of 1.0.

5.21.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.21.11 Conclusions and Recommendations

Ten screening samples and four laboratory samples were collected in and adjacent to the footprint of the former barium nitrate grinding facility 16-025(y). Barium was reported slightly above the background UTL in one of the laboratory samples, and mercury was reported as estimated at the upper limit of background in two. No inorganic or organic contamination was found above SALs and no COPCs were identified.

The biased sampling strategy at this former barium-nitrate grinding building was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on the information about the location, orientation, construction, use of the former building, and mode of decommissioning. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, sampling at two locations was judged sufficient to indicate whether or not such contamination is present at levels of concern. Because of the high initial screening result, three laboratory samples were collected at one of these locations. All samples were analyzed for all potential contaminants based on historical knowledge of operations in TA-16-55.

PRS 16-025(y) is recommended for NFA based on NFA Criterion 5 because contamination is not present at this site at levels that present a risk to human health.

5.22 PRS 16-034(c)

This PRS is the site of the former warehouse hut TA-16-491, located at T-Site (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.22.1 History

PRS 16-034(c) is discussed in detail in Subsection 5.24 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

The warehouse hut was located northeast of TA-16-490 on ground sloping gently to the east. It was constructed in 1945. During World War II, the building was used to store tools (Martin and Hickmott 1993, 15-16-514), but by 1950 it was used for x-ray exposure experiments on rats and rabbits (Martin and Hickmott 1993, 15-16-500). The building contained no sumps or plumbing. It was abandoned in December 1959. Before destruction by burning in 1960, the building was found to be contaminated with HE (Engineering Department 1959, 15-16-256).

The potential contamination at this PRS was identified as metals, SVOCs, and HE.

5.22.2 Description

TA-16-491 was a 6 ft wide x 24 ft long x 9 ft high wooden-frame construction building with a wooden floor. It was located on fairly level ground.

5.22.3 Previous Investigation(s)

No previous field investigations were conducted at this PRS.

5.22.4 Field Investigation

The goal of the Phase I investigation at PRS 16-034(c), as outlined in the approved RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect residual HE in the surface and near-surface soil at the site of the building footprint. The mode of decommissioning of the building by burning suggests that residual contamination is unlikely at this PRS.

Addendum 1 (LANL 1994, 1160) specified screening soil samples, 0 to 1 ft depth intervals, from five locations and selecting one laboratory sample only if positive field screening results were obtained. The plan called for taking the screening samples at the four quadrants of the building and at the building center. The laboratory sample was to be selected from the screening samples using the following prioritized biasing scheme: (1) a sample with a positive HE spot test kit result; and (2) a sample with above two times background radiation readings. In response to an EPA NOD (EPA 1994, 15-16-644), two laboratory samples were collected (based on the above scheme), even if all field screening results were negative.

One deviation was made from the work plan. The screening samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of five field screening samples were taken from five locations in the building footprint. The samples were collected from the 0 to 1 ft depth interval. The field screening samples were taken within the four quadrants of the building and at the building center (Fig. 5.22.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which had wooden floors, is hypothesized to be either: (1) HE spills near door areas; or (2) leakage from cracks within wooden floors.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). Samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050). The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. Two screening samples screened positive for HE using the D-Tech™ kit (Table 5.22.4-1).

TABLE 5.22.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4147 southwest quadrant	16-4147	0 - 1	0316-97-0566	negative	background	< 0.5	0.5 - 1.5
0316-97-4148 northwest quadrant	16-4148	0 - 1	NA[a]	negative	background	< 0.5	< 0.5
0316-97-4149 northeast quadrant	16-4149	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4150 southeast quadrant	16-4150	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4151 center	16-4151	0 - 1	0316-97-0560	negative	background	0.5 - 1.5	< 0.5

a. NA = Not analyzed.

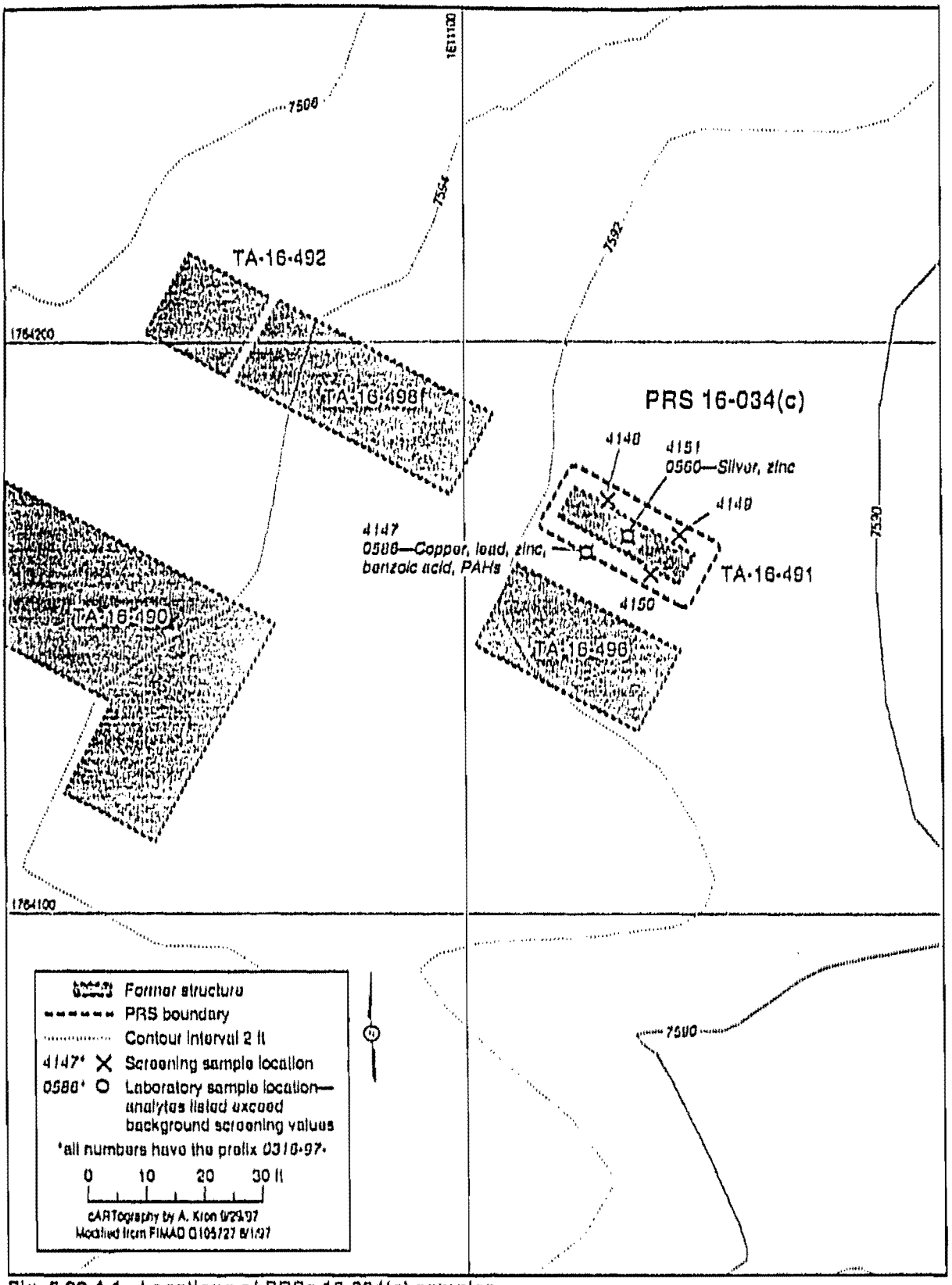


Fig. 5.22.4-1 Locations of PRSs 16-034(c) samples.

Screening sample 0316-97-4147 contained the highest concentration of TNT (0.5 - 1.5 mg/kg) and screening sample 0316-97-4151 contained the highest concentration of RDX (0.5 - 1.5 mg/kg). Those samples were submitted to the laboratory for analysis (Table 5.22.4-1). The sample was analyzed for metals, SVOCs, and HE (Table 5.22.4-2).

TABLE 5.22.4-2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES TAKEN AT PRS 16-034(c)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MATRIX	INORGANICS	SVOCS	HE
16-4147	0316-97-0586	0 - 1	soil	3403R	3401R	3402R
16-4151	0316-97-0560	0 - 1	soil	3403R	3401R	3402R

5.22.5 Evaluation of Inorganic Chemicals

Copper, lead, and zinc were detected above background UTLs. Silver was reported by the laboratory at 3.1 mg/kg. The data was qualified as estimated (J) because the duplicate recovery of silver was outside the acceptable limit. No valid antimony results are available for this PRS, as discussed in Section 4.1. Baseline validation indicated no other problems that affect the use of these inorganic data.

TABLE 5.22.5-1
INORGANIC CHEMICALS WITH CONCENTRATIONS AT OR ABOVE BACKGROUND SCREENING VALUES FOR PRS 16-034(c)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	UTL (MG/KG)	MEDIA	DEPTH (FT)
Copper	0316-97-0586	30	2800	15.5	Soil	0-1
Lead	0316-97-0586	120	400	23.3	Soil	0-1
Silver	0316-97-0560	3.1(J)[a]	380	NC[b]	Soil	0-1
Zinc	0316-97-0560	91	23000	50.8	Soil	0-1
Zinc	0316-97-0586	480	23000	50.8	Soil	0-1

a. J = Analyte was positively identified, but the result is estimated to be more uncertain than would normally be expected for that analysis.
b. NC = not calculated

5.22.6 Evaluation of Radionuclides

Radionuclides were not analyzed for at PRS 16-034(c) because historical evidence indicated that radioactive material was not stored or used in the warehouse hut. Additionally, field screening did not indicate the presence of radioactive constituents.

5.22.7 Evaluation of Organic Chemicals

The detected SVOCs were reported below the EQLs and above the detection limits (Table 5.22.7-1). No HE was detected in samples 0310-97-0580 and 0310-97-0560, despite indications of the presence of TNT and RDX in the associated field screening samples. The positive D-Tech™ results, which suggested that low levels of TNT and RDX were present, were not confirmed by the fixed laboratory analysis. The D-Tech™ kits have been shown to provide false positives due to interferences with humic materials. See Section 4.3.2 for further details.

No other organic chemicals were detected in the samples. Baseline validation indicates no data quality problems associated with these analyses that would affect the use of these organic data.

TABLE 5.22.7-1
DETECTED ORGANIC CHEMICALS FOR PRS 16-034(c)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	MEDIA	DEPTH (FT)
Benzoic Acid	0316-97-0586	0.054	100000	Soil	0-1
Methylnaphthalene[2-]	0316-97-0586	0.046	NC[a]	Soil	0-1
Naphthalene	0316-97-0586	0.039	1000	Soil	0-1

a. NC = not calculated

5.22.8 Risk-Based Screening Assessment

Four inorganic and three semivolatile organic chemicals were detected above UTLs and EQLs. Lead was present at 30% of its SAL in sample 0316-97-0586, but all of the remaining chemicals were reported at less than 2% of their SALs. Although methylnaphthalene[2-] has no SAL, this PAH compound is present at a low concentration which is orders of magnitude below SALs for similar compounds. The evaluation of this PAH compound is considered to be complete based on the evaluation of PAHs with the available SALs. Refer to Section 5.0.1 for a further discussion of PAH compounds without SALs.

Four inorganic and two organic chemicals were carried forward from the background comparison and organic constituent evaluation. Analytes are divided into two classes, noncarcinogens and carcinogens, for the screening assessment depending on which toxicological effect forms the basis of their SAL. This separation is required to evaluate possible additive effects within each class of chemical. The MCE evaluation for PRS 16-034(c) was not performed for carcinogenic effects because no chemicals in this class were present above background levels.

An MCE calculation was performed using the sum of the maximum concentrations at this PRS. The MCE calculations are presented in Table 5.22.8-1. The MCE result for noncarcinogens is 0.3.

TABLE 5.22.7-1
MCE CALCULATION FOR PRS 16-034(c)

	MAXIMUM CONCENTRATION	SAL	
ANALYTE	MG/KG	MG/KG	NORMALIZED VALUE
Noncarcinogenic Effects			
Copper	30	2800	0.01071
Lead	120	400	0.30000
Silver	3	380	0.00789
Zinc	480	23000	0.02087
Benzoic acid	0.05	100000	0.00000
Naphthalene	0.04	1000	0.00004
TOTAL			0.33

5.22.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-034(c) because contaminants were not detected at levels at or above SALs.

5.22.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.22.11 Conclusions and Recommendations

Five screening samples and two laboratory sample were collected within the footprint of the former warehouse hut TA-16-491. The laboratory samples were selected from the two screening samples that screened positive for HE. HE was not reported in either laboratory sample. Inorganic chemicals (copper, lead, silver and zinc) were detected in both samples, above background UTLs but below SALs. There are no valid antimony data, but antimony is not implicated by either historical information or current ER data from TA-16 as a likely contaminant of concern at this site. Three SVOCs were detected in one laboratory sample at low levels and far below the SALs. The data show that no contaminants are present at this site at levels of concern to human health.

The biased sampling and analysis strategy at this former warehouse hut was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on information about the location, orientation, construction, use of the former building, and mode of decommissioning. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, two confirmatory laboratory samples are sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory samples were selected based on field screening results, and were analyzed for all potential contaminants based on historical knowledge of operations in TA-16-491.

PRS 16-034(c) is recommended for human-health NFA based on NFA Criterion 5 because contamination is not present at this site at levels that present a potential risk to human health.

5.23 PRS 16-034(d)

This PRS is the site of former non-HE machine shop TA-16-492, located at T-Site (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.23.1 History

PRS 16-034(d) is discussed in detail in Subsection 5.24 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

The non-HE machine shop was located north of TA-16-490. It was built in March 1945. Interviews with site workers suggest that its only function was as a staff machine shop. No HE machining was done in the shop (Martin and Hickmott 1993, 15-16-500; Martin and Hickmott 1993, 15-16-514). The building contained no sumps or plumbing. It was abandoned in December 1959. Before being burned in 1960, the building was found to be contaminated with HE (Engineering Department 1959, 15-16-256).

The potential contamination at this PRS was identified as metals, SVOCs, and HE.

5.23.2 Description

TA-16-492 was a 16 ft wide x 16 ft long x 9 ft high wooden-frame construction building with a wooden floor. It was located on fairly level ground.

5.23.3 Previous Investigation(s)

No previous field investigations were conducted at this PRS.

5.23.4 Field Investigation

The goal of the Phase I investigation at PRS 16-034(d), as outlined in the approved RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160) was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect residual HE in the surface and near-surface soil at the site of the building footprint. The mode of decommissioning of the building by burning suggests that residual contamination is unlikely at this PRS.

Addendum 1 (LANL 1994, 1160) specified screening soil samples, 0 to 1 ft depth intervals, from five locations and selecting one laboratory sample only if positive field screening results were obtained. The plan called for taking the screening samples at the four quadrants of the building and at the building center. The laboratory sample was to be selected from the screening samples using the following prioritized biasing scheme: (1) a sample with a positive HE spot test kit result; and (2) a sample with above two times background radiation readings. In response to an EPA NOD (EPA 1994, 15-16-644), two laboratory samples were collected (based on the above scheme), even if all field screening results were negative.

One deviation was made to the approved work plan. The samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of five field screening samples were taken from five locations in and adjacent to the building footprint. The samples were collected from the 0 to 1 ft depth interval. The field screening samples were taken within the four quadrants of the building and at the building center (Fig. 5.23.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which had wooden floors, is hypothesized to be via leakage from cracks within wooden floors.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-200™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). The samples were analyzed for RDX and TNT using the D-Tech™ Immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050). The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. Four samples screened positive for HE using the D-Tech™ kit (Table 5.23.4-1).

TABLE 5.23.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4157 southeast quadrant	16-4157	0 - 1	NA[a]	negative	background	< 0.5	< 0.5
0316-97-4158 northeast quadrant	16-4158	0 - 1	0316-97-0587	negative	background	< 0.5	1.5 - 3.0
0316-97-4159 northwest quadrant	16-4159	0 - 1	NA	negative	background	< 0.5	0.5 - 1.5
0316-97-4160 southwest quadrant	16-4160	0 - 1	NA	negative	background	< 0.5	0.5 - 1.5
0316-97-4161 center	16-4161	0 - 1	0316-97-0563	negative	background	< 0.5	0.5 - 1.5

a. NA = Not analyzed.

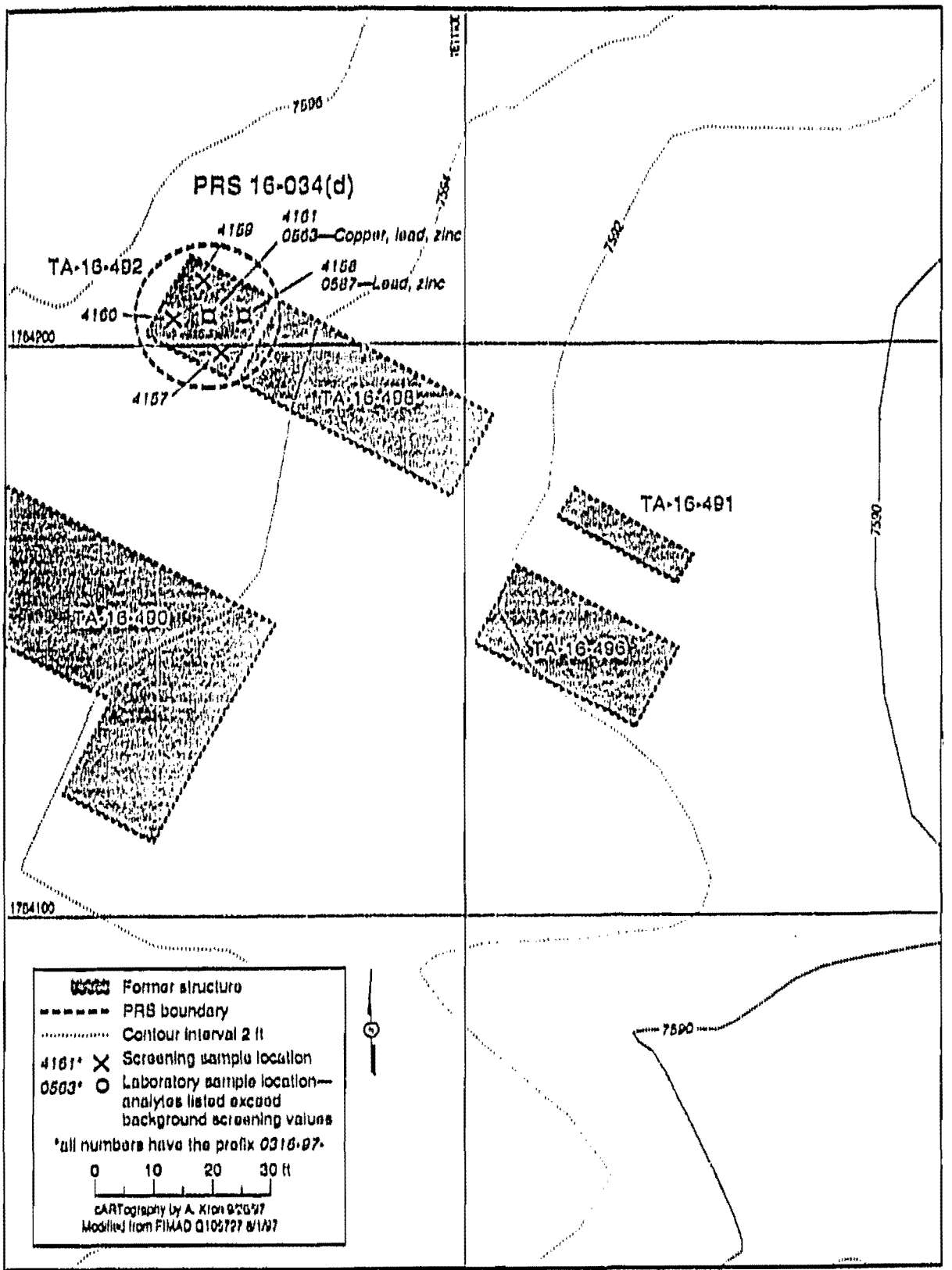


Fig. 5.23.4-1 Locations of PRS 16-034(d) samples.

Screening sample 0316-97-4158 contained the highest concentration of TNT (1.5 - 3.0 mg/kg). Screening sample 0316-97-4161 was one of four locations which contained an elevated concentration of TNT (0.5 - 1.5 mg/kg) and was located at the center of the former structure. These two samples were submitted to the laboratory for analysis (Table 5.23.4-1). The samples were analyzed for inorganic chemicals, SVOCs, and HE (Table 5.23.4-2).

TABLE 5.23.4-2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES TAKEN AT PRS 16-034(d)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MATRIX	INORGANICS	SVOCS	HE
16-4158	0316-97-0587	0 - 1	soil	3403R	3401R	3420R
16-4161	0316-97-0563	0 - 1	soil	3403R	3401R	3420R

5.23.5 Evaluation of Inorganic Chemicals

Copper, lead and zinc were detected above background UTLs (Table 5.23.5-1). No valid antimony results are available for this PRS, as discussed in Section 4.1. Baseline validation indicated no other problems that affect the use of these inorganic data.

TABLE 5.23.5-1
INORGANIC CHEMICALS WITH CONCENTRATIONS AT OR ABOVE BACKGROUND SCREENING VALUES FOR PRS 16-034(d)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	UTL (MG/KG)	MEDIA	DEPTH (FT)
Copper	0316-97-0563	18	2800	15.5	Soil	0-1
Lead	0316-97-0563	260	400	23.3	Soil	0-1
Lead	0316-97-0587	200	400	23.3	Soil	0-1
Zinc	0316-97-0563	67	23000	50.8	Soil	0-1
Zinc	0316-97-0587	55	23000	50.8	Soil	0-1

5.23.6 Evaluation of Radionuclides

Radionuclides were not analyzed for at PRS 16-034(d) because historical evidence indicated that radioactive material was not stored or used in the warehouse hut. Additionally, field screening did not indicate the presence of radioactive constituents.

5.23.7 Evaluation of Organic Chemicals

No organic chemicals were detected in samples 0316-97-0587 and 0316-97-0563, despite indications of the presence of TNT in the associated field screening samples. The positive D-

Tech™ result, which suggested that low levels of TNT were present, was not confirmed by the fixed laboratory analysis. The D-Tech™ kits have been shown to provide false positives due to interferences with humic materials. See Section 4.3.2 for further details.

Both samples were reanalyzed for SVOCs because of poor internal standard recovery in the initial analysis. Baseline validation indicated no problems that affect the use of the data from these reanalyses.

6.23.8 Risk-Based Screening Assessment

Lead was present at 50 to 65% of SAL in both laboratory sample. All other chemicals were either undetected or present at less than 1% of SAL. Visual inspection of the data suggests that an MCE calculation would yield a value far below the target level of 1.0.

6.23.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-034(d) because contaminants were not detected at levels at or above SALs.

6.23.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

6.23.11 Conclusions and Recommendations

Five field screening samples and two laboratory samples were collected within the footprint of former building TA-16-402. The laboratory samples were selected from the four screening samples with positive screening results. HE and other organics were not detected. Copper, lead and zinc were detected above background UTLs but below SALs. There are no valid antimony data, but antimony is not implicated by either historical information or current ER data from TA-16 as a likely contaminant of concern at this site. The data show that no contaminants are present at this site at levels of concern to human health.

The biased sampling and analysis strategy at this former machine shop was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on information about the location, orientation, construction, use of the former building, and mode of decommissioning. Because the likelihood

of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, two confirmatory laboratory samples are sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory samples were based on field screening results, and were analyzed for all potential contaminants based on historical knowledge of operations in TA-16-492.

PRS 16-034(d) is recommended for human-health NFA based on NFA Criterion 5 because contamination is not present at this site at levels that present a potential risk to human health.

5.24 PRS 16-034(e)

This PRS is the site of former storage building TA-16-496, located at T-Site (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.24.1 History

PRS 16-034(e) is discussed in detail in Subsection 5.24 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

TA-16-496 was relocated to the present site on Job Orders No.157102 and 157234 in July 1948. The building was used for storage (Martin and Hickmott 1993, 15-16-514). The building contained no sumps or plumbing. It was shown to be contaminated with HE before being abandoned in 1959 and burned in 1960 (Engineering Department 1959, 15-16-256).

The potential contamination at this PRS was identified as metals, SVOCs, and HE.

5.24.2 Description

The storage building was located east of TA-16-490 on ground sloping slightly to the east. TA-16-496 was a 16 ft by 32 ft by 9 ft building of wooden-frame construction with a wooden floor.

5.24.3 Previous Investigation(s)

No previous field investigations were conducted at this PRS.

5.24.4 Field Investigation

The goal of the Phase I investigation at PRS 16-034(e), as outlined in the approved RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160), was to determine if contaminants were

present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect residual HE in the surface and near-surface soil at the site of the building footprint. The mode of decommissioning of the building by burning suggests that residual contamination is unlikely at this PRS.

Addendum 1 (LANL 1994, 1160) specified screening soil samples, 0 to 1 ft depth intervals, from five locations and selecting one laboratory sample only if positive field screening results were obtained. The plan called for taking the screening samples at the four quadrants of the building and at the building center. The laboratory sample was to be selected from the screening samples using the following prioritized biasing scheme: (1) a sample with a positive HE spot test kit result; and (2) a sample with above two times background radiation readings. In response to an EPA NOD (EPA 1994, 15-16-644), two laboratory samples were collected (based on the above scheme), even if all field screening results were negative.

One deviation was made from the work plan. The screening samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of five field screening samples were taken from five locations in the building footprint. The samples were collected from the 0 to 1 ft depth interval. The field screening samples were taken within the four quadrants of the building and at the building center (Fig. 5.24.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant

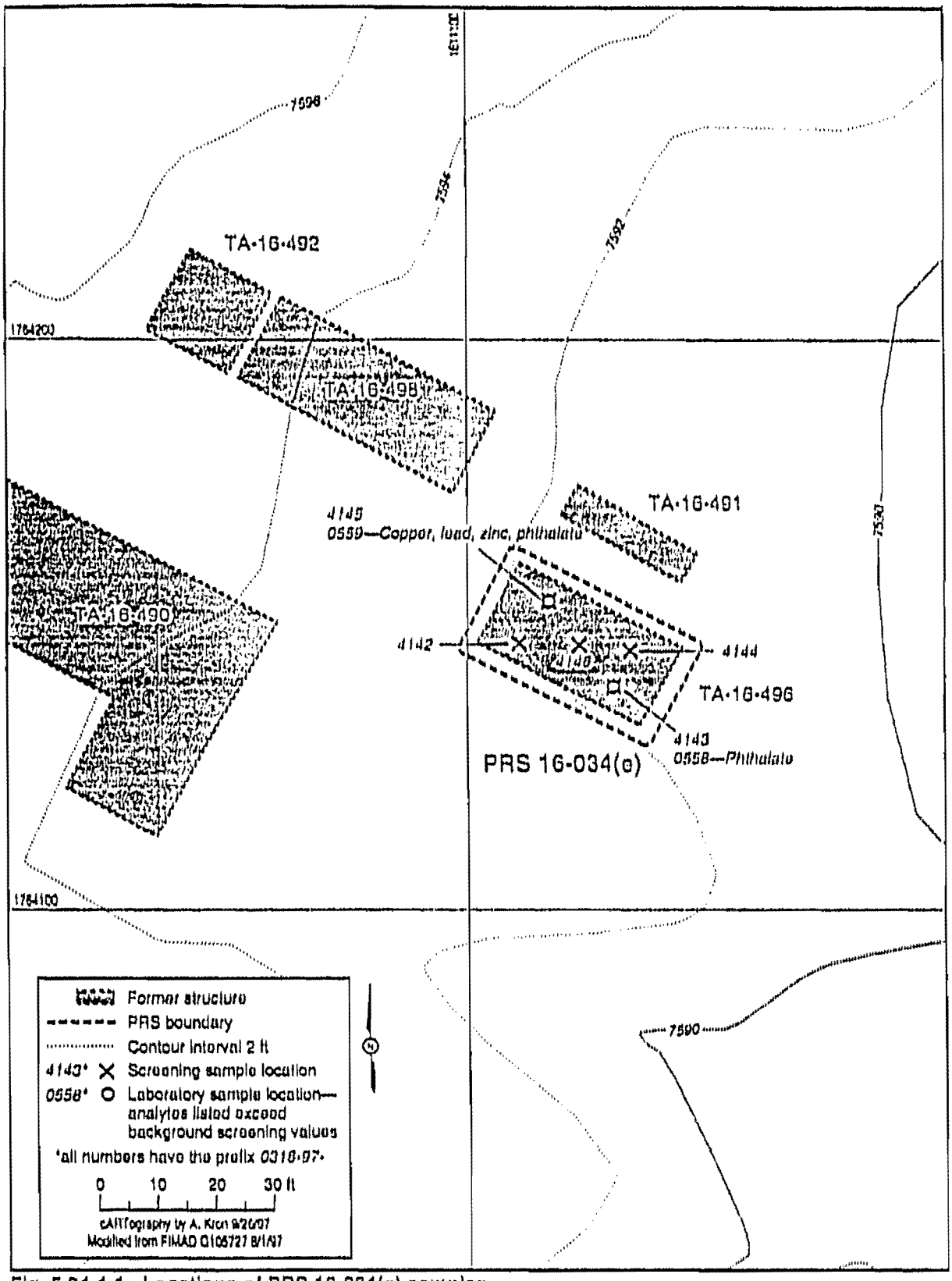


Fig. 5.24.4-1 Locations of PRS 16-034(e) samples.

dispersal mechanism for operations in this building, which had wooden floors, is hypothesized to be via leakage from cracks within wooden floors.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). Samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050). The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. Three samples screened positive for HE using the D-Tech™ kit (Table 5.24.4-1).

TABLE 5.24.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4142 southwest quadrant	16-4142	0 - 1	NA[a]	negative	background	0.5 - 1.5	< 0.5
0316-97-4143 southeast quadrant	16-4143	0 - 1	0316-97-0558	negative	background	0.5 - 1.5	0.5 - 1.5
0316-97-4144 northeast quadrant	16-4144	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4145 northwest quadrant	16-4145	0 - 1	0316-97-0559	negative	background	< 0.5	0.5 - 1.5
0316-97-4146 center	16-4146	0 - 1	NA	negative	background	< 0.5	< 0.5

a. NA = Not analyzed.

Screening sample 0316-97-4143 contained elevated concentrations of RDX and TNT (0.5 to 1.5 mg/kg for both analytes). This sample was submitted to the laboratory for analysis. Screening sample 0316-97-4145 was one of two remaining samples which contained an elevated concentration of HE (0.5 to 1.5 mg/kg TNT) and was selected randomly. The random sample was selected by using a random-number generator to select a number one to two. These numbers corresponded to the southeast and northwest quadrants (the quadrant samples containing HE). The northeast quadrant sample was selected. This sample was submitted to the laboratory for

analysis (Table 5.24.4-1). The samples were analyzed for metals, SVOCs, HE, and total uranium (Table 5.24.4-2).

TABLE 5.24.4-2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES TAKEN AT PRS 16-034(o)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MEDIA	SVOC	HE	INORGANIC	RADIONUCLIDES
16-4143	0316-97-0558	0-1	Soil	3401R	3402R	3403R	3404R
16-4145	0316-97-0559	0-1	Soil	3401R	3402R	3403R	3404R

5.24.5 Evaluation of Inorganic Chemicals

Copper, lead and zinc were detected in one of the two laboratory samples above background UTL (Table 5.24.5-1). No valid antimony results are available for this PRS, as discussed in Section 4.1. Baseline validation indicated no other problems that affect the use of these inorganic data.

TABLE 5.24.5-1
INORGANIC CHEMICALS WITH CONCENTRATIONS AT OR ABOVE BACKGROUND SCREENING VALUES FOR PRS 16-034(o)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	UTL (MG/KG)	MEDIA	DEPTH (FT)
Copper	0316-97-0559	18	2800	15.5	Soil	0-1
Lead	0316-97-0559	99	400	23.3	Soil	0-1
Zinc	0316-97-0559	60	23000	50.8	Soil	0-1

5.24.6 Evaluation of Radionuclides

Total uranium was detected at 3 mg/kg in both samples. The data were qualified as undetected (U) because this level was less than five times the concentration of uranium in the associated blank, and therefore considered indistinguishable from blank contamination. The technique used for the uranium analysis provides results with a low bias. However, even if low bias is accounted for, uranium is not present at levels near UTLs. Baseline validation indicated no data quality problems associated with these analyses. The data presents no evidence for a release of radioactive constituents at the site.

5.24.7 Evaluation of Organic Chemicals

Bis(2-ethylhexyl)phthalate, a common plasticizer and laboratory contaminant, was present at levels below the EQL in these samples (Table 5.24.7-1). No HE was detected, despite field indications that low levels of HE might be present in the samples selected for laboratory analysis.

The positive D-Tech™ result, which suggested that low levels of TNT were present, was not confirmed by the fixed laboratory analysis. The D-Tech™ kits have been shown to provide false positives due to interferences with humic materials. See Section 4.3.2 for further details.

No other organic chemicals were detected. Baseline validation indicates no data quality problems associated with these analyses that would affect the use of these organic data

TABLE 5.24.7-1
DETECTED ORGANIC CHEMICALS FOR PRS 16-034(e)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	MEDIA	DEPTH (FT)
Bis(2-ethylhexyl)phthalate	0316-97-0558	0.063	32	Soil	0-1
Bis(2-ethylhexyl)phthalate	0316-97-0559	0.066	32	Soil	0-1

5.24.8 Risk-Based Screening Assessment

Lead was reported at 25% of SAL in one sample, and copper and zinc were also above UTLs in this sample, but at less than 0.5% of SAL. Antimony data was rejected. Bis(2-ethylhexyl)phthalate was detected below the EQL in both samples, at less than 0.5% of SAL. Chemicals were not present at levels at or above SALs at PRS 16-034(e). Visual examination of the data suggest that an MCE calculation would yield a value far below the target level of 1.0.

5.24.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-034(e) because contaminants were not detected at levels at or above SALs.

5.24.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.24.11 Conclusions and Recommendations

Five screening samples and two laboratory samples were collected within the footprint of the former storage building TA-16-496. The laboratory samples were selected from three screening samples that screened positive for HE. No HE was detected in the laboratory analyses. Lead, copper and zinc were found above background UTLs in one of the laboratory samples, but well below SALs. There are no valid antimony data, but antimony is not implicated by either historical

information or current ER data from TA-16 as a likely contaminant of concern at this site. Bis(2-ethylhexyl)phthalate was detected below EQLs and well below SALs. No inorganic or organic chemicals were detected at levels at or above SALs. The data show that no contaminants are present at this site at levels of concern to human health.

The biased sampling and analysis strategy at this former storage building was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on information about the location, orientation, construction, use of the former building, and mode of decommissioning. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, two confirmatory laboratory samples are sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory samples were based on field screening results, and were analyzed for all potential contaminants based on historical knowledge of operations in TA-16-496.

PRS 16-034(e) is recommended for human-health NFA based on NFA Criterion 5 because contamination is not present at this site at levels that present a potential risk to human health.

5.25 PRS 16-034(f)

This PRS is the site of former laboratory TA-16-498, located at T-Site (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.25.1 History

PRS 16-034(f) is discussed in detail in Subsection 5.24 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

The laboratory was initially used for storage and as an eating area (Martin and Hickmott 1993, 15-16-514), but by 1950, it was used by draftsmen in the western end, by site photographers in its center, and for plutonium autoradiography experiments in its eastern end (Martin and Hickmott 1993, 15-16-500). Small scale photoprocessing was done in this building in support of the plutonium autoradiography experiments. The building contained no sumps. TA-16-498 was constructed in June 1945. The building was abandoned in December 1959. It was found to be contaminated with HE during the survey that preceded demolition by burning in 1960 (Engineering Department 1959, 15-16-256).

The potential contamination at this PRS was identified as metals, SVOCs, HE, and radionuclides.

5.25.2 Description

TA-16-490 was a 16 ft by 42 ft by 9 ft high wooden-frame construction building with wooden floors located northeast of TA-16-490 on fairly level ground.

5.25.3 Previous Investigation(s)

No previous field investigations were conducted at this PRS.

5.25.4 Field Investigation

The goal of the Phase I investigation at PRS 16-034(l), as outlined in the approved RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect residual HE in the surface and near-surface soil at the site of the building footprint. The mode of decommissioning of the building by burning suggests that residual contamination is unlikely at this PRS.

Addendum 1 (LANL 1994, 1160) specified screening soil samples, 0 to 1 ft depth intervals, from five locations and selecting two laboratory samples based on field screening results. The plan called for taking the screening samples at the four quadrants of the building and at the building center. The laboratory samples were to be selected from the screening samples using the following prioritized biasing scheme: (1) samples with a positive HE spot test kit result; (2) samples with above two times background radiation readings; (3) a sample from the building center; and (4) a random sample.

Two deviations were made from the approved work plan.

- The samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.
- Two samples were collected from 0 to 0.83 ft depth intervals (rather than the required 0 to 1 ft interval) because the hand auger met refusal.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of five field screening samples were taken from five locations in the building footprint. The samples were collected from the 0 to 1 ft depth interval. The field screening samples were taken within the four quadrants of the building and at the building center (Fig. 5.25.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which had wooden floors, is hypothesized to be via HE or radioactive spills or leakage from cracks within wooden floors.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). Samples were analyzed for RDX and TNT using the D-Tech™ Immunoassay HE field screening kit (EPA SW-846 Methods 4051 And 4050). The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

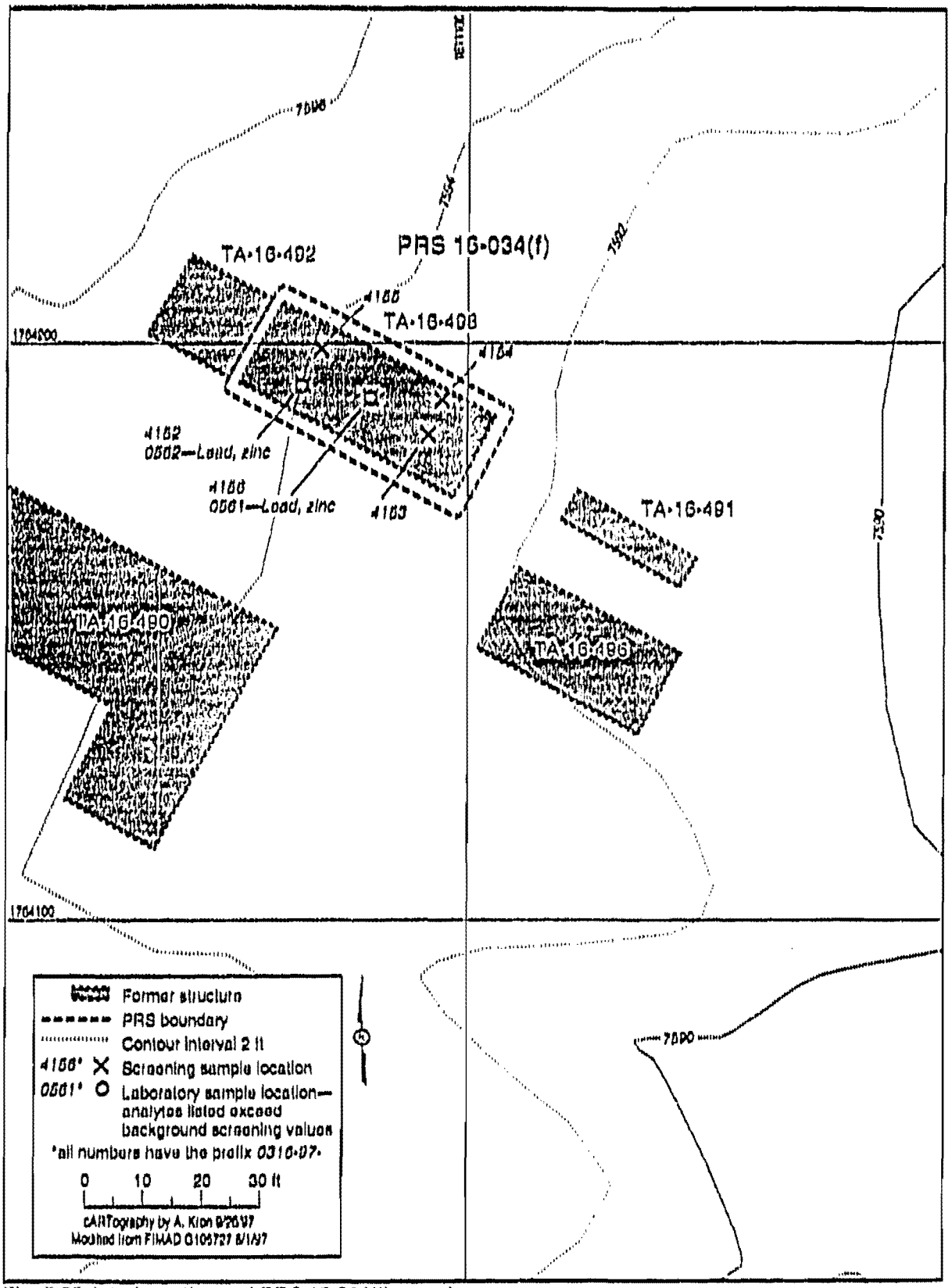


Fig. 5.25.4-1 Locations of PRS 16-034(f) samples.

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. Three samples screened positive for HE using the D•Tech™ kit (Table 5.25.4•1).

TABLE 5.25.4•1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D•TECH RDX (MG/KG)	D•TECH TNT (MG/KG)
0316•97•4152 southwest quadrant	16•4152	0 • 0.83	0316•97• 0562	negative	background	0.5 • 1.5	0.5 • 1.5
0316•97•4153 southeast quadrant	16•4153	0 • 0.83	NA[a]	negative	background	< 0.5	< 0.5
0316•97•4154 northwest quadrant	16•4154	0 • 1	NA	negative	background	< 0.5	< 0.5
0316•97•4155 northeast quadrant	16•4155	0 • 1	NA	negative	background	< 0.5	0.5 • 1.5
0316•97•4156 center	16•4156	0 • 1	0316•97• 0561	negative	background	< 0.5	0.5 • 1.5

a. NA = Not analyzed.

Screening sample 0316•97•4152 contained elevated concentrations of RDX and TNT (0.5 to 1.5 mg/kg for both analytes). Screening sample 0316•97•4156 contained an elevated concentration of TNT (0.5 to 1.5 mg/kg) and was located in the center of the former structure. These two samples were submitted to the laboratory for analysis (Table 5.25.4•1). The sample was analyzed for metals, SVOCs, HE, isotopic uranium, isotopic plutonium, and cyanide (Table 5.25.4•2).

TABLE 5.25.4•2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES TAKEN AT PRS 16•034(F)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MATRIX	SVOC	HE	INORGANIC	RADIONUCLIDES
16•4156	0316•97•0561	0•1	Soil	3401R	3402R	3403R	3404R
16•4152	0316•97•0562	0•.83	Soil	3401R	3402R	3403R	3404R

5.25.5 Evaluation of Inorganic Chemicals

Lead and zinc were detected in both samples at concentrations above background UTLs (Table 5.25.5•1). No valid antimony results are available for this PRS, as discussed in Section 4.1. Continuing calibration data was missing for cyanide and this data is qualified as estimated undetected (UJ). Baseline validation revealed no other problems with the inorganic analyses that affect the use of these inorganic data.

TABLE 5.25.5-1
INORGANIC CHEMICALS WITH CONCENTRATIONS AT OR ABOVE BACKGROUND SCREENING VALUES FOR PRS 16-034(F)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	UTL (MG/KG)	MEDIA	DEPTH (FT)
Lead	0316-97-0561	39	400	23.3	Soil	0-1
Lead	0316-97-0562	31	400	23.3	Soil	0-.83
Zinc	0316-97-0561	59	23000	50.8	Soil	0-1
Zinc	0316-97-0562	52	23000	50.8	Soil	0-.83

5.25.6 Evaluation of Radionuclides

No radionuclides were detected above MDAs, UTLs, or SALs. Uranium-235 was reported as estimated with high bias (J+) in sample 0316-97-0562. The estimated value 0.19 mg/kg is slightly above the reported uncertainty of 0.1 mg/kg and below the UTL and SAL.

5.25.7 Evaluation of Organic Chemicals

No HE were detected in samples 0316-97-0561 and 0316-97-0562, despite indications of the presence of TNT and RDX in the associated field screening samples. The positive D-Tech™ results, which suggested that low levels of TNT and RDX were present, was not confirmed by the fixed laboratory analysis. The D-Tech™ kits have been shown to provide false positives due to interferences with humic materials. See Section 4.3.2 for further details.

Sample 0316-97-0561 was reanalyzed for SVOCs because of poor internal standard recovery in the initial analysis. Bis(2-ethylhexyl)phthalate was detected between 0.09 and 0.1 mg/kg in both samples (Table 5.25.7-1). Baseline validation indicated no other problems that affect the use of the data from this reanalysis, or from the SVOC analysis of sample 0316-97-0562.

TABLE 5.25.7-1
DETECTED ORGANIC CHEMICALS FOR PRS 16-034(F)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	MEDIA	DEPTH (FT)
Bis(2-ethylhexyl)phthalate	0316-97-0561	0.1(J)	32	Soil	0-1

5.25.8 Risk-Based Screening Assessment

Lead and zinc were detected at concentrations above background UTLs but at less than 10% of SALs. Antimony results were rejected as not valid, and cyanide was reported as undetected. The

one organic chemical detected, a common plasticizer, was present at less than 0.5% of its SAL. Uranium-235, even if present at the reported level, is at less than 2% of its SAL. No chemicals were present at levels at or above SALs at PRS 16-034(f). Visual inspection of the data suggests that an MCE calculation would yield a value far below the target level of 1.0.

5.25.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-034(f) because no contaminants were detected above SALs.

5.25.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.25.11 Conclusions and Recommendations

Five screening samples and two laboratory samples were collected within the footprint of the former storage building TA-16-498. The laboratory samples were selected from the three samples that screened positive for HE. No HE was detected in the laboratory analysis. Lead and zinc were detected above background levels in one of the laboratory samples, but well below SALs. There are no valid antimony data, but antimony is not implicated by either historical information or current ER data from TA-16 as a likely contaminant of concern at this site. No inorganic or organic chemicals were detected at or above SALs. The data show that no contaminants are present at this site at levels of concern to human health.

The biased sampling and analysis strategy at this former laboratory was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on information about the location, orientation, construction, use of the former building, and mode of decommissioning. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, two confirmatory laboratory samples are sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory samples were based on field screening results, and were analyzed for all potential contaminants based on historical knowledge of operations in TA-16-498.

PRS 16-034(l) is recommended for human-health NFA based on NFA Criterion 5 because contamination is not present at this site at levels that present a potential risk to human health.

5.26 PRS 16-034(l)

This PRS is the site for the former equipment storage building TA-16-47, located in the GMX-3 area (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.26.1 History

PRS 16-034(l) is discussed in detail in Subsection 5.19 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

TA-16-47 was an equipment-storage building completed in 1945. It is unknown what items were stored in this building, but it is possible that HE or HE contaminated materials were included. Surveys completed before combustion suggested that the structure was free of HE contamination (Engineering Department 1956, 15-16-256), however a former site worker (Blackwell 1983, 15-16-076) believed it was contaminated. The building had no sump or plumbing. The building was abandoned and destroyed by intentional burning in 1960.

The potential contamination at this PRS was identified as metals, SVOCs, and HE.

5.26.2 Description

TA-16-47 was of wooden-frame construction (11 ft long x 11 ft wide X 8.5 ft high) with a concrete foundation and floor. It was located roughly 10 ft south of TA-16-46, a rest house. Currently this site is level, with no well-defined drainage.

5.26.3 Previous Investigation(s)

No previous field investigations were conducted at this PRS.

5.26.4 Field Investigation

The goal of the Phase I investigation at PRS 16-034(l), as outlined in the approved RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The

potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect residual HE in the surface and near-surface soil at the site of the building footprint. The mode of decommissioning of the building by burning suggests that residual contamination is unlikely at this PRS.

Addendum 1 (LANL 1994, 1160) specified screening soil samples, 0 to 1 ft depth intervals, from four locations and selecting one laboratory sample if a positive field screening reading is obtained. The plan called for taking the samples at the four quadrants of the building. The laboratory sample was to be selected from the screening samples using the following prioritized biasing scheme: (1) a sample with positive HE spot test kit result; and (2) a sample with above two times background radiation reading. In response to an EPA NOD (EPA 1994, 15-16-644), screening samples were collected from 1 to 2 ft depth intervals (as well as the required 0 to 1 ft intervals) to confirm that the soil beneath this concrete floored building had not been disturbed during decommissioning, and one laboratory sample was collected (based on the above scheme) even if all field screening results were negative.

One deviation was made from the work plan. The screening samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of eight field screening samples were taken from four locations in the building footprint. Two samples were collected from each location, at 0 to 1 ft and 1 to 2 ft depth intervals. The samples were collected near the corners of the four quadrants of the building (Fig. 5.20.4-1). These locations were selected to ensure spatial variability and because the most likely

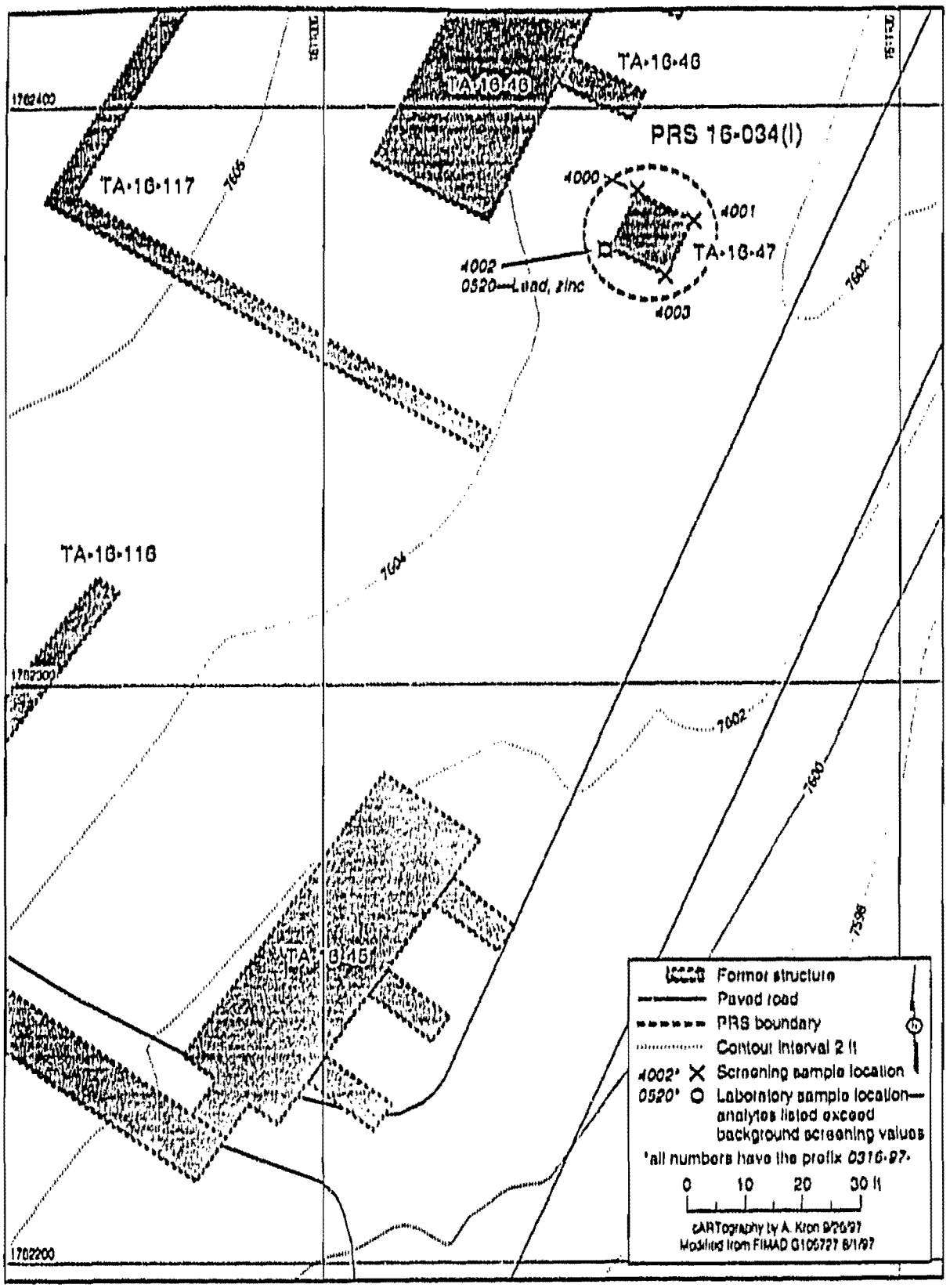


Fig. 5.26.4-1 Locations of PRS 16-034(l) samples.

contaminant dispersal mechanism for operations in this building, which had concrete floors, is hypothesized to be from leakage at the floor/wall joints.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). Samples at 0 to 1 ft depth intervals were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050). The 0 to 1 ft intervals were selected for further characterization, rather than the 1 to 2 ft intervals, because the soil beneath the PRS structure is undisturbed, as confirmed by the soil descriptions in the sample collection logs. If contamination is present within the structure footprint, it is most likely present at shallow depths directly beneath the structure. The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. Three samples screened positive for HE using the D-Tech™ kit (Table 5.26.4-1).

TABLE 5.26.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4000 northwest quadrant	16-4000	0 - 1	NA[a]	negative	background	<0.5	0.5 - 1.5
0316-97-4001 northeast quadrant	16-4001	0 - 1	NA	negative	background	<0.5	<0.5
0316-97-4002 southwest quadrant	16-4002	0 - 1	0316-97-0520	negative	background	0.5 - 1.5	0.5 - 1.5
0316-97-4003 southeast quadrant	16-4003	0 - 1	NA	negative	background	0.5 - 1.5	<0.5

a. NA = Not analyzed.

Screening sample 0316-97-4002 contained the highest concentrations of TNT and RDX (0.5 to 1.5 mg/kg for both analytes) and was submitted to the laboratory for analysis (Table 5.26.4-1). The sample was analyzed for metals, SVOCs, and HE (Table 5.26.4-2).

TABLE 5.26.4-2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES
FOR PRS 16-034(L)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MATRIX	SVOC	HE	INORGANIC
16-4002	0316-97-0520	0-1	Soil	3318R	3319R	3320R

5.26.5 Evaluation of Inorganic Chemicals

Lead and zinc were detected at concentrations above background UTLs (Table 5.26.5-1). The lead value of 60.5 mg/kg is estimated (J) because the duplicate recovery for lead in this sample was outside the acceptable 20% range. The result, although approximate, is usable for comparison both to a UTL at approximately 40% of the reported result and a SAL that is more than six times as large as this result. Baseline validation revealed no other problems with the inorganic analyses.

TABLE 5.26.5-1
INORGANIC CHEMICALS WITH CONCENTRATIONS AT OR ABOVE
BACKGROUND SCREENING VALUES FOR PRS 16-034(L)

ANALYTE	REPORTING UNITS	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	UTL (MG/KG)	MEDIA	DEPTH (FT)
Lead	MG/KG	0316-97-0520	60.5(J*)	400	23.3	Soil	0-1
Zinc	MG/KG	0316-97-0520	81.7	23000	50.8	Soil	0-1

a. J = Analyte was positively identified, but the result is estimated to be more uncertain than would normally be expected for that analysis.

5.26.6 Evaluation of Radionuclides

Radionuclides were not analyzed for at PRS 16-034(l) because historical evidence indicated that radioactive material was not stored or used in the equipment building. Additionally, field screening did not indicate the presence of radioactive constituents.

5.26.7 Evaluation of Organic Chemicals

No organic chemicals were detected in sample 0316-97-0520, despite indications of the presence of TNT and RDX in the associated field screening sample. The positive D-Tech™ results, which suggested that low levels of TNT and RDX were present, was not confirmed by the fixed laboratory analysis. The D-Tech™ kits have been shown to provide false positives due to interferences with humic materials. See Section 4.3.2 for further details. Baseline validation indicates no data quality problems associated with these analyses that would affect the use of these organic data.

5.26.8 Risk-Based Screening Assessment

Lead was estimated at about 15% of its SAL and zinc was reported at less than 0.5% of SAL. Chemicals were not present at levels at or above SALs at PRS 16-034(l). Visual examination of the data suggests that an MCE calculation would yield a value far below the target level of 1.0.

5.26.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-034(l) because contaminants were not detected at levels at or above SALs.

5.26.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.26.11 Conclusions and Recommendations

Eight screening samples and one laboratory sample were collected from in and adjacent to the footprint of the former equipment building TA-16-47. The laboratory sample was selected from among the three screening samples with positive HE screening results. Lead and zinc were reported at concentrations above background UTLs but below SALs. No inorganic or organic contamination was found above SALs. The data show that no contaminants are present at this site at levels of concern to human health.

The biased sampling and analysis strategy at this former equipment building was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on information about the location, orientation, construction, use of the former building, and mode of decommissioning. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, a single confirmatory laboratory sample is sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory sample was selected from screening samples based on field screening results, and was analyzed for all potential contaminants based on historical knowledge of operations in TA-16-47.

PRS 16-034(l) is recommended for human-health NFA based on NFA Criterion 5 because contamination is not present at this site at levels that present a potential risk to human health.

5.27 PRS 16-034(m)

This PRS is the site of former laboratory building TA-16-86, in the GMX-2 area (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.27.1 History

PRS 16-034(m) is discussed in detail in Subsection 5.20 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

TA-16-86 was a small laboratory building with no plumbing fixtures or sumps, constructed in 1945. It contained temperature-controlled curing ovens. One former site worker recalled drying plumbatol (PbO + TNT) charges. In at least one case, such a charge caught on fire (Martin and Hickmott 1993, 15-16-498). In contrast, another site worker recalled that the building was used as a magazine (Martin 1993, 15-16-477). It was abandoned in December 1959. The building was listed as being HE contaminated before its destruction by burning in 1960 (Engineering Department 1959, 15-16-256).

The potential contamination at this PRS was identified as metals, SVOCs, and HE.

5.27.2 Description

TA-16-86 was 10 ft long x 16 ft wide x 10 ft high, of wooden-frame construction with a wooden floor. It was located on level ground.

5.27.3 Previous Investigation(s)

No previous field investigations were conducted at this PRS.

5.27.4 Field Investigation

The goal of the Phase I investigation at PRS 16-034(m), as outlined in the approved RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive

activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect residual HE in the heterogeneous surface and subsurface soil at the site of the building footprint. The mode of decommissioning of the building by burning suggests that residual contamination is unlikely at this PRS.

Addendum 1 (LANL 1994, 1160) specified screening soil samples, 0 to 1 ft depth intervals, from five locations and selecting one laboratory sample based on field screening results. The plan called for taking the screening samples at the four quadrants of the building and at the building center. The laboratory sample was to be selected from the screening samples using the following prioritized biasing scheme: (1) a sample with a positive HE spot test kit result; (2) a sample with above two times background radiation readings; and (3) a sample at the building center. In response to the EPA NOD (EPA 1994, 15-16-044), two laboratory samples were collected (based on the above scheme) rather than one laboratory sample.

One deviation was made from the work plan. The screening samples were analyzed for RDX and TNT using the D-Tech™ Immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of five field screening samples were taken from five locations in the building footprint. The samples were collected from the 0 to 1 ft depth interval. The field screening samples were within the four quadrants of the building and at the building center (Fig. 5.27.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which had wooden floors, is hypothesized to be via leakage from cracks within wooden floors.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe

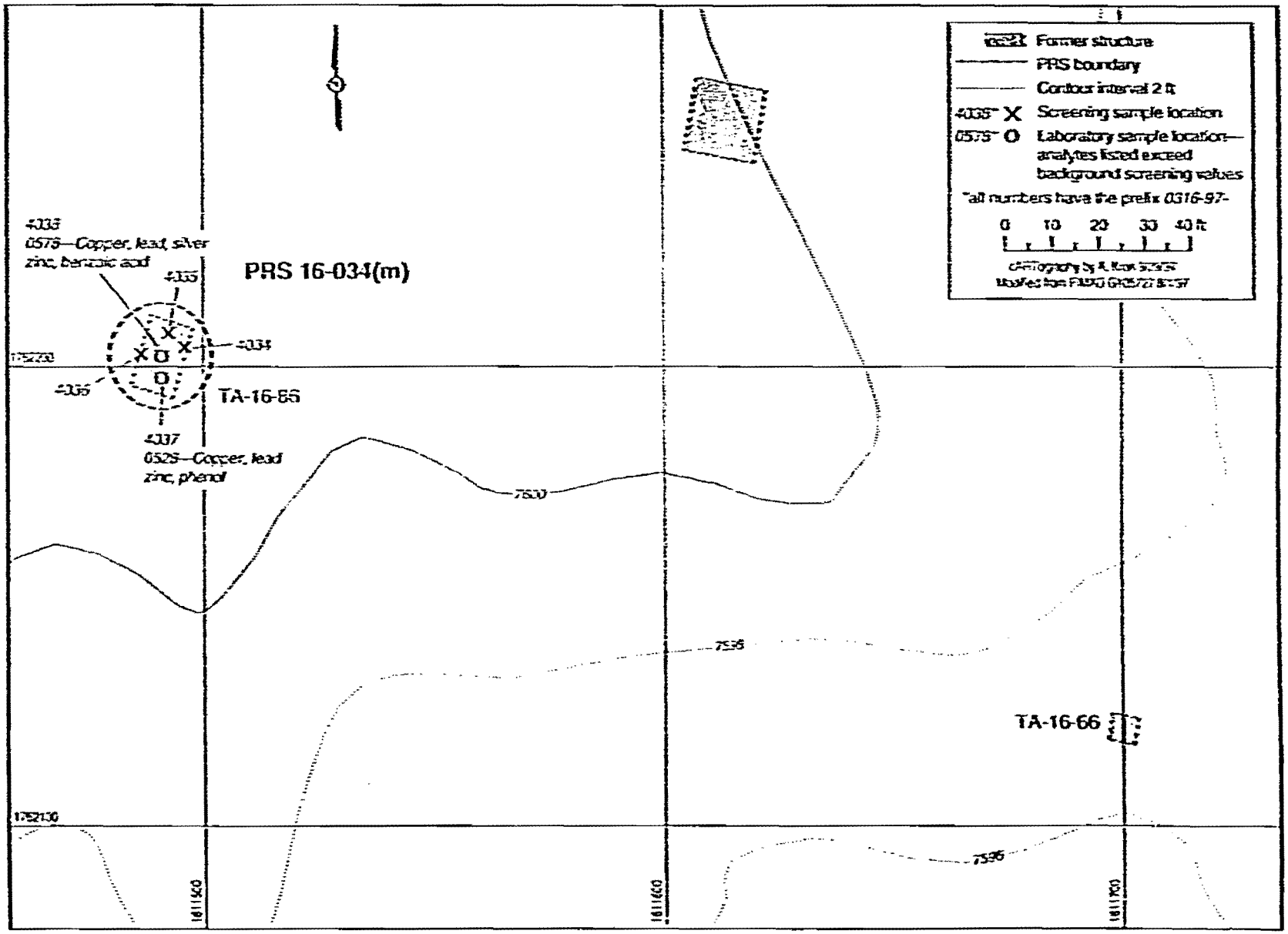


Fig. 5.27.4-1 Locations of PRS 16-034(m) samples.

(LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). Samples were analyzed for RDX and TNT using the D-Tech™ Immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050). The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. One sample screened positive for HE using the D-Tech™ kit (Table 5.27.4-1).

TABLE 5.27.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4034 northeast quadrant	16-4034	0 - 1	NA[a]	negative	background	< 0.5	< 0.5
0316-97-4035 northwest quadrant	16-4035	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4036 southwest quadrant	16-4036	0 - 1	NA	negative	background	< 0.5	< 0.5
0316-97-4037 southeast quadrant	16-4037	0 - 1	0316-97-0528	negative	background	0.5 - 1.5	< 0.5
0316-97-4038 center	16-4038	0 - 1	0316-97-0578	negative	background	< 0.5	< 0.5

a. NA = Not analyzed.

Screening sample 0316-97-4037 contained the highest concentration of HE (0.5 to 1.5 mg/kg RDX) and sample 0316-97-4038 was the building center location. These two samples were submitted to the laboratory for analysis (Table 5.27.4-1). The samples were analyzed for metals, SVOCs, and HE (Table 5.27.4-2).

TABLE 5.27.4-2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES TAKEN AT PRS 16-034(M)

LOCATION ID	SAMPLE ID	DEPTH (FT)	MATRIX	SVOC	HE	INORGANIC
16-4037	0316-97-0528	0-1	Soil	3457R	3458R	3459R
16-4038	0316-97-0578	0-1	Soil	3457R	3458R	3459R

5.27.5 Evaluation of Inorganic Chemicals

Copper, lead, silver, and zinc were detected at levels above UTLs but below SALs (Table 5.27.5-1). The copper, and zinc data are estimated (J-qualified) because the duplicate recovery was

below the acceptable 20% limit. Sample 0316-97-0528 was used for duplicate analysis in this laboratory batch. Antimony in the two samples was undetected by the laboratory at 6.7 mg/kg and 9.6 mg/kg. The antimony data were estimated undetected (UJ) by the data validator because the matrix spike recoveries were below acceptable levels. This result is accepted as undetected as discussed in Section 4.1. The qualifiers in Table 5.27.5-1 were assigned during baseline and focused data validation. Data validation indicated no other problems with the data that would affect their use.

TABLE 5.27.5-1
INORGANIC CHEMICALS WITH CONCENTRATIONS AT OR ABOVE BACKGROUND SCREENING VALUES FOR PRS 16-034 (M)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	UTL (MG/KG)	MEDIA	DEPTH (FT)
Antimony	0316-97-0528	9.6 (UJ)	31	1	Soil	0-1
Antimony	0316-97-0578	6.7 (UJ)	31	1	Soil	0-1
Copper	0316-97-0528	71.5(J[b])	2800	15.5	Soil	0-1
Copper	0316-97-0578	24(J)	2800	15.5	Soil	0-1
Lead	0316-97-0528	64.5	400	23.3	Soil	0-1
Silver	0316-97-0528	2.2	380	NC[a]	Soil	0-1
Silver	0316-97-0578	0.87	380	NC	Soil	0-1
Zinc	0316-97-0528	190(J)	23000	50.8	Soil	0-1
Zinc	0316-97-0578	57.7(J)	23000	50.8	Soil	0-1

a. NC = not calculated
b. J = Analyte was positively identified, but the result is estimated to be more uncertain than would normally be expected for that analysis.

5.27.6 Evaluation of Radionuclides

Radionuclides were not analyzed for at PRS 16-034(m) because historical evidence indicated that radioactive material was not stored or used in the laboratory building. Additionally, field screening did not indicate the presence of radioactive constituents.

5.27.7 Evaluation of Organic Chemicals

Trace amounts of benzoic acid and phenol were present above instrument detection levels but below EQLs (Table 5.27.7-1). Baseline validation revealed no problems with the organic analyses that would affect their use.

No HE was detected in sample 0316-97-0528, despite indications of the presence of RDX in the associated field screening sample. The positive D-Tech™ result, which suggested that low levels of RDX were present, was not confirmed by the fixed laboratory analysis. The D-Tech™ kits have been shown to provide false positives due to interferences with humic materials. See Section

4.3.2 for further details. Baseline validation indicates no data quality problems associated with these analyses.

TABLE 5.27.7-1
DETECTED ORGANIC CHEMICALS FOR PRS 16-034(M)

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	MEDIA	DEPTH (FT)
Benzoic Acid	0316-97-0578	0.11	100000	Soil	0-1
Phenol	0316-97-0528	0.043	39000	Soil	0-1

5.27.8 Risk-Based Screening Assessment

Lead was reported at 16% of SAL and copper at 2.5% of SAL in one of the two laboratory samples. Other detected inorganic chemicals were reported at less than 1% of SALs. Two organic compounds were detected above instrument detection levels but below EQLs and far below SALs. No chemicals were present at levels at or above SALs at PRS 16-034(m). Visual inspection of the data suggest that an MCE calculation would yield a value far below the target level of 1.0.

5.27.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS 16-034(m) because contaminants were not detected at levels at or above SALs.

5.27.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.27.11 Conclusions and Recommendations

Five screening samples and two laboratory samples were collected in and adjacent to the footprint of the former laboratory building TA-16-86. One laboratory sample was selected from the only screening sample which screened positive for HE. The other laboratory sample was selected from the center location. No HE was detected in the samples. Copper, lead, silver, and zinc were detected at levels above background UTLs but below SALs. Two organic compounds were detected above instrument detection levels but below EQLs and SALs. No inorganic or organic contamination was detected at levels at or above SALs. The data show that no contaminants are present at this site at levels of concern to human health.

The biased sampling and analysis strategy at this former laboratory building was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on information about the location, orientation, construction, use and mode of decommissioning of the former building. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, two confirmatory laboratory samples are sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory samples were based on field screening results, and were analyzed for all potential contaminants based on historical knowledge of operations in TA-16-86.

PRS 16-034(m) is recommended for human-health NFA based on NFA Criterion 5 because contamination is not present at this site at levels that present a potential risk to human health.

5.28 PRS C-16-005

This PRS is the site of former equipment storage and HE machining facility TA-16-53, located in the GMX-2 area (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.28.1 History

PRS C-16-005 is discussed in detail in Subsection 5.20 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

TA-16-53 was an optical equipment storage and HE machining facility. The building was constructed in the spring of 1945 and contained a hydraulic press for HE processing. A former site worker claimed to have machined the inner charges for the Trinity device in this building (Martin and Hickmott 1993, 15-16-498). Another worker claimed that both HE machining and casting were done in this building (Martin 1993, 15-16-477). The building had a primary sump on the south side of the southern barricade and a secondary sump 100 ft to the southwest of the building, which had a drain line that exited to the south, eventually flowing into the main drainage ditch for the GMX-2 area. The sumps, PRS 16-029(b2), are addressed in Addendum 1 (LANL 1994, 1160). The building was determined to be contaminated with HE before its demolition by burning in 1960.

The potential contamination at this PRS was identified as metals, SVOCs, and HE.

5.28.2 Description

TA-16-53 was 39 ft long by 16 ft long by 14 ft high with a 6 ft long by 17 ft wide by 8 ft high addition. TA-16-53 was located northeast of TA-16-49. The former location of the building is level, the drainage area slopes slightly to the east. It was wooden-frame construction with a concrete foundation and floor. It was surrounded on three sides with an earthen barricade.

5.28.3 Previous Investigation(s)

No previous field investigations were conducted at this PRS.

5.28.4 Field Investigation

The goal of the Phase I investigation at PRS C-16-005, as outlined in the approved RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect residual HE contamination in heterogeneous surface and near-surface soil at the site of the building footprint. The mode of decommissioning of the building by burning suggests that residual contamination is unlikely at this PRS.

Addendum 1 (LANL 1994, 1160) specified screening soil samples, 0 to 1 ft depth intervals, from six locations and selecting two laboratory samples based on field screening results. The plan called for taking the samples at the four quadrants of the building, at the building center, and adjacent to the location of the door. The laboratory samples were to be selected from the screening samples using the following prioritized biasing scheme: (1) samples with positive HE spot test kit result; (2) samples with above two times background radiation reading; (3) a sample at the door location; and (4) a sample at center location. In response to EPA NOD (EPA 1994, 15-16-644), screening samples were collected from 1 to 2 ft depth intervals (as well as the required 0

to 1 ft intervals) to confirm that the soil beneath this concrete floored building had not been disturbed during decommissioning.

One deviation was made from the work plan. The screening samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit. This analysis was performed in addition to the required HE spot test analysis because the D-Tech™ kits can detect specific potential contaminants and provide lower detection limits (1 ppm or less) than the HE spot test. This screening was used to further characterize the samples in the field for biasing purposes.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of twelve field screening samples from six locations were taken in the building footprints. Two samples were collected from each location, at 0 to 1 ft and 1 to 2 ft depth intervals. The samples were collected near the corners of the four quadrants of the buildings, the building center, and at the door location (Fig. 5.28.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which had concrete floors, is hypothesized to be via either: (1) HE spills near door areas; or (2) leakage at the floor/wall joints.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler). The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). Samples at 0 to 1 ft depth intervals were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050). The 0 to 1 ft intervals were selected for further characterization, rather than the 1 to 2 ft intervals, because the soil beneath the PRS structure is undisturbed, as confirmed by the soil descriptions in the sample collection logs. If contamination is present within the structure footprint, it is most likely present at shallow depths directly beneath the structure. The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

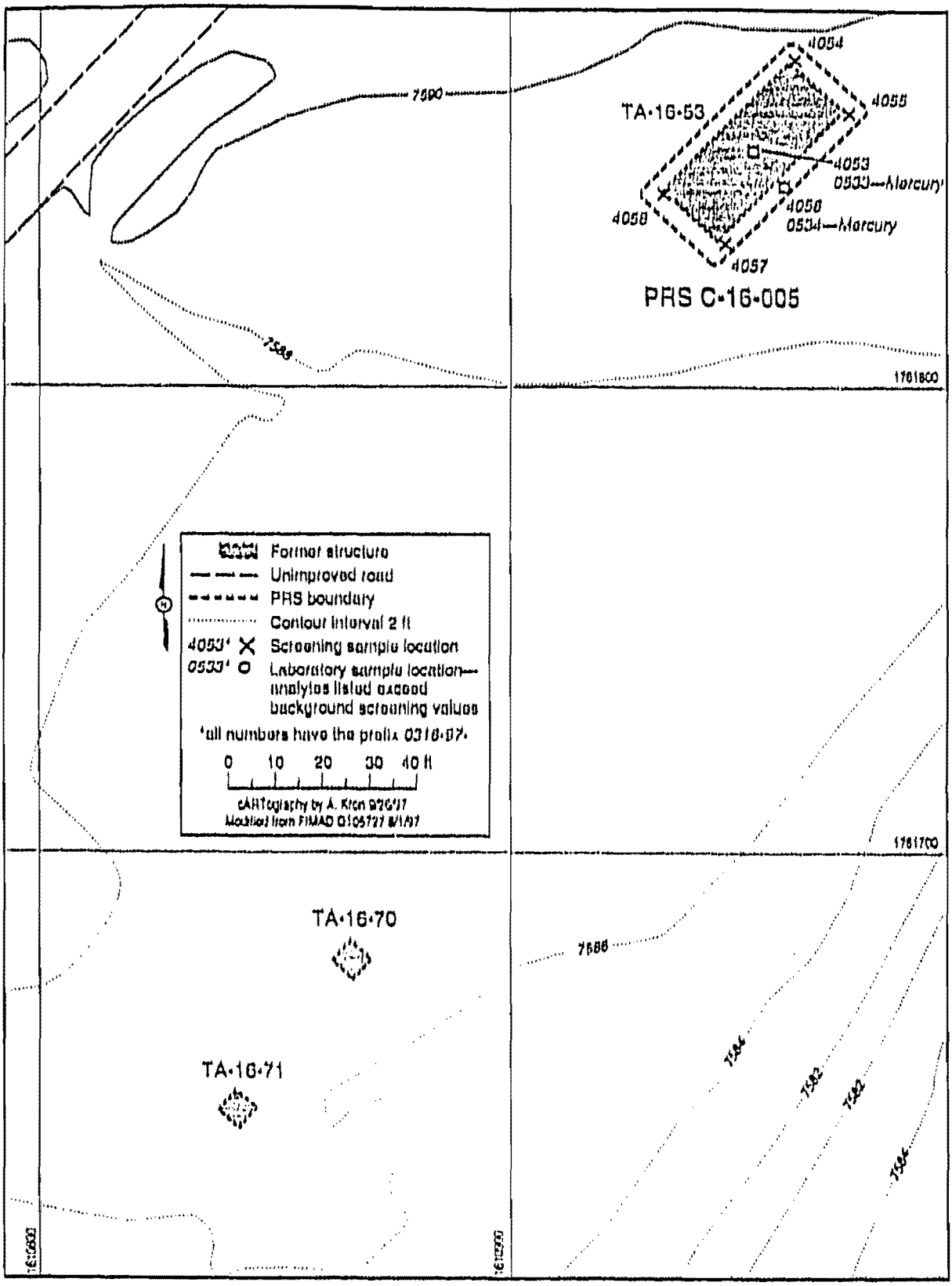


Fig. 5.26.4-1 Locations of PRS C-16-005 samples.

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. Five samples screened positive for HE using the D-Tech™ kit (Table 5.28.4-1).

TABLE 5.28.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	D-TECH RDX (MG/KG)	D-TECH TNT (MG/KG)
0316-97-4053 center	16-4053	0 - 1	0316-97-0533	negative	background	< 0.5	0.5 - 1.5
0316-97-4054 northwest quadrant	16-4054	0 - 1	NA[a]	negative	background	< 0.5	0.5 - 1.5
0316-97-4055 northeast quadrant	16-4055	0 - 1	NA	negative	background	< 0.5	0.5 - 1.5
0316-97-4056 door	16-4056	0 - 1	0316-97-0534	negative	background	< 0.5	0.5 - 1.5
0316-97-4057 southeast quadrant	16-4057	0 - 1	NA	negative	background	0.5 - 1.5	< 0.5
0316-97-4058 southwest quadrant	16-4058	0 - 1	NA	negative	background	< 0.5	< 0.5

a. NA = Not analyzed.

Screening samples 0316-97-4053 and 0316-97-4056 contained elevated concentrations of TNT (0.5 to 1.5 mg/kg). Sample 0316-97-4053 was the center location, and sample 0316-97-4056 was the door location. The two samples were submitted to the laboratory for analysis (Table 5.28.4-1). The laboratory samples were analyzed for metals, SVOCs, and HE (Table 5.28.4-2).

TABLE 5.28.4-2
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES
TAKEN AT PRS C-16-005

LOCATION ID	SAMPLE ID	DEPTH (FT)	MATRIX	INORGANICS	SVOCS	HE
16-4053	0316-97-0533	0-1	soil	3352R	3351R	3353R
16-4056	0316-97-0534	0-1	soil	3352R	3351R	3353R

5.28.5 Evaluation of Inorganic Chemicals

Mercury was detected in both samples above background levels. Results for sample 0316-97-0534 was reported as estimated (J) (Table 5.28.5-1). As discussed in Section 4.1, the data of Feranbaugh et al (1990, 46453) are being used to make background evaluations for mercury for data reported below the EQL of 0.1 mg/kg. Baseline validation revealed no other problems with the inorganic analyses that affect the use of these data.

TABLE 5.28.5-1
INORGANIC CHEMICALS WITH CONCENTRATIONS AT OR ABOVE BACKGROUND SCREENING VALUES FOR PRS C-16-005

ANALYTE	SAMPLE ID	SAMPLE VALUE (MG/KG)	SAL (MG/KG)	UTL (MG/KG)	MEDIA	DEPTH (FT)
Mercury	0316-97-0533	0.35	23	0.1	Soil	0-1
Mercury	0316-97-0534	0.05(J[a])	23	0.1	Soil	0-1

a. J = Analyte was positively identified, but the result is estimated to be more uncertain than would normally be expected for that analysis.

5.28.6 Evaluation of Radionuclides

Radionuclides were not analyzed for at PRS C-16-005 because historical evidence indicated that radioactive material was not stored or used in the building. Additionally, field screening did not indicate the presence of radioactive constituents.

5.28.7 Evaluation of Organic Chemicals

No organic chemicals were detected in samples 0317-97-0533 and 0316-97-0534, despite indications of the presence of TNT in the associated field screening samples. The positive D-Tech™ results, which suggested that low levels of TNT were present, was not confirmed by the fixed laboratory analysis. The D-Tech™ kits have been shown to provide false positives due to interferences with humic materials. See Section 4.3.2 for further details. All undetected SVOCs in sample 0316-97-0534 were qualified estimated undetected (UJ), due to problems with an internal standard, but as discussed in Section 4.3.1 these were accepted as undetected following focused validation. Baseline validation indicated no problems that affect the use of these data.

5.28.8 Risk-Based Screening Assessment

Mercury was reported in both samples at less than 2% of the SAL. No chemicals were present at levels at or above SALs at PRS C-16-005.

5.28.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS C-16-005 because contamination was not detected at levels at or above SALs.

5.28.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.28.11 Conclusions and Recommendations

Twelve screening samples and two laboratory samples were collected in and adjacent to the footprint of the former equipment storage and HE machining facility TA-16-53. Laboratory samples were selected from among the five screening samples that screened positive for HE. No HE was detected in the laboratory samples. Mercury was reported in both samples above background levels but below SAL. No inorganic or organic contamination was found at concentrations above SALs. The data show that no contaminants are present at this site at levels of concern to human health.

The biased sampling and analysis strategy at this former equipment storage building was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on information about the location, orientation, construction, use of the former building, and mode of decommissioning. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, two confirmatory laboratory samples are sufficient to indicate whether or not such contamination is present at levels of concern. The laboratory samples were selected based on field screening results, and were analyzed for all potential contaminants based on historical knowledge of operations in TA-16-53.

PRS C-16-005 is recommended for human-health NFA based on NFA Criterion 5 because contamination is not present at this site at levels that present a potential risk to human health.

5.29 PRS C-16-017

This PRS is the site of former steam plant TA-16-502, located at T-Site (Fig. 5.0-1). It is recommended for human-health NFA because no contaminants were detected above SALs.

5.29.1 History

PRS C-16-017 is discussed in detail in Subsection 5.24 of the RFI Work Plan for Operable Unit 1082, Addendum 1 (LANL 1994, 1160).

TA-16-502 was built in September 1945. The steam plant was located at the entrance of T-Site south of the road to the operational area. It is not known what algaecides were used in this facility, but chromates are the most likely additives. The building contained no sumps. It was abandoned in 1959 and destroyed by burning in early 1960.

The potential contamination at this PRS was identified as metals and SVOCs.

5.29.2 Description

TA-16-502 was a 16 ft by 16 ft by 9 ft wooden-frame construction building with a wooden floor. It was located on level ground.

5.29.3 Previous Investigation(s)

No previous field investigations were conducted at this PRS.

5.29.4 Field Investigation

The goal of the Phase I investigation at PRS C-16-017, as outlined in the approved work plan (LANL 1994, 1160), was to determine if contaminants were present in soils at levels of concern. The sampling design is consistent with the current industrial land use scenario of the conceptual model described in Section 4.3 of the RFI work plan. The potential for contamination at this PRS is hypothesized to be via either: (1) leaks and spills from the past operations; or (2) ash, debris, or contamination left behind after the former building was burned and remnants removed. The potential release mechanisms at this PRS are hypothesized to be via either: (1) infiltration of potential contamination into the near-surface soil; or (2) mechanical movement and mixing of potentially contaminated surface soil during the removal of the former building. There was no historic subsurface construction (or other intrusive activities) at this PRS, and there are no surface water collection points or drainages present that would have spread contamination to the subsurface. Biased sampling was designed to detect residual metals associated with algaecides in the surface and near-surface soil at the site of the building footprint. The mode of decommissioning of the building by burning suggests that residual contamination is unlikely at this PRS.

Addendum 1 (LANL 1994, 1160) specified screening soil samples, 0 to 1 ft depth intervals, from five locations and selecting one laboratory sample only if positive field screening results were obtained. The plan called for taking the screening samples at the four quadrants of the building and at the building center. The laboratory sample was to be selected from the screening samples using the following prioritized biasing scheme: (1) a sample with an elevated chromium concentration. In response to an EPA NOD (EPA 1994, 15-16-644), one laboratory sample was collected (based on the above scheme), even if all field screening results were negative.

One deviation was made from the work plan (LANL 1994, 1160). All of the samples were screened for HE using the HE spot test kit and the D-Tech™ immunoassay HE field screening

kits, and one laboratory sample was analyzed for HE. Although HE was not a potential contaminant at this steam plant, HE is a potential contaminant at other sites throughout T-Site. The analyses were performed to confirm that no HE was present at this site.

The building was accurately surveyed using a Trimble™ GPS Total Station. Aerial photographs were used to determine the building position, and the center of the building was surveyed with an estimated accuracy of 2 ft. Screening sample locations were further determined and surveyed relative to the center point and within the known dimensions of the building.

A total of five field screening samples were taken from five locations in the building footprint. The samples were collected from the 0 to 1 ft depth interval. The field screening samples were taken within the four quadrants of the building and at the building center (Fig. 5.29.4-1). These locations were selected to ensure spatial variability and because the most likely contaminant dispersal mechanism for operations in this building, which had wooden floors, is hypothesized to be via spills or leakage from cracks within wooden floors.

All samples were collected with a manually driven hand auger (LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler. The soil samples were screened in the field for HE and beta/gamma radioactivity using the HE spot test kit with modified Griess™ reagents (LANL-ER-SOP-10.06,R0, High Explosive Spot Test) and an Eberline ESP1™ radiological meter with HP-260™ probe (LANL-ER-SOP-10.07, R0, Field Monitoring for Surface and Volume Radioactivity Levels). Samples were analyzed for RDX and TNT using the D-Tech™ immunoassay HE field screening kit (EPA SW-846 Methods 4051 and 4050) and for metals using a Tracor Northern Spectrace 9000 XRF (LANL-ER-SOP-10.08, Operation of the Spectrace 9000 Field-Portable X-Ray Fluorescence Instrument). The soil was described and logged on the Sample Collection Log forms (LANL-ER-SOP-01.04, Sample Control and Field Documentation).

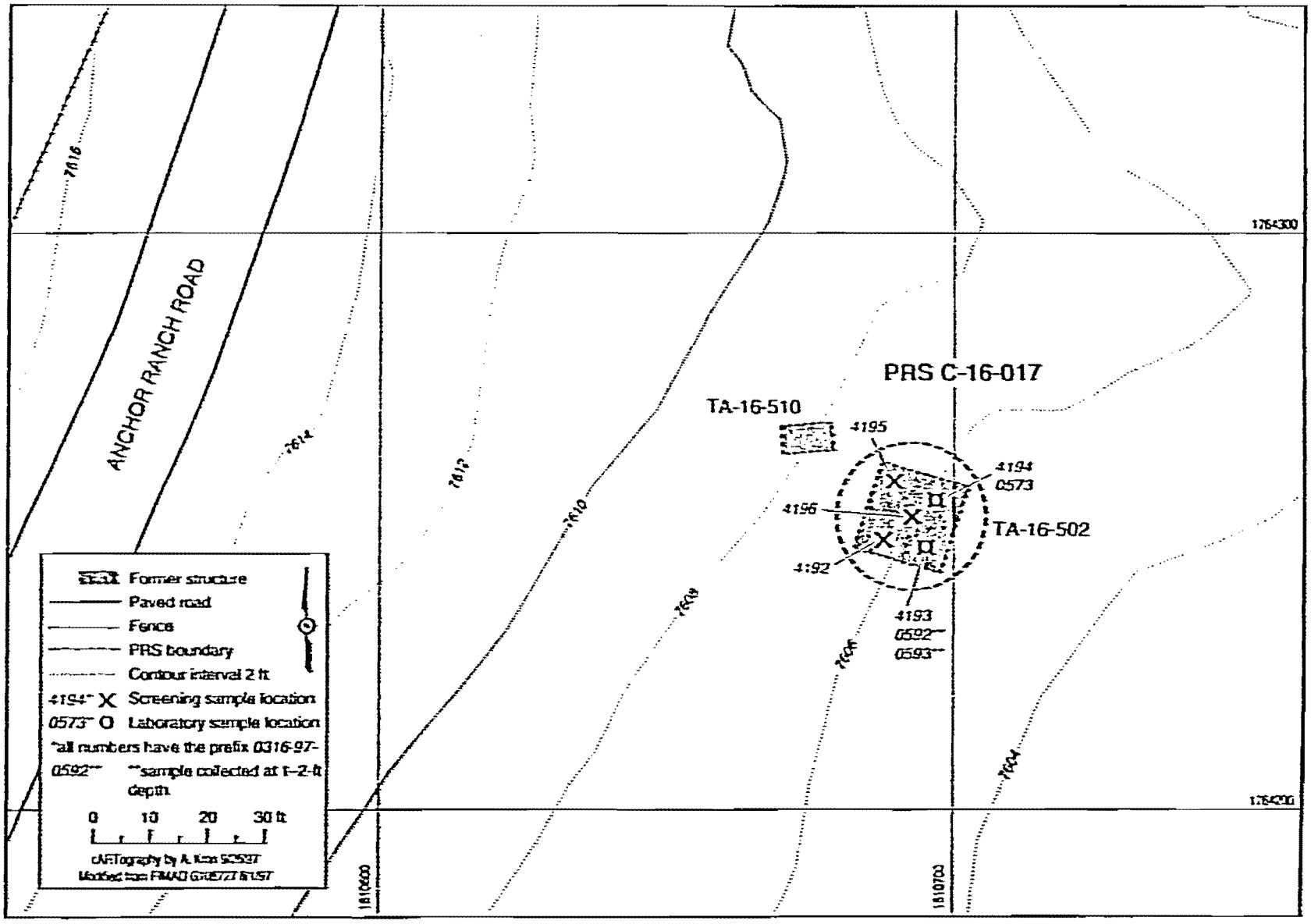


Fig. 5.29.4-1 Locations of PRS C-16-017 samples.

All samples screened negative for HE using the HE spot test kit and contained background radioactivity. Three samples screened positive for HE using the D-Tech™ kit. Samples at one location screened above detect for chromium (Table 5.29.4-1).

TABLE 5.29.4-1
SUMMARY OF FIELD SCREENING RESULTS

SCREENING SAMPLE NO.	LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	XRF CR (MG/KG)	D-TECH RDX (MG/K)	D-TECH TNT (MG/KG)
0316-97-4192 southwest quadrant	16-4192	0 - 1	NA[a]	negative	bkg.	ND[b]	< 0.5	0.5 - 1.5
0316-97-4193 southeast quadrant	16-4193	0 - 1	NA	negative	bkg.	530 ± 334	< 0.5	< 0.5
0316-97-4194 northeast quadrant	16-4194	0 - 1	0316-97-0573	negative	bkg.	ND	< 0.5	0.5 - 1.5
0316-97-4195 northwest quadrant	16-4195	0 - 1	NA	negative	bkg.	ND	< 0.5	0.5 - 1.5
0316-97-4196 center	16-4196	0 - 1	NA	negative	bkg.	ND	< 0.5	< 0.5

a. NA = Not analyzed.
b. ND = Not detected.

Three laboratory samples were collected from this PRS. One laboratory sample was selected based on HE screening results. Screening sample 0316-97-4194 was one of three samples which contained an elevated concentration of TNT (0.5 - 1.5 mg/kg) and was selected randomly. The random sample was selected by using a random-number generator to select a number one through three. These numbers corresponded to the northeast, northwest, and southwest quadrants. The northeast quadrant sample was selected. This sample was submitted to the laboratory for analysis (Table 5.29.4-1).

Two laboratory samples were selected based on chromium screening results. The chromium concentrations were not significantly above background, however concentrations were slightly elevated at the southeast quadrant location (16-4193). (The screening chromium values above are reported as concentrations plus or minus two standard deviations). Samples 0316-97-0592 and 0316-97-0593 were collected as QA/QC duplicates from 1 to 2 ft depths and were submitted to the laboratory for analysis (Table 5.29.4-2).

TABLE 5.29.4-2
SUMMARY OF FIELD SCREENING RESULTS
FOR QA/QC SAMPLES

LOCATION ID	DEPTH (FT)	LAB SAMPLE NO.	HE SPOT TEST	RAD SCREEN	XRF CR (MG/KG)	D-TECH RDX (MG/KG)	D-TECH TNT (MG/K)	QA/QC SAMPLE
16-4193 southeast quadrant	1 - 2	0316-97-0592	negative	bkg.	990 ± 746	< 0.5	< 0.5	0316-97-0593

The laboratory samples were analyzed for metals, SVOCs, and HE (Table 5.29.4-3).

TABLE 5.29.4-3
SUMMARY OF REQUEST NUMBERS FOR LABORATORY SAMPLES
TAKEN AT PRS C-16-017

LOCATION ID	SAMPLE ID	DEPTH (FT)	MATRIX	INORGANICS	SVOCS	HE
16-4194	0316-97-0573	0 - 1	soil	3440R	3438R	3440R
16-4193	0316-97-0592	1 - 2	soil	3528R	3526R	NA
16-4193	0316-97-0593	1 - 2	soil	3528R	3526R	NA

5.29.5 Evaluation of Inorganic Chemicals

No inorganic chemicals were present at levels greater than UTL in the laboratory samples from PRS C-16-017. Chromium was reported in the 500-1000 mg/kg range in screening samples from location 16-4193, but with very large measurement errors; the detection limit for chromium using the XRF was about 500 mg/kg. The high field screening result was not confirmed by laboratory analysis; chromium results for the duplicate samples collected from 1 to 2 ft at this location were 8.3 and 8.4 mg/kg, well within the background range for chromium.

5.29.6 Evaluation of Radionuclides

Radionuclides were not analyzed for at PRS C-16-017 because historical evidence indicated that radioactive material was not stored or used in the steam plant. Additionally, field screening did not indicate the presence of radioactive constituents.

5.29.7 Evaluation of Organic Chemicals

No HE was detected in any sample. The positive D-Tech™ result for the screening sample associated with sample 0316-97-0573, which suggested that low levels of TNT were present, was not confirmed by the fixed laboratory analysis. The D-Tech™ kits have been shown to provide

false positives due to interferences with humic materials. See Section 4.3.2 for further details. Baseline validation indicates no data quality problems associated with these analyses.

No other organic chemicals were detected in samples 0316-97-0573, 0316-97-0592 or 0316-97-0593. Baseline validation indicates no data quality problems associated with these analyses.

5.29.8 Risk-Based Screening Assessment

No screening assessment was performed because chemicals were not present at levels or above UTLs, EQLs, or SALs at PRS C-16-017.

5.29.9 Preliminary Human Health Assessment

No human health risk assessment was performed for PRS C-16-017 because contamination was not detected at or above UTLs, EQLs or SALs.

5.29.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this PRS will be deferred until the PRS can be assessed as part of the ecological exposure unit methodology currently being developed.

5.29.11 Conclusions and Recommendations

Seven screening samples and three laboratory samples were collected in the footprint of the former steam plant C-16-017. One laboratory sample was selected from the location with the highest HE screening result, but this result was not confirmed by laboratory analysis. The other laboratory samples were QA/QC duplicate splits which were selected from the location with the highest XRF screening result for chromium. No inorganic or organic contamination was found above UTLs, EQLs, or SALs in any of the samples. The data show that no contaminants are present at this site at levels of concern to human health.

The biased sampling strategy at this former steam plant was designed to ensure that residual contamination would be detected if it were present within the PRS. Screening locations and depths were selected based on the information about the location, orientation, construction, use of the former building, and mode of decommissioning. Because the likelihood of contamination within the building footprint is judged to be low following the removal of the building, and the likelihood of finding contamination is high based on the biased sampling, sampling at the two locations with positive field screening results is judged sufficient to indicate whether or not such

contamination is present at levels of concern. The laboratory samples were analyzed for all potential contaminants based on historical knowledge of operations in TA-16-502

PRS C-16-017 is recommended for NFA based on NFA Criterion 5 because contamination is not present at this site at levels that present a risk to human health.

6.0 REFERENCES

Ackerman, Major J. O., June 11, 1945. "Preparedness for Emergency Production at S-Site", Los Alamos Scientific Laboratory Memorandum to G. B. Kistiakowsky (X Division) from J. O. Ackerman (X-3), Los Alamos, New Mexico. (1945, 15-16-509)

ATSDR (Agency for Toxic Substances and Disease Registry) August 1995. "Toxicological Profile for Polycyclic Aromatic Hydrocarbons (PAHs) (Update)." ER ID 55663. (ATSDR 1995, 1408)

Blackwell, C., D., November 17, 1983. "Structures Removed From TA-16", Los Alamos National Laboratory Memorandum HSE 8-83-794 to A. J. Ahlquist (HSE-8) from C. D. Blackwell (HSE-1), Los Alamos, New Mexico. (Blackwell 1983, 15-16-076)

Blake, W. D., F. Goff, A. I. Adams, and D. Counce, May 1995. "Environmental Geochemistry for Surface and Subsurface Waters in the Pajarito Plateau and Outlying Areas, New Mexico," Los Alamos National Laboratory Report LA-12912-MS, UC 903, Los Alamos, New Mexico. (Blake et al. 1995, 1355)

Bowen, B. M., May 1990. "Los Alamos Climatology," Los Alamos National Laboratory Report LA-11735-MS, Los Alamos, New Mexico. (Bowen 1990, 0033)

Bradley, L. J. N., B. H. Magee, and S. L. Allen, 1994. "Background Levels of Polycyclic Aromatic Hydrocarbons (PAH) and Selected Metals in New England Urban Soils," in *Journal of Soil Contamination*, Vol. 3(4), p. 349. ER ID 46492. (Bradley et al. 1994, 1144)

Broxton, D. E., R. T. Ryti, D. Carlson, R. Warren, E. Kluk, and S. Chipera, March 21, 1996. "Natural Background Geochemistry of the Bandelier Tuff at MDA P, Los Alamos National Laboratory," Los Alamos National Laboratory Report LA-UR-96-1151, Los Alamos, New Mexico. (Broxton et al. 1996, 1305)

Buckland, C. W., August 15, 1957. "Radiation and Health Clearance at 'S' and 'T' Site Buildings," Los Alamos National Laboratory Memorandum to S. E. Russo (ENG-3) from C. W. Buckland (H-1), Los Alamos, New Mexico. (Buckland 1957, 15-16-243)

Buckland, C. W. , July 18, 1966. "Monitoring Results from Survey of Concrete Pads and Debris Following Burning of Superstructures," Los Alamos National Laboratory Memorandum to W. C. Courtwright from C. W. Buckland, Los Alamos, New Mexico. (Buckland 1966, 15-6-136)

Crockett, A. B., H. D. Craig, and T. F. Jenkins, May 1997. "On-Site Analytical Methods for Explosives," On-Site Analysis, American Environmental Laboratory, Shelton, Connecticut pp 27-29. (Crockett et al. 1997, 1411)

Crockett, A. B., H. D. Craig, T. F. Jenkins, and W. E. Sisk, November 1996. "Field Sampling and Selecting On-Site Analytical Methods for Explosives in Soil," In Federal Facilities Forum Issue, EPA/540/R-97/501, Office of Research and Development and Office of Solid Waste and Emergency Response, US Environmental Protection Agency, Washington, D. C. (Crockett et al. 1996, 1412)

Dorries, A. M. (Ed.), June 1,1996. "Risk-Based Corrective Action Process," Revision 1, Los Alamos National Laboratory Report LA-UR-96-2811, Los Alamos, New Mexico. (Dorries 1996, 1297)

Dunham , D., January 1996. " Biological and Floodplain/Wetland Assessment for the Steam Plant Project", Los Alamos National Laboratory Report LA-UR-96-108, Los Alamos, New Mexico. (Dunham 1996, 1996, 15-16-622)

Edwards, N.T., 1983. "Polycyclic Aromatic Hydrocarbons (PAHs) in the Terrestrial Environment—A Review." J. Environ. Quality, Vol. 12(4), P. 427-441,. ER ID No.55636. (Edwards 1983, 1407)

Engineering Department, October 2, 1959. "Vacated LASL Structures," C. W. Buckland (H-1), Los Alamos National Laboratory Memorandum, Los Alamos, New Mexico. (Engineering Department 1959, 15-16-256)

Environmental Protection Group, July 1994. "Environmental Surveillance at Los Alamos during 1992," Los Alamos National Laboratory Report LA-12764-ENV, Los Alamos, New Mexico. (Environmental Protection Group 1994, 1179)

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

EPA (US Environmental Protection Agency), July 1992. "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, Third Edition, Final Update 1, Office of Solid Waste and Emergency Response, Washington, DC. (EPA 1992, 1207)

EPA (US Environmental Protection Agency), April 1992. "Guidance for Data Usability in Risk Assessment (Part A)," Final, No. 9285.7-09A, Office of Emergency and Remedial Response, Washington, DC. ER ID No. 54947. (EPA 1992, 1166)

EPA (US Environmental Protection Agency), October 1994. "Notice of Deficiency, RFI Work Plan Operable Unit 1082 Addendum 1" Letter from William Honker (EPA) to Joseph Vozella (LAAO), EPA Region 6, Hazardous Waste Management Division, Dallas, Texas. (EPA 1994, 15-16-644)

EPA (US Environmental Protection Agency), September 1, 1995. "Region IX Preliminary Remediation Goals (PRGs) Second Half 1995," San Francisco, California. (EPA 1995, 1307)

Environmental Restoration Decision Support Council and Earth Science Council, June 30, 1997. "Application of LANL Background Data to ER Project Decision-Making, Part II: Radionuclides in Soils, Sediments and Tuff," Los Alamos National Laboratory Report (review draft), ER ID No. 56186, Los Alamos, New Mexico. (Environmental Restoration Decision Support Council and Earth Science Council 1997, 1414)

Environmental Restoration Project, September 1996. "RFI Report for Potential Release Sites in TA-16: 16-003(k), 16-021(c), Field Unit 3," Los Alamos National Laboratory Report LA-UR-96-3191, Los Alamos, New Mexico. (Environmental Restoration Project 1996, 1419)

Fenenbaugh, R. W., E. S. Gladney, and G. H. Brooks, Jr., October 1990. "Sigma Mesa: Background Elemental Concentrations in Soil and Vegetation, 1979," Los Alamos National Laboratory Report LA-11941-MS, Los Alamos, New Mexico. (Fenenbaugh et al. 1990, 0099)

Fresquez, P. R., M. A. Mullen, J. K. Fenenbaugh, and R. A. Perona, April 1996. "Radionuclides and Radioactivity in Soils Within and Around Los Alamos National Laboratory, 1974 through 1994: Concentrations, Trends, and Dose Comparisons," Los Alamos National Laboratory Report LA-13149-MS, Los Alamos, New Mexico (Fresquez et al. 1996, 1360)

Gardner, J.N., T. Kolbe, and S. Chang, January 1993. "Geology, Drilling, and Some Hydrologic Aspects of Seismic Hazards Program Core Holes, Los Alamos National Laboratory, New Mexico," Los Alamos National Laboratory Report LA-12460-MS, Los Alamos, New Mexico. (Gardner et al. 1993, 0848)

Gautier, M. A., E. S. Gladney, E. A. Jones, N. L. Koski, B. T. O'Malley, G. H. Brooks, and W. D. Moss, December 1992. "Quality Assurance for Environmental Chemistry: 1991," Los Alamos National Laboratory Report LA-12346-MS, Volumes I and II, Los Alamos, New Mexico. (Gautier et al. 1992, 0947)

Gautier, M. A. (Ed.), Analytical Chemistry Techniques and Quality Assurance, Los Alamos National Laboratory Report LA-10300-M, Los Alamos, New Mexico. (Gautier, 1417).

Knudsen, T.P., P. Black, O. Myers, and B. Vandenplas, April 1996. "Technical Approach to Data Assesment for ER Project Site Characterization Decisions," Los Alamos National Laboratory Report, Los Alamos, New Mexico (Knudsen et al 1996, 1299).

Longmire, P. A., D. E. Broxton, and S. L Reneau (Eds.), October 1995. "Natural Background Geochemistry and Statistical Analysis of Selected Soil Profiles, Sediments, and Bandelier Tuff, Los Alamos, New Mexico," Los Alamos National Laboratory Report LA-UR-95-3486, Los Alamos, New Mexico. (Longmire et al. 1995, 1266)

LANL (Los Alamos National Laboratory) July 1993, "RFI Work Plan for Operable Unit 1082," Los Alamos National Laboratory LA-UR-93-11196, Los Alamos, New Mexico. (LANL 1993, 1094)

LANL (Los Alamos National Laboratory) May 1994, "RFI Work Plan for Operable Unit 1082, Addendum 1" Los Alamos National Laboratory LA-UR-94-1580, Los Alamos, New Mexico. (LANL 1994, 1160)

LANL (Los Alamos National Laboratory), February 1995. "Installation Work Plan for Environmental Restoration," Revision 4, Los Alamos National Laboratory Report LA-UR-95-740, ER ID No. 49822, Los Alamos, New Mexico. (LANL 1995, 1164)

LANL (Los Alamos National Laboratory), July 1995. "RFI Work Plan for Operable Unit 1082," Addendum II, Los Alamos National Laboratory Report LA-UR-95-1038, Los Alamos, New Mexico. (LANL 1995, 1342)

LANL (Los Alamos National Laboratory), July 1995. "Statement of Work-Analytical Support," Revision 2, RFP No. 9-XS1-Q4257, ER ID No. 49738, Los Alamos, New Mexico. (LANL 1995, 1278)

LANL (Los Alamos National Laboratory), March 1996. "Quality Assurance Project Plan Requirements for Sampling and Analysis," Los Alamos National Laboratory Report LA-UR-96-441, Los Alamos, New Mexico. (LANL 1996, 1292)

Martin, B., November 17, 1993. "Early S-Site History: Lee Hilton Interview," Los Alamos National Laboratory Memorandum CST-6-ER/BM-93-060 to File from B. Martin (CST-6), Los Alamos, New Mexico. (Martin 1993, 15-16-477)

Martin, B. and D. Hickmott, May 6, 1993. "Early S-Site History: Melvin Brooks Interview," Los Alamos National Laboratory Memorandum CLS-ER/BM-93:022 to File from B. Martin (CLS-DO) and D. Hickmott (EES-1), Los Alamos, New Mexico. (Martin and Hickmott 1993, 15-16-496)

Martin, B. and D. Hickmott, June 14, 1993. "Early T-Site History:L. Bailey Interview," Los Alamos National Laboratory Memorandum CLS-ER/BM-93:35 to File from B. Martin (CLS-DO) and D. Hickmott (EES-1), Los Alamos, New Mexico. (Martin and Hickmott 1993, 15-16-500)

Martin, B. and D. Hickmott, December 6, 1993. "Early S-Site History: L. Norman Interview," Los Alamos National Laboratory Memorandum CLS-ER/BM-93:061 to File from B. Martin (CLS-DO) and D. Hickmott (EES-1), Los Alamos, New Mexico. (Martin and Hickmott 1993, 15-16-514)

McDonald, E.V., R.D. Ryti, P.A. Longmire, and S.L. Reneau, March 1996. "Background Geochemistry of Soils and Colluvium at MDA-P, Los Alamos National Laboratory," Los Alamos National Laboratory Report LA-UR-96-1092, Los Alamos, New Mexico. (McDonald et al. 1996, 1354)

National Park Service, September 19, 1983. "Archeology and Historic Preservation; Secretary of the Interior's Standards and Guidelines," Notice, Federal Register, Vol. 48, No. 190, p. 44716. (National Park Service 1983, 0632)

Project Consistency Team. "Project Consistency Team (PCT) Policy Memo Notebook," (Controlled), Environmental Restoration Project, Los Alamos National Laboratory, Los Alamos, New Mexico. (Project Consistency Team, 1210)

Raymer, D.F., January 1996. "Biological and Floodplain/Wetland Assessment for Environmental Restoration Program, Operable Unit 1082, TAs 11, 13, 16, 24, 37, and 28," Los Alamos National Laboratory Report LA-UR-93-4182, Los Alamos, New Mexico. (Raymer 1996, 15-16-621)

Rogers, M.A., 1995. "Insert for Geologic Map of the Los Alamos National Laboratory Reservation," Mara Inc., Los Alamos, New Mexico. (Rogers 1995, 1353)

Ryti, R., P. Longmire, and E. McDonald, March 29, 1996. "Application of LANL Background Data to ER Project Decision-Making, Part I: Inorganics," Los Alamos National Laboratory Report LA-UR-96-1534, ER ID No. 54585, Los Alamos, New Mexico. (Ryti et al. 1996, 1298)

Schulte, H. F., May 14, 1959. "Contamination Surveys - Abandoned Structures," Los Alamos National Laboratory Memorandum to S. E. Russo (ENG-3) from H. F. Schulte (H-5), Los Alamos, New Mexico. (Schulte 1959, 15-16-263)

Taylor, T. J., January 18, 1995. "Approval of the Operable Unit 1082 RFI Workplan," Department of Energy, Los Alamos Area Office Memorandum to H. Janson (EM/ER) from T. J. Taylor (DOE/LAAO), Los Alamos, New Mexico. (Taylor 1995, 15-15-645)

Truslow, E. R., March 1973. "Nonscientific Aspects of Los Alamos Project Y, 1942 through 1946," "Early S-Site Experiences," Appendix by E. Wilder, Jr., AL-5200, Los Alamos, New Mexico. (Truslow 1973, 15-16-264)

West, O. R., D. W. Bottrell, C. K. Bayne, R. L. Siegrist, and W. H. Holden, April 1997. "A scientific basis for revising regulatory holding times for VOC water samples," On-Site Analysis, American Environmental Laboratory, Shelton, Connecticut, pp. 15-16. (West et al, 1997, 1416)

Wingfield, E. E., May 27, 1960. "Demolition of Buildings by Burning" Atomic Energy Commission Memorandum form E. E. Wingfield (AEC), Los Alamos, New Mexico. (Wingfield 1960, 15-16-117)

Wingfield, E. E., January 29, 1960. "Demolition of Building by Fire," Atomic Energy Commission Memorandum from E. E. Wingfield (AEC), Los Alamos, New Mexico. (Wingfield 1960, 15-16-117)

THIS PAGE LEFT INTENTIONALLY BLANK

APPENDIX A ANALYTICAL SUITES

Results of analyses can be found in the Facility for Information Management and Display (FIMAD). Hard copies of supporting information will be provided upon request.

Chemicals that are reported by analytical laboratories as not detected have not been included in the tables of this RFI report. Nonetheless, undetected analytes are often part of the decision-making process and it is important to note that these chemicals were analyzed for. This appendix lists the target analytes in each analytical suite included in the tables of Section 5.

INORGANIC SUITE

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

SEMIVOLATILE ORGANIC COMPOUND (SVOC) SUITE

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

INDIVIDUAL RADIONUCLIDES

Strontium-90	Total Uranium	Cobalt-60	Radium-226

RADIONUCLIDE SUITE - GAMMA SPECTROSCOPY

Actinium-228	Americium-241	Annihilation Radiation	Barium-140
Bismuth-211	Bismuth-212	Bismuth-214	Cadmium-109
Cerium-139	Cerium-144	Cesium-134	Cesium-137
Cobalt-57	Cobalt-60	Europium-152	Lanthanum-140
Lead-210	Lead-211	Lead-212	Lead-214
Manganese-54	Mercury-203	Neptunium-237	Potassium-40
Protactinium-231	Protactinium-233	Radium-223	Radium-224
Radium-226	Radon-219	Ruthenium-106	Selenium-75
Sodium-22	Strontium-85	Thallium-208	Thorium-227
Thorium-234	Tin-113	Uranium-235	Yttrium-88
Zinc-65			

HIGH EXPLOSIVES SUITE

2-Amino-4,6-DNT	HMX	RDX
4-Amino-2,6-DNT	Nitrobenzene (NB)	Tetryl
1,3-Dinitrobenzene (1,3-DNB)	o-Nitrotoluene (2-NT)	1,3,5-Trinitrobenzene (1,3,5-TNB)
2,4-Dinitrotoluene (2,4-DNT)	m-Nitrotoluene (3-NT)	2,4,6-Trinitrotoluene (2,4,6-TNT)
2,6-Dinitrotoluene (2,6-DNT)	p-Nitrotoluene (4-NT)	

APPENDIX B DATA VALIDATION

The following tables summarize the results of quality assurance/quality control data validation for all analytical results used to support recommendations in this RFI report. Tables are presented in order of request number for each sample delivery group sent for laboratory analysis. The tables are grouped by analytical suite. Request numbers for each PRS are cited in Section 5.X.4, in Table 5.X.4-1 entitled Summary of Request Numbers for Samples Taken at PRS XX-XXX.

Tables in this appendix cover radiochemical analysis (Table B-1), HE analysis (Table B-2), inorganic analysis (Table B-3), and SVOC analysis (Table B-4).

TABLE B-1
DATA QUALITY EVALUATION FOR RADIOCHEMISTRY ANALYSES AT TA-16

SUITE	REQUEST NUMBER[a]	COMMENTS
Radionuclides	3404R	The laboratory control sample for uranium-235 was above the acceptable limit of 125%. As a result, samples 0316-97-0562 and 0316-97-0572 were qualified as estimated with a high bias (J+[b]). Even if the high bias is taken into consideration, the level of uranium-235 in these samples is not near a decision level. Bismuth-211 values are qualified as estimated (J[c])due to poor duplicate recovery. Bismuth-211 is included in the analysis as a measure of data quality. It is not a COPC at these sites and no decision level exists for bismuth-211. All data are accepted as useable with qualification.
Radionuclides	3420R	Radium analysis did not have a matrix spike. This did not affect the quality of the data. All data are useable.
Radionuclides	3460R	Duplicate results for lead-212 are not within the acceptable range. All lead-212 values are J-qualified. Lead-212 is included in the analysis as a measure of data quality. It is not a COPC at these sites and no decision level exists for lead-212. Radium analysis did not have a matrix spike. Radium is not a COPC for these sites. This did not affect the quality of the data. All data are accepted as useable.

[a] Environmental Restoration Project analytical request number
[b] J+ = Analyte was positively identified, result is likely biased high.
[c] J = Analyte was positively identified, numerical value is estimated to be more uncertain than would normally be expected for that analysis.

TABLE B-2
DATA QUALITY EVALUATION FOR HIGH EXPLOSIVES ANALYSES AT TA-16

SUITE	REQUEST NUMBER[A]	COMMENTS
HE	3319R	All data are useable without qualification.
HE	3335R	All data are useable without qualification.
HE	3402R	All data are useable without qualification.
HE	3418R	All data are useable without qualification.
HE	3439R	All data are useable without qualification.
HE	3440R	All data are useable without qualification.
HE	3442R	All data are useable without qualification.
HE	3463R	All data are useable without qualification.
HE	3468R	All data are useable without qualification.
HE	3527R	All data are useable without qualification.

[A] Environmental Restoration Project analytical request number

TABLE B-3
DATA QUALITY EVALUATION FOR INORGANIC ANALYSES AT TA-16

SUITE	REQUEST NUMBER[A]	COMMENTS
Inorganics	3320R	Spike recovery of arsenic was above the acceptable 125% limit. Arsenic data were qualified as estimated with a high bias (J+[b]). However, arsenic values are not near a decision level, even when the high bias is taken into consideration. Duplicate recovery for lead was outside the acceptable 20% range and these values were P-qualified[c]. Samples 0316-97-0521 and 0316-97-0576 have levels of lead near a decision level and may be affected by the poor duplicate recovery results. All other samples are not significantly affected by the poor duplicate recovery. All lead data should be qualified as estimated (J[e]). All data are useable with qualification.
Inorganics	3334R	All data except for mercury analysis are A-qualified because a sample not associated with this request number was used as the matrix spike and duplicate sample. The sample used for the matrix spike and duplicate was associated with request number 3440R (see below). This is a reasonable sample to use as matrix spike and duplicate for these samples. All data are accepted as useable without qualification.
Inorganics	3339R	The matrix spike and duplicate sample for the inorganic analysis (excluding cyanide and mercury analysis) were conducted on a sample not associated with the samples in this request. A sample from another request, associated with activities in this field unit and at this site, was used for duplicate and spike samples. As a result, all values (excluding those for mercury and cyanide) were qualified as absent. The matrix spike results and duplicate analysis results were all within the acceptable range. All data are useable with qualification.

Inorganics	3352R	Beryllium was present in the preparation blank. Samples containing less than 5 times the amount of beryllium in the blank were qualified as U[f]. The matrix spike and duplicate sample for the mercury analysis were conducted on a sample not associated with the samples in this request. A sample from another request, associated with activities in this field unit and at this site, was used for duplicate and spike samples. As a result, mercury values were qualified as absent. The matrix spike results and duplicate analysis results were all within the acceptable range. All mercury values are acceptable without qualification. Mercury values B-qualified by the analytical laboratory (indicating that the value reported is between the contract required detection level and the instrument detection level) are qualified as UJ[f] due to the implicit inaccuracies at the low level of detection. The duplicate analysis for antimony was below the acceptable level of 75%. Antimony data was UJ-qualified. All data are useable with qualification.
Inorganics	3403R	Continuing calibration data for cyanide analysis are missing. Cyanide results are qualified as absent (A). Initial calibration data is available and within the acceptable range. Cyanide data should be qualified as UJ, estimated undetected. The duplicate recovery of aluminum and manganese are outside the acceptable 20% limit. These data are P-qualified. The duplicate recovery of silver was also outside the acceptable limit although it was not P-qualified. All three elements should be considered estimated and qualified as J. The matrix spike recovery of manganese was above the acceptable 125% limit and manganese data are qualified as estimated with a high bias (J+). The matrix spike recovery for selenium was below the acceptable 75% limit. All selenium values are UJ-qualified. The matrix spike recovery of antimony was well below the acceptable limit and all antimony data was rejected and qualified as R[h],P[i]. The duplicate recovery was also well outside the acceptable limit. All antimony data should be rejected and qualified as R. All data are useable with qualification.
Inorganics	3419R	Beryllium and selenium were detected in the preparation blank. All beryllium values were qualified as U. All selenium values containing less than 5 times the value found in the blank were qualified as U. The matrix spike recovery for antimony and selenium were below the acceptable level of 75%. Samples with antimony and selenium at levels greater than the estimated detection limit are qualified as estimated with a low bias (J-). All other antimony and selenium values are qualified as UJ. Aluminum, chromium, and iron had duplicate recovery values lower than the acceptable value. Silver had duplicate recovery values higher than the acceptable value. These four elements were P-qualified because of poor duplicate recoveries. They should be considered estimated and qualified with a J. All data are useable with qualification.
Inorganics	3440R	Beryllium and thallium were detected in the preparation blank sample. Analytical samples containing less than 5 times the amount in the blank were qualified as U. No sample contained beryllium or thallium at levels above background levels or near action levels. The matrix spike for antimony was below the acceptable level of 50%. All antimony values are UJ-qualified. All data are considered useable with qualification.
Inorganics	3443R	The spike sample and duplicate sample analyses were conducted on a sample not associated with this request. The sample was a LANL sample from another field unit. All samples were qualified as A. The spike results for manganese were below the acceptable limit of 75%. All manganese samples should be qualified as estimated with a low bias (J-). Duplicate results for arsenic, cobalt, manganese, selenium, vanadium, and thallium were outside the acceptable value of 20%. These compounds should be J-qualified, to indicate that they are estimates. Manganese values should retain the J- qualifier given for poor spike analytical results. All data are useable with qualification.

Inorganics	3459R	Beryllium and selenium were detected in the preparation blank sample. Analytical samples containing less than 5 times the amount in the blank were qualified as U. No sample contained beryllium or selenium at levels above background levels or near action levels. Spike recovery of manganese, antimony, and selenium was below the acceptable limit of 75%. All antimony and selenium data are qualified as UJ. All manganese data are qualified as J-. No manganese values are near background levels or action levels. Duplicate recovery of zinc and copper was below the acceptable 20% limit. Zinc and copper data are P-qualified. Zinc and copper values are not near action levels. Zinc and copper data should be considered estimated and J-qualified. This did not affect the quality of the data for the purposes of this report. All data are considered useable with qualification.
Inorganics	3528R	All data were qualified as absent because the matrix spike and duplicate analysis were conducted on a sample not associated with samples in this request.

[a] Environmental Restoration Project analytical request number

[b] J+ = Analyte was positively identified, result is likely biased high.

[c] P = Professional judgment should be applied before using the data.

[d] J = Analyte was positively identified, numerical value is estimated to be more uncertain than would normally be expected for that analysis.

[e] A = Absent; some portion of the data package is missing.

[f] U = Analyte was not detected.

[g] UJ = Analyte was not detected, numerical value is an estimate of the EQL.

[h] R = Rejected.

[i] PM = Professional judgment should be applied before using the data. Manual review of the raw data is recommended.

[j] J- = Analyte was positively identified, result is likely biased low.

TABLE B-4

DATA QUALITY EVALUATION FOR SEMIVOLATILE ORGANIC COMPOUNDS ANALYSES AT TA-16

SUITE	REQUEST NUMBER[a]	COMMENTS
SVOCs	3318R	The internal standards associated with samples 0316-97-0521, -0022, -0574, -0575, -0576 had area counts outside the acceptable limits. Undetected compounds were qualified as UJ[b]. Detected compounds were qualified as J[d],PM[i]. Inspection of the data indicates that detected compounds should be qualified as estimated (J). All data are useable with qualification.
SVOCs	3333R	One internal standard associated with sample 0316-97-0525 did not meet the acceptable criteria. All analytes in this sample were qualified as UJ. All data are useable with qualification.
SVOCs	3338R	All data are useable.
SVOCs	3351R	Two internal standards were out of control. Perylene was below the acceptable 50% limit for samples 0316-97-0527, -0534, -0535, -0537, and -0577. Chrysene was below the acceptable 50% limit for samples 0316-97-0537 and 0316-97-0577. As a result of this, all undetected compounds in these samples were UJ-qualified. In sample 0316-97-0377, pyrene was detected and was qualified as J,PM. Inspection of the data indicates that this value should be qualified as J. All data are useable with qualification.

SVOCs	3401R	One internal standard associated with samples 0316-97-0587, -0561, and -0563 was below the acceptable level of 50%. All data in these samples were qualified as UJ. All three samples were reanalyzed with better internal standard performance. The reanalyzed results should be used instead of the original sample results. Internal standards associated with samples 0316-97-0560, -0561, -0563, -0555, -0555RE, -0563RE, -0587RE, -0560RE, and -0561RE were above the acceptable 100% limit. Detected compounds in these samples were qualified as J,PM. Inspection of the data indicates that these compounds should be considered estimated and J-qualified. All reanalyzed results should be used instead of the original sample results. All data are useable with qualification.
SVOCs	3417R	The response area for one internal standard was below the acceptable limit of 50% for sample 0316-97-0545. As a result, all the data in this sample were qualified UJ. All data are useable with qualification.
SVOCs	3438R	All data are useable.
SVOCs	3441R	All data are useable.
SVOCs	3457R	Samples 0316-97-0540, -0541, -0548, -0557, -0580, and -0581 missed the extraction holding time by one day. Samples 0316-97-0539, -0542, and -0543 missed the extraction holding time by two days. All data in these samples were PM-qualified. Recent EPA findings indicate that minor deviations from the extraction holding times has little effect on sample results for solid samples. All data are considered usable. The undetected compounds in these samples should be qualified as estimated undetected (UJ) and the detected compounds should be qualified as estimated (J). All data are useable with qualification.
SVOCs	3526R	One internal standard had a recovery of 49%, just below the 50% acceptable limit. Compounds associated with this internal standard were qualified as UJ. All data are acceptable with qualification.

[a] Environmental Restoration Project analytical request number

[a] U = Analyte was not detected.

[b] UJ = Analyte was not detected, numerical value is an estimate of the EQL.

[c] J = Analyte was positively identified, numerical value is estimated to be more uncertain than would normally be expected for that analysis.

[d] PM = Professional judgment should be applied before using the data. Manual review of the raw data is recommended.

TABLE B-5

DATA QUALITY EVALUATION FOR TOTAL URANIUM ANALYSES AT TA-16

SUITE	REQUEST NUMBER[a]	COMMENTS
Uranium	3336R	Analysis consisted of total acid digestion followed by KPA analysis. KPA analysis can cause results to be biased low. However no sample result in this request is near an action level. All data are useable without qualification
Uranium	3404R	Analysis consisted of total acid digestion followed by KPA analysis. KPA analysis can cause results to be biased low. However no sample result in this request is near an action level. All data are useable without qualification.

[a] Environmental Restoration Project analytical request number

RFI Report for
Potential Release Site

10-008

Field Unit 1

Environmental Restoration Project

September 1997

A Department of Energy
Environmental Cleanup Program

Los Alamos
NATIONAL LABORATORY

LA-UR-97-3771

EXECUTIVE SUMMARY

This report presents the results of the Phase I Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) conducted at former Technical Area (TA) 10, Potential Release Site (PRS) 10-008 at Los Alamos National Laboratory (LANL). A separate investigation was not conducted at PRS 10-008. Samples collected during the 1994 RFI at PRSs 10-001(a-d) were used to evaluate PRS 10-008. Included in this report are the data assessment and analysis approach used in this investigation, and the site-specific results, conclusions, and recommendations regarding RCRA constituents for the PRSs listed above. 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.

PRS 10-008 is a former satellite firing site located approximately 1 400 ft northwest of the primary firing sites (PRSs 10-001[a-d]) in Bayo Canyon. This PRS was identified during 1994 interim action activities to address shrapnel in Bayo Canyon. During the interim action, shrapnel was found embedded in the northwestern sides of trees in this area, opposite the known primary firing sites. This suggested the existence of an additional firing site. Archival research indicates that this firing site was used for nonradioactive shots during the 1940s. The primary firing pads were active from the 1943 to 1961. Site-wide decommissioning of the firing sites, the radiochemistry laboratory, and associated structures at TA-10 was completed in 1963. TA-10 was released to Los Alamos County in 1967.

The objectives of the Phase I RFI at PRS 10-001(a-d) were the same as the objectives for PRS 10-008. These objectives were to determine whether residual RCRA chemicals (particularly barium, beryllium, or lead) existed in surficial deposits in the vicinity of the firing sites and to confirm that radiological constituents identified at these sites during previous investigations did not pose an unacceptable risk to human health. Thirteen samples were collected in the vicinity of PRS 10-008. These samples were submitted to a fixed laboratory for analysis of target analyte list (TAL) metals, high explosives, strontium-90, uranium, and gamma spectroscopy.

Background comparison and screening assessment of the fixed laboratory analytical results indicated that no chemicals are present at the site at levels that pose an unacceptable risk to human health. Therefore, PRS 10-008 is proposed for no further action (NFA) based on NFA Criterion 5 (see Table ES-1).

TABLE ES-1

SUMMARY OF PROPOSED ACTIONS

			PROPOSED ACTION				
PRS NUMBER	HSWA[a]	RADIONUCLIDE COMPONENT[b]	NFA CRITERION	FURTHER ACTION[c]	ADD TO HSWA MODULE[d]	RATIONALE	SECTION NUMBER
10-008	X	X	5			RCRA and radionuclide contamination at or below SALs.	5.1

[a] An X in this column indicates that the site is listed on the Hazardous and Solid Waste Amendments (HSWA) Module (Module VIII) of the Laboratory's RCRA operating permit.
[b] An X in this column indicates that the site has a radionuclide component.
[c] VCA, EC, further investigation, or CMS.
[d] An X in this column indicates that hazardous constituents were confirmed at a site not already listed on the HSWA Module. The site requires further action; therefore, the site needs to be added to the Module.

CONTENTS

1.0 INTRODUCTION 1
1.1 General Site History 1
1.2 RFI Overview 4
1.3 Field Activities 4
2.0 ENVIRONMENTAL SETTING 5
2.1 Climate 5
2.2 Geology 5
2.2.1 Geologic Setting 5
2.2.2 Soils 6
2.3 Hydrology 6
2.3.1 Surface Water 6
2.3.2 Ground Water 6
2.4 Biological Surveys 7
2.5 Cultural Surveys 7
3.0 APPROACH TO DATA ASSESSMENT AND ANALYSIS 7
3.1 Sample Analysis 8
3.1.1 Analytical Methods 8
3.1.2 Data Validation 9
3.2 Background Comparisons 11
3.2.1 Inorganic Chemicals 11
3.2.2 Radionuclides 12
3.2.3 Organic Chemicals 13

3.2.4 Risk-Based Screening Assessment 13
3.3 Human Health Assessment 14
3.3.1 Risk Due to Naturally Occurring Inorganic Chemicals in Soils (Background) 14
3.3.2 Risk Assessment 15
3.4 Ecological Assessment 15
4.0 RESULTS OF QUALITY ASSURANCE/QUALITY CONTROL ACTIVITIES 17
4.1 Inorganic Analyses 17
4.2 Organic Analyses 18
4.3 Radiochemistry Analyses 19
5.0 RESULTS, CONCLUSIONS, AND RECOMMENDATIONS 20
5.1 PRS 10-008 20
5.1.1 History 20
5.1.2 Description 20
5.1.3 Previous Investigations 20
5.1.4 Field Investigation 21
5.1.5 Evaluation of Inorganic Chemicals 23
5.1.6 Evaluation of Radionuclides 25
5.1.7 Evaluation of Organic Chemicals 25
5.1.8 Human Health Screening Assessment 26
5.1.9 Human Health Risk Assessment 27
5.1.10 Preliminary Ecological Assessment 27
5.1.11 Conclusions and Recommendations 27

6.0 REFERENCES 28

APPENDIX A ANALYTICAL RESULTS A-1

APPENDIX B DATA VALIDATION B-1

APPENDIX C RISK ASSESSMENT CALCULATIONS C-1

LIST OF TABLES

TABLE 3.3.1-1 Risk Due to Background Concentrations of Inorganic Chemicals in Soil Assuming a Residential Scenario 16

TABLE 5.1.4-1 Summary of Samples Collected at PRS 10-008 23

TABLE 5.1.5-1 Inorganics with Concentrations Exceeding Background Screening Values at PRS 10-008 25

TABLE 5.1.7-1 Organics with Concentrations Exceeding Background Screening Values at PRS 10-008 25

TABLE 5.1.8-1 Multiple Chemical Evaluation for Noncarcinogenic Effects at PRS 10-008 27

LIST OF FIGURES

Figure 1.1-1 Location of TA-10 within Los Alamos National Laboratory, Los Alamos County, New Mexico. 2

Figure 1.1-2 Location of TA-10 with respect to Laboratory TAs and surrounding holdings. 3

Fig. 5.1.4-1 Locations of samples collected during the 1994 RFI at PRSs 10-001(a–d) that apply to PRS 10-008. 22

Fig. 5.1.5-1 Locations of detected organic analytes and inorganic analytes and radionuclides detected at levels exceeding background screening values at PRS 10-008. 24

1.0 INTRODUCTION

This report presents results of the Phase I Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) at former Technical Area (TA) 10, Potential Release Site (PRS) 10-008 at Los Alamos National Laboratory (LANL). A separate investigation was not conducted at PRS 10-008. Samples collected during the 1994 RFI at PRSs 10-001(a-d) were used to evaluate PRS 10-008. Included in this report are the data assessment and analysis approach used in this investigation, and the site-specific results, conclusions, and recommendations regarding RCRA constituents for the PRS listed above. 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.

1.1 General Site History

TA-10, also referred to as Bayo Site, was located in Bayo Canyon between Kwage Mesa to the south and Otowi Mesa to the north (Figs. 1.1-1 and 1.1-2). TA-10 was used from 1943 to 1961 as a firing site to conduct experiments using high explosives (HE) in conjunction with nuclear weapons research. The site consisted of firing pads, control buildings, battery buildings, a radiochemistry laboratory, subsurface disposal systems, and other associated structures.

TA-10 was constructed to test assemblies containing conventional HE and components made from depleted or natural uranium. The assemblies were loaded with a lanthanum-140 source of several hundred to several thousand curies for blast diagnostics. The lanthanum-140 (40.3 hour half-life) was contaminated with a small amount of strontium-90 (28.8 year half-life). The detonations at TA-10 resulted in dispersion of radioactive materials, including uranium, lanthanum-140, and strontium-90, in the forms of aerosols and solid debris.

PRS 10-008 is a former satellite firing site located approximately 1 400 ft northwest of the primary firing sites (PRSs 10-001[a-d]) in Bayo Canyon. This PRS was identified during 1994 interim action activities to address shrapnel in Bayo Canyon. During the interim action, shrapnel was found embedded in the northwestern sides of trees in this area, opposite the known primary firing sites. This suggested the existence of an additional firing site. Archival research indicates that this firing site was used for nonradioactive shots during the 1940s. The primary firing pads were active from the 1943 to 1961.

Decontamination and decommissioning activities at TA-10 started in 1960 with demolition and burning of several buildings. Explosives testing ceased in 1961. Site-wide decommissioning of the firing sites, the radiochemistry laboratory, and associated structures was completed in 1963. TA-10 was released to Los Alamos County in 1967.

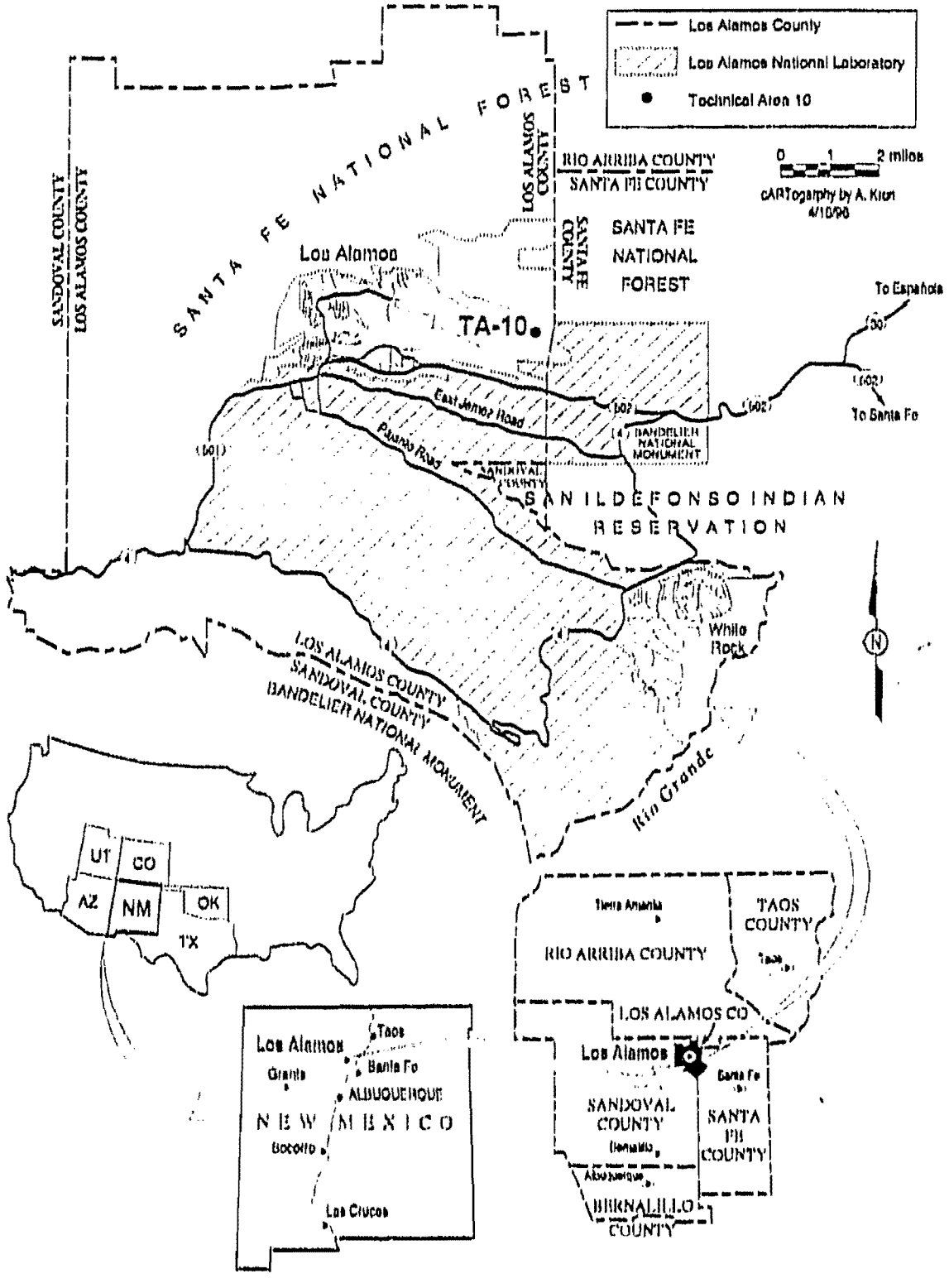


Figure 1.1-1 Location of TA-10 within Los Alamos National Laboratory, Los Alamos County, New Mexico.

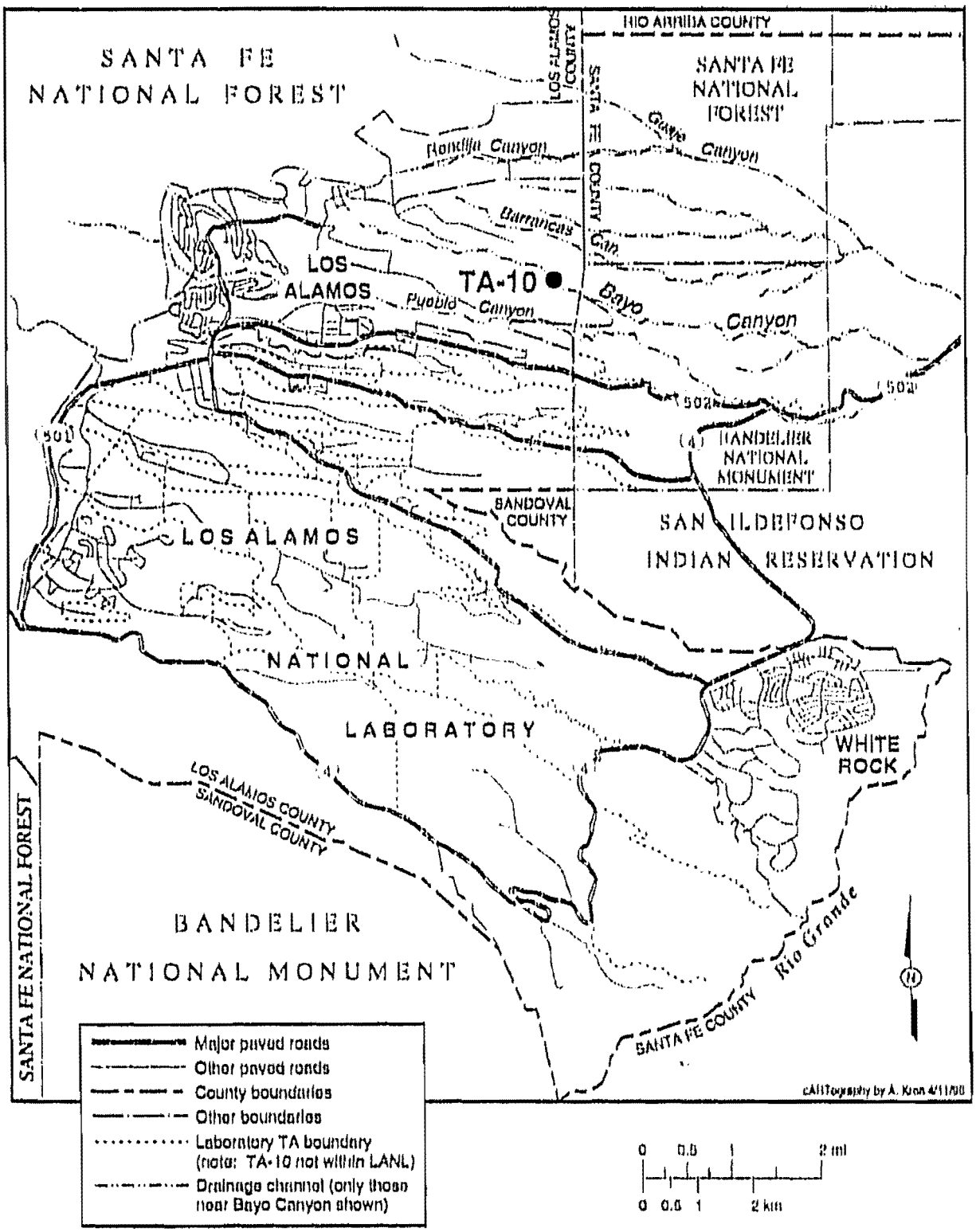


Figure 1.1-2 Location of TA-10 with respect to Laboratory TAs and surrounding holdings.

1.2 RFI Overview

A Phase I RFI was conducted for PRSs 10-001(a-d) in 1994. The sampling grid used in this investigation included the area within an approximate radius of 2 500 ft from the primary firing pads. This area included PRS 10-008. PRS 10-008 was identified during the 1994 interim action in Bayo Canyon, the EPA was informed, and a request was made to add the new PRS to the permit. The objectives of the RFI for PRSs 10-001(a-d) were the same as the objectives for PRS 10-008. Therefore, rather than writing a separate sampling and analysis plan for PRS 10-008, data from the 1994 investigation that applied to the area of PRS 10-008 were used to evaluate this site.

The objectives of the Phase I RFI at PRS 10-008 were to determine whether residual RCRA chemicals (particularly barium, beryllium, or lead) existed in surficial deposits in the vicinity of the firing sites and to confirm that radiological constituents identified at these sites during previous investigations did not pose an unacceptable risk to human health. Surface soil investigations conducted in 1977 for the Atomic Energy Commission (AEC) Formerly Utilized Site Remedial Action Program (FUSRAP) indicated that strontium-90 and uranium were the only residual radiological constituents remaining at the site (Mayfield et al. 1979, 0818). These investigations suggested that there were no unacceptable health risks from this radiological contamination (LANL 1992, 0783).

The conceptual exposure model for PRS 10-008 is also the same as the model used for PRSs 10-001(a-d). This model assumes that the primary receptors are visitors and potential future residents, and the primary exposure pathways are ingestion, inhalation, and dermal contact with soil. This model is described in detail in Section 2.3 of the RFI Work Plan for Operable Unit (OU) 1079 (LANL 1992, 0783).

1.3 Field Activities

Field activities were not specifically conducted for PRS 10-008. During the 1994 RFI for PRSs 10-001(a-d), surface soil samples were collected according to a statistically based grid pattern to address residual contamination dispersed from the firing sites. The samples collected during this investigation were used to evaluate PRS 10-008. Field activities were conducted in accordance with the RFI Work Plan for OU 1079 (LANL 1992, 0783), DOE and LANL directives and policies, and LANL Environmental Restoration (ER) Project Standard Operating Procedures (SOPs) (LANL, 0875).

A detailed discussion of the field activities conducted at PRSs 10-001(a-d) is included in the RFI Report for Solid Waste Management Units (SWMUs)10-001(a-d) (LANL 1995, 06-0130).

ER-ES-050615.441

The investigation included a geodetic survey, field screening for beta and gamma radiation, and collection of surface samples. The details of these activities as applicable to PRS 10-008 are included in Section 5.1.4 of this report.

2.0 ENVIRONMENTAL SETTING

The environmental setting of the Laboratory is described in Section 2.4 of Revision 5 the Installation Work Plan (IWP) for Environmental Restoration (LANL 1995, 1275). A detailed discussion of the environmental setting for the TA-10 Bayo Canyon area, including climate, geology, hydrology, and a conceptual hydrogeologic model for the area and its surroundings, is presented in the RFI Work Plan for OU 1079 (LANL 1992, 0783). 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 to range from 50°F to 90°F in Bayo Canyon. During the winter, temperatures typically range from 15°F to 50°F. The average annual rainfall in the area of TA-10 averages about 18 in. Of this total, approximately 40% occurs as brief intense thunderstorms during July and August. Stream flow in the canyon can occur as a result of these storms. Spring snowmelt runoff may also induce stream flow in the canyon.

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 Revision 5 of the IWP (LANL 1995, 1275). A summary of that material, emphasizing conditions expected near PRS 10-008, is presented below.

PRS 10-008 is located in Bayo Canyon at an elevation of about 6 600 to 6 740 ft and between Kwage Mesa to the south and Otowi Mesa to the north. Adjacent mesa tops range from about 7 000 ft to slightly over 7 100 ft. The upper portions of the canyon walls are vertical or near-vertical cliffs which are cut into the Tshirege Member of the Bandelier Tuff. From the base of the cliffs, steep slopes ranging from 10° to 30° lead downward to wide, gentle slopes, and then to a relatively flat canyon floor.

2.2.2 Soils

The slopes and canyon floor are mainly cut into the (lower) Otowi Member of the Bandelier Tuff. The slopes are overlain by talus and colluvium derived from the cliffs above. The canyon floor consists of broad, low-angle side slopes covered with colluvium that ranges in thickness from less than 1 ft to more than 6 ft. The canyon floor also includes stream terraces and an ephemeral, braided stream channel with banks from 1.5 ft to 6 ft high. Between 20 ft to 26 ft of Quaternary stream alluvium underlie the canyon floor.

2.3 Hydrology

The hydrology of the Pajarito Plateau is summarized in Section 2.5.2 of Revision 5 of the IWP (LANL 1995,1275). Site specific conditions are summarized below.

2.3.1 Surface Water

Surface water flow on the canyon slopes and bottom is mostly sheet flow generated during intense rainfall. Shallow tributary channels leading to the main channel collect water that flows over the cliffs and across the ground surface. The only sediment sampling station in Bayo Canyon is located at the intersection with Los Alamos Canyon, about two miles to the east.

The ephemeral stream in Bayo Canyon carries water only during intense thunderstorm activity. Individual flooding events may cause realignment of the main channel.

2.3.2 Ground Water

The elevation of the main aquifer is about 6 000 ft above sea level, approximately 600 ft below the level of Bayo Canyon at the former site of TA-10. No perched or alluvial aquifers were suspected to be present in Bayo Canyon, and none were encountered during subsurface investigations conducted at the site. Ninety-five holes were drilled in Bayo Canyon to depths of approximately 50 ft as a part of the TA-10 subsurface characterization. The data for these boreholes are presented in the RFI Report for PRSs 10-002(a-b), 10-003(a-c), 10-004(a-b), 10-005, and 10-007 (LANL 1996, 06-0131). The holes encountered only damp alluvium and Bandelier Tuff. Two holes were deepened and cased to the contact between the Bandelier Tuff and the underlying Puyé Formation at a depth of approximately 70 ft below the floor of Bayo Canyon. Because of uncertainty regarding whether a saturated zone might potentially (either permanently or seasonally) overlie the contact, one hole was completed as a groundwater monitoring well and the second was equipped with a suction lysimeter to measure formation pore water in unsaturated rock. To date, no saturated conditions have been observed.

2.4 Biological Surveys

Biological resource field surveys have been conducted in the area of PRS 10-008 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 Review Requirements (DOE 1979, 0633); and DOE Order 5400.1, "General Environmental Protection Program" (DOE 1988, 0075).

2.5 Cultural Surveys

A cultural resource survey has been conducted in the area of PRS 10-008 as required by the National Historic Preservation Act (amended). Twenty-eight archaeological sites are located within the area of OU 1079. All sites located in the survey area were avoided and were not impacted by sampling activities.

3.0 APPROACH TO DATA ASSESSMENT AND ANALYSIS

The approach to data assessment used by the ER Project is described in the policy document "Risk-Based Corrective Action Process" (Dorries 1996, 1297). The approach includes:

- sampling and analysis design,
- field investigation and collection of field and quality assurance (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 sets,
- exploratory data analysis,
- focused validation when necessary to further assess questionable data,
- comparison of validated analytical results with LANL background data,
- comparison of validated analytical results with screening action levels (SALs),

- evaluation of sufficiency of data sets 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 RFI report.

3.1 Sample Analysis

Samples were collected in accordance with the sampling design specified in the RFI Work Plan for OU 1079 (LANL 1992, 0783). Samples were submitted to the Mobile Radiochemical Analytical Laboratory (MRAL) and to the sample management office (SMO).

3.1.1 Analytical Methods

The following analytical suites were used for the sample analyses in this RFI report: target analyte list (TAL) metals, HE, gamma spectroscopy, total uranium, and strontium-90. 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, 1278). The allowed methods are current Environmental Protection Agency (EPA) SW-846 and Contract Laboratory Program (CLP) methods or equivalent for TAL metals, high explosives, gamma spectroscopy, total uranium, and strontium-90. Prior to analysis for inorganic chemicals, solid samples were digested according to EPA SW-846 method 3050 or equivalent (EPA 1992, 1207). The subcontracts specify LANL-approved methods for radiochemical analyses according to the technologies identified in the subcontract (e.g., americium-241 by alpha spectroscopy, tritium by liquid scintillation, or multiple gamma-emitting isotopes by gamma spectroscopy). Analytical method selection is described in Appendix IV of the ER Project Quality Assurance Project Plan Requirements for Sampling and Analysis (QAPP), which is included as Chapter 4 of Revision 6 of the LANL IWP (LANL 1996, 1379). 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 QAPP along with the target analytes for each analytical suite.

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 contain the information necessary to determine data sufficiency for decision-making. For analytical data used for decisions discussed in this RFI report, baseline data validation under the ER protocol was performed as described in the QAPP (LANL 1996, 1379).

This process produced validation reports with data qualifiers designating potential deficiencies for affected results. Each data qualifier is accompanied by a reason code that provides information about the deficiency which 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.

Data were qualified (i.e., a marker was attached to the data results) for a variety of reasons during the baseline validation process. The baseline validation procedure used for routine analytical services provides information about the reason the qualifier was applied and its potential impact on the affected data. 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 LANL ER Project baseline validation process are as follows.

- "A" signifies that the data required for data review and evaluation are not available.
- "U" signifies that the analyte was not positively identified in the sample, and the associated value is the sample-specific EQL/EDL.
- "J" signifies that 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+" signifies that the analyte was positively identified, and the result is likely to be biased high.
- "J-" signifies that the analyte was positively identified, and the result is likely to be biased low.
- "UJ" signifies that the analyte was not positively identified in the sample, and the associated value is an estimate of the sample-specific EQL/EDL.

- "RPM" signifies that without further review of the raw data, the sample results are unusable due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. Presence or absence cannot be verified. Any results qualified as RPM must be evaluated for relevance to data use.

- "P" signifies that professional judgment should be applied to using the data in decision-making.

- "PM" signifies that 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.

- "R" signifies that the data are rejected as a result of major problems with quality assurance/quality control (QA/QC) parameters.

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 (1) the variability or uncertainty of the reported data, or (2) data quality prior to 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 RFI 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.

Laboratory contaminants are sometimes found in method blanks used by the analytical laboratories during organic analyses. When this occurs, there is a potential for samples to also be contaminated. To account for method blank contamination in samples, the "10 times" and

"5 times" rules are applied as described in the EPA document "Contract Laboratory Program National Functional Guidelines for Organic Data Review" (EPA 1994, 1205). The "10 times" rule states that when a common laboratory contaminant is found in the method blank, any values of that analyte detected in the samples at levels less than 10 times the method blank concentration should be considered nondetected and a "U" qualifier should be added to the data. Common laboratory contaminants for volatile organic compound (VOC) analysis include acetone, methylene chloride, and 2-butanone; common laboratory contaminants for semivolatile organic compound (SVOC) analysis include the common phthalates. The "5 times" rule states that when an analyte that is not a common laboratory contaminant is found in the method blank, any values of that analyte detected in the samples at levels less than 5 times the method blank concentration should be considered nondetected and a "U" qualifier should be added to the data. These rules were used in addressing the data for PRS 10-008 as discussed in Section 4.0 of this report.

3.2 Background Comparisons

3.2.1 Inorganic Chemicals

Detected inorganic chemicals are compared with natural background distributions to determine whether they should be retained as chemicals of potential concern (COPCs) or eliminated from further consideration. The inorganic background data used in this RFI report are from the following source:

- soil samples collected throughout Los Alamos County for which chemical analyses were performed for certain inorganic (metal) chemicals (Longmire et al. 1995, 1142; Longmire et al. 1995, 1206).

The RFI data considered in this report were collected from soil. The ER Project procedure is to make comparisons of PRS data to the most geologically relevant subset of the LANL-wide background data. 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), the maximum reported concentration, or, in the case of nondetected chemicals, the detection limit. These background screening values are derived from LANL-wide soil background data, and details on the calculation of these values are presented in Longmire et al. (1995, 1206). Certain inorganic chemicals in certain media have no LANL-wide background data. For these exceptions, PRS sample-specific detection limits are used as nominal background screening values. In this report, silver is the only chemical that lacks background data.

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, are used for these evaluations. The Gehan test is best suited for assessing complete shifts in distribution in a statistically robust manner, whereas the Quantile test is better suited for assessing shifts of a subset of the data. Between the two tests, most types of differences between distributions can be captured. 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, 1210; Ryti et al. 1996, 1298). Observed significance levels (p-values) for these tests are presented in Section 5.1.5 of this report. If a p-value is less than a specified probability, typically 0.05 or 5%, then there is some reason to suspect that there is a difference between the background and site distributions; otherwise, no difference is indicated. The results of these statistical tests, when available, are used in addition to the results of the comparison with background screening values to determine whether a chemical is considered greater than 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 naturally occurring radionuclides.

The LANL 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 RFI report are from the following sources:

- soil samples collected throughout Los Alamos County for which chemical analyses were performed for certain naturally occurring radioactive chemicals (Longmire et al. 1995, 1142; Longmire et al. 1995, 1266).
- background concentrations of radioactive chemicals associated with global fallout from atmospheric nuclear testing (e.g., plutonium, cesium, strontium, and tritium) reported in LANL Environmental Surveillance reports (Purtymun et al. 1987, 0211; ESG 1988, 0408; ESG 1989, 0308; Environmental Protection Group 1990, 0497; Environmental Protection Group 1992, 0740).

These two sources apply only to surface data where the depth ranges from 0–2 ft. Certain radionuclides in certain media have no LANL-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 are carried forward in the screening assessment process. Chemicals not detected in any sample are 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. 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 whether 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, 1297). 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 are sufficient to support the decision, a no further action (NFA) recommendation may be proposed based on human health concerns.

If COPCs remain after the screening assessment, several options exist for the PRS. 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 3.3.1-1 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, 1307). 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. (UTLs and maximum concentration values are identical to those described in Section 3.2.1, Inorganic Chemicals.)

The background risks based on the LANL SAL residential exposure model are provided in Table 3.3.1-1. 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.

Three of the background inorganic chemicals provided in Table 3.3.1-1 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, 0559).

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 assessment was performed for PRS 10-008.

3.4 Ecological Assessment

In cooperation with the New Mexico Environment Department and EPA Region 6, the LANL 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.

TABLE 3.3.1-1

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}	1×10^{-5}
Barium	130	315	0.03	0.09	NC	NC
Beryllium	0.696	1.95	0.003	0.008	6×10^{-5}	1×10^{-5}
Cadmium[e]	0.2	2.6[d]	0.005	0.07	1×10^{-10}	2×10^{-9}
Chromium[f]	8.6	10.3	9.0×10^{-5}	0.0002	NC	NC
Cobalt	6	10.2	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	60.8	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 1998.
[b] Background concentrations taken from the Longmire et al. all-soil-horizons data set (1995, 1142).
[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.

4.0 RESULTS OF QUALITY ASSURANCE/QUALITY CONTROL ACTIVITIES

4.1 Inorganic Analyses

There was a general problem with the inorganics analysis for PRS 10-008. Samples were not analyzed until four to seven months after collection due to difficulties at the LANL SMO. This caused all of the samples to miss the recommended holding times for mercury (28 days) and cyanide (14 days). Cyanide was only analyzed in request 19518. A number of the sample analyses also exceeded the recommended holding time for TAL metals (six months). However, based on LANL and EPA SW846 guidelines, the following facts should be considered:

(1) These holding times are based on unpreserved water samples, and all of the samples were solid samples collected in the top six inches of soil;

(2) Soil samples are less likely to undergo the biotransformation from elemental mercury to organomercury compounds (the volatile compounds responsible for the 28-day holding time for mercury) than water samples because of the nature of the soil samples;

(3) The site was decommissioned over 30 years ago, so any metals released in the area have been exposed to the environment for over 30 years and would have already undergone any chemical transformations to which they might be susceptible in a sample collection jar.

(4) Additionally, mercury and cyanide are not on the COPC list because they were not associated with Laboratory activities at the firing sites. However, mercury and cyanide were analyzed as part of the TAL metals list. This was because the COPCs lead, beryllium, and barium are included in the TAL metals list, and it is more cost-effective to analyze the entire TAL metals list than to analyze a few specific analytes.

Based on this information and on the LANL data validation guidelines, it is reasonable to conclude that the missed holding times do not have a substantial effect on the data. Because cyanide and mercury holding times were greatly exceeded, all cyanide and mercury data are qualified J or UJ. None of the other metals are qualified for the missed holding times because the holding times were not grossly exceeded.

Four samples were analyzed for TAL metals in requests 19785 (two samples) and 19792 (two samples). All QC parameters were met for those requests except for the missed holding times

described above. All TAL metals data for these requests are valid and usable as qualified for the reasons discussed above.

Five samples were analyzed for TAL metals in request 19518. All QC parameters were met for this request with one exception. There were low recoveries in two blind QC samples for arsenic (70% and 67%) and chromium (66% and 63%). Blind QC samples are used as indicators of the analytical laboratory's ability to produce similar results to the "accepted" concentrations produced by the QC laboratory. A low percent recovery in the blind QC sample may indicate incomplete recovery from the digestion or extraction process or problems with the analysis. There is also the possibility of heterogeneity in the QC sample itself. As required in the LANL data validation guidelines, the data for arsenic and chromium are qualified J or UJ to account for the possible low bias. All TAL metals data for request 19518 are valid and usable as qualified because the possible low bias is considered in the screening process (see Sections 5.1.5 and 5.1.8).

Two samples were analyzed for TAL metals in request 19759. All QC parameters were met for this request with one exception. There was a high recovery of lead (244%) and a low recovery of chromium (69%) in the blind QC sample. As discussed above, a low percent recovery in the blind QC sample may indicate incomplete recovery from the digestion or extraction process, problems with the analysis, or possibly heterogeneity in the QC sample itself. A high percent recovery may result from more efficient extraction and digestion of the sample at the analytical laboratory, or possibly heterogeneity in the QC sample. As required in the LANL data validation guidelines, the data for lead and chromium are qualified J or UJ to account for the possible high and low bias. All TAL metals data for request 19759 are valid and usable as qualified because the possible high and low biases are considered in the screening process (see Sections 5.1.5 and 5.1.8).

4.2 Organic Analyses

Two samples were analyzed for HE in requests 17913 and 17916. All QC parameters were met for these requests with one exception. The recommended holding time of 14 days was exceeded by two days. However, based on LANL and EPA SW846 guidelines, the following facts should be considered:

(1) The holding time is only recommended (not required) because it is based on unpreserved water samples, and all of the samples were solid samples collected in the top six inches of soil;

(2) The site was decommissioned over 30 years ago, so any HE released in the area have been exposed to the environment for over 30 years and would have already undergone any chemical transformations to which they might be susceptible in a sample collection jar preserved in a freezer.

Based on this information and the LANL data validation guidelines, it is reasonable to conclude that the missed holding times do not have a substantial effect on the data. Therefore, all data are considered valid and usable and no qualifiers were added.

4.3 Radiochemistry Analyses

One sample was analyzed for gamma activity using gamma spectroscopy in request 19706. All QC parameters were within allowed limits for this analysis. All data are valid and usable without added qualifiers.

Eleven samples were analyzed for total uranium and strontium-90 in requests 19705, 19762, 19765, and 19768. In request 19765, all QC parameters were within allowed limits for these analyses and all data are valid and usable without added qualifiers.

In requests 19705, 19762, and 19768, all QC parameters were met with the following exception. There were high and low recoveries in the blind QC samples. In request 19705, there were high recoveries for strontium-90 (121%) and uranium (122% and 123%). In request 19762, there was a low recovery for uranium (78%). In request 19768, there was high recovery for uranium (130%). As discussed above, a low percent recovery in the blind QC sample may indicate incomplete recovery from the digestion or extraction process, problems with the analysis, or possibly heterogeneity in the QC sample itself. A high percent recovery may result from more efficient extraction and digestion of the sample at the analytical laboratory, or possibly heterogeneity in the QC sample. As required in the LANL data validation guidelines, the data for these analytes in these requests are qualified J to address the possible high or low bias. All radiochemistry data for these requests are valid and usable as qualified because the possible high and low biases are considered in the screening process (see Sections 5.1.7 and 5.1.8).

5.0 RESULTS, CONCLUSIONS, AND RECOMMENDATIONS

5.1 PRS 10-008

PRS 10-008 is a former satellite firing site located approximately 1 400 ft northwest of the primary firing sites (PRSs 10-001[a-d]) in Bayo Canyon. Samples collected during the 1994 RFI of PRSs 10-001(a-d) were used to evaluate this site because PRS 10-008 is located within the area characterized during the 1994 investigation. Based on the results of these samples, no chemicals are retained as COPCs for PRS 10-008. Therefore, this site is recommended for NFA.

5.1.1 History

PRS 10-008 is a former satellite firing site located approximately 1 400 ft northwest of the primary firing sites (PRSs 10-001[a-d]) in Bayo Canyon. This PRS was identified during 1994 interim action activities to address shrapnel in Bayo Canyon. During the interim action, shrapnel was found embedded in the northwestern sides of trees in this area, opposite the known primary firing sites. This suggested the existence of an additional firing site. Archival research indicates that this firing site was used for nonradioactive shots during the 1940s. These shots used the same assemblies as the primary firing pads without the radioactive component. The primary firing pads were active from the 1943 to 1961.

Decontamination and decommissioning activities at TA-10 started in 1960 with demolition and burning of several buildings. Explosives testing ceased in 1961. Site-wide decommissioning of the firing sites, the radiochemistry laboratory, and associated structures was completed in 1963. TA-10 was released to Los Alamos County in 1967. Portions of Bayo Canyon are currently open to the public for recreational use. The area including PRS 10-008 is currently fenced and is not open to the public.

5.1.2 Description

PRS 10-008 is located on the floor of Bayo Canyon. As discussed in the RFI Work Plan for OU 1079, the canyon floor area was heavily disturbed during the 1963 remediation of the Bayo Canyon firing pads and surrounding area (LANL 1992, 0783). For further descriptive information about this site, refer to Section 2.0 of this report.

5.1.3 Previous Investigations

Several investigations and studies have been conducted over the years at TA-10 and the surrounding area. The results of these investigations are summarized in the RFI Work Plan for

OU 1079. (LANL 1992, 0783). These investigations included test hole drilling, soil sampling, and a radiological survey conducted under the DOE FUSRAP.

The 1977 FUSRAP resurvey program was designed to provide a basis for estimating potential exposure scenarios under conditions of continued recreational use, light construction, and as an occupied residential area. The FUSRAP exposure estimates included data from soil and sediment sampling, air sampling, and dosimetry measurements.

In addition, an extensive interim action was conducted in 1994 and 1995 to remove shrapnel from Bayo Canyon (LANL 1995, 06-0134; LANL 1995, 06-0133). This interim action included complete enumeration of metallic anomalies in 3-in. depth intervals within selected 100-ft² subunits, as well as removal of visible surface shrapnel or shrapnel present in the 0- to 2-in. depth interval from adjacent 10 000 ft² areas. The interim action focused on the area surrounding the primary firing pads, including the location of PRS 10-008. The spatial distribution of shrapnel provided an excellent indicator of the location and magnitude of possible chemical releases associated with test detonations.

5.1.4 Field Investigation

The 1994 RFI for PRSs 10-001(a–d) began with a geodetic survey to establish the locations of former structures associated with former TA-10 operations and the surface sample grid. Surface soil sample locations were established in a 17 000 000 ft² grid with a 500-ft grid interval. Sample locations corresponded to grid nodes. If a grid node fell on bedrock, it was relocated to the nearest soil outcrop and surveyed. The grid consisted of 68 surface sample locations plus ten random samples.

Thirteen of these 68 samples were collected in the vicinity of PRS 10-008 (Fig 5.1.4-1). Location 10-1014 was located near the center of PRS 10-008, and locations 10-1006, 10-1007, 10-1008, 10-1013, 10-1015, 10-1022, 10-1023, 10-1023, and 10-1024 were located adjacent to location 10-1014. Two samples were collected at locations 10-1022, 10-1023, and 10-1023, and one sample was collected at the remaining seven locations. A summary of the samples collected and analyses performed is included in Table 5.1.4-1.

Samples were collected on grid nodes from the surface soil on the canyon bottom, talus on the mesa slope, and soil/crushed tuff on the mesa tops to a depth of 6 in. Samples were screened in the field for beta and gamma radiation using a Ludlum™ Model 2221 with a shielded Geiger-Mueller™ (GM) probe. Samples were collected, analyzed for gross alpha, beta, and gamma radiation by the MRAL, and shipped to fixed laboratories for analysis of TAL metals, HE, gamma spectroscopy, total uranium, and strontium-90.

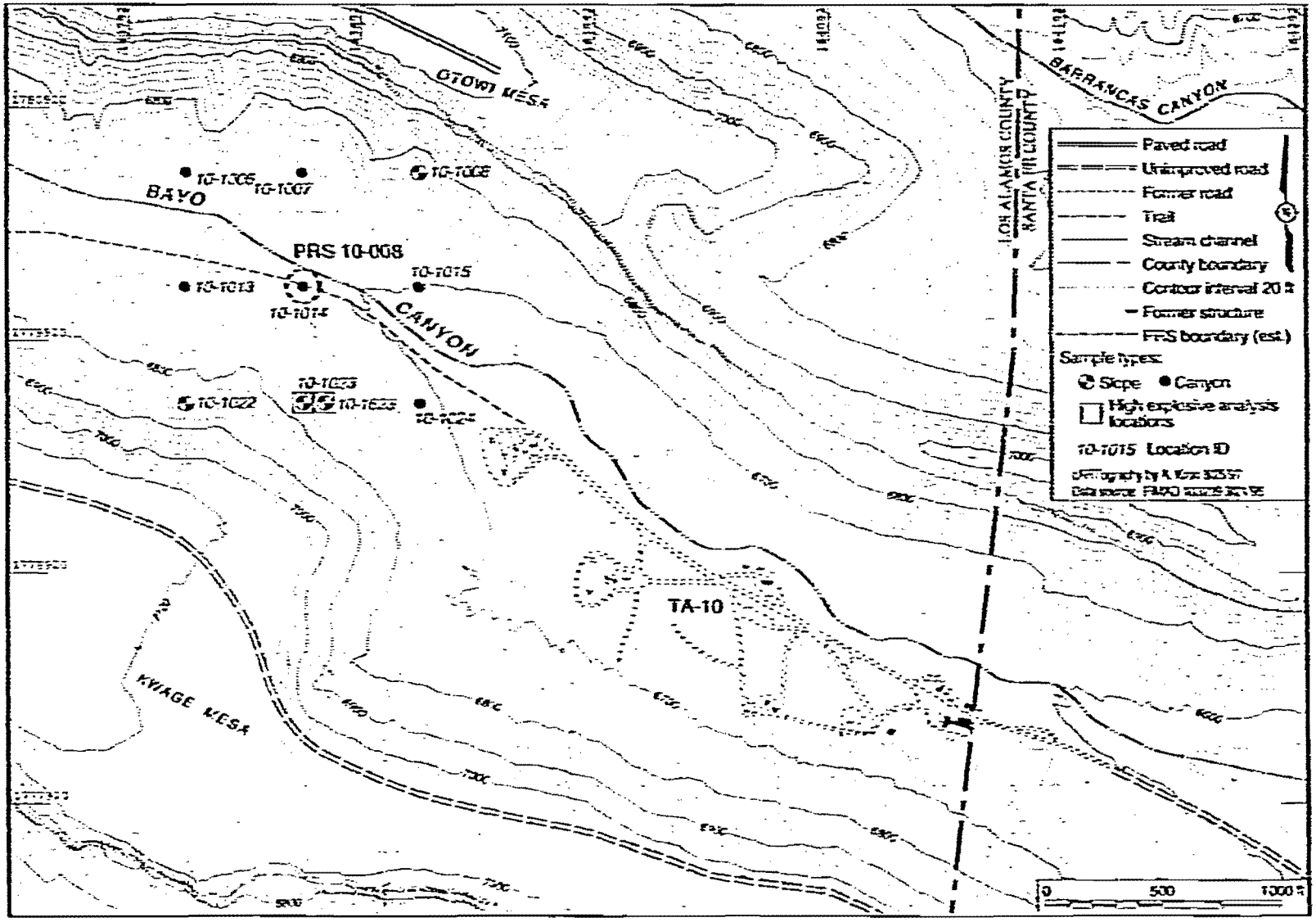


Fig. 5.1.4-1 Locations of samples collected during the 1994 RFI at PRSs 10-001(a–d) that apply to PRS 10-008.

TABLE 5.1.4-1

SUMMARY OF SAMPLES COLLECTED AT PRS 10-008

LOCATION ID	SAMPLE ID	DEPTH (In.)	MEDIA	TAL METALS[a]	HIGH EXPLOSIVES	STRONTIUM-90 & URANIUM	GAMMA SPEC[b]
10-1006	AAB5513	0-4	Soil	19785	—	19705	—
10-1007	AAB5515	0-4	Soil	19785	—	19705	—
10-1008	AAB5460	0-4	Soil	19518	—	19708	—
10-1013	AAB5469	0-4	Soil	19518	—	19768	—
10-1014	AAB5467	0-4	Soil	19518	—	19768	—
10-1015	AAB5451	0-5	Soil	19792	—	19705	—
10-1022	AAB5461	0-4	Soil	19759	—	19762	—
10-1022	AAB5485	0-4	Soil	19759	—	19762	—
10-1023	AAB5462	2-4	Soil	19518	—	19768	—
10-1023	AAB5608	0-4	Soil		17918	—	19706
10-1024	AAB5456	0-4	Soil	19792	—	19705	—
10-1023	AAB5527	0-2	Soil		17913	—	—
10-1023	AAB5465	0-4	Soil	19518	—	19768	—

[a] TAL metals = Target analyte list metals.
[b] Gamma spec = Gamma spectroscopy.

5.1.5 Evaluation of Inorganic Chemicals

Eleven samples collected from the area of PRS 10-008 were analyzed for TAL metals and uranium. Three inorganics (lead, mercury, and uranium) were detected at concentrations exceeding their background screening values. The concentrations of these analytes for each sample that has at least one value above the background screening values are presented in Table 5.1.5-1. The locations where these analytes were detected at levels exceeding background screening values are shown in Fig. 5.1.5-1.

The qualifiers shown in the table were assigned during baseline validation as discussed in Section 4.0 of this report. The mercury data are qualified J because the sample holding time was exceeded, indicating a possible low bias. The uranium and lead data were qualified J because of high recoveries in the blind QC sample, indicating a possible high bias.

Lead, mercury, and uranium will be carried forward to the screening assessment.

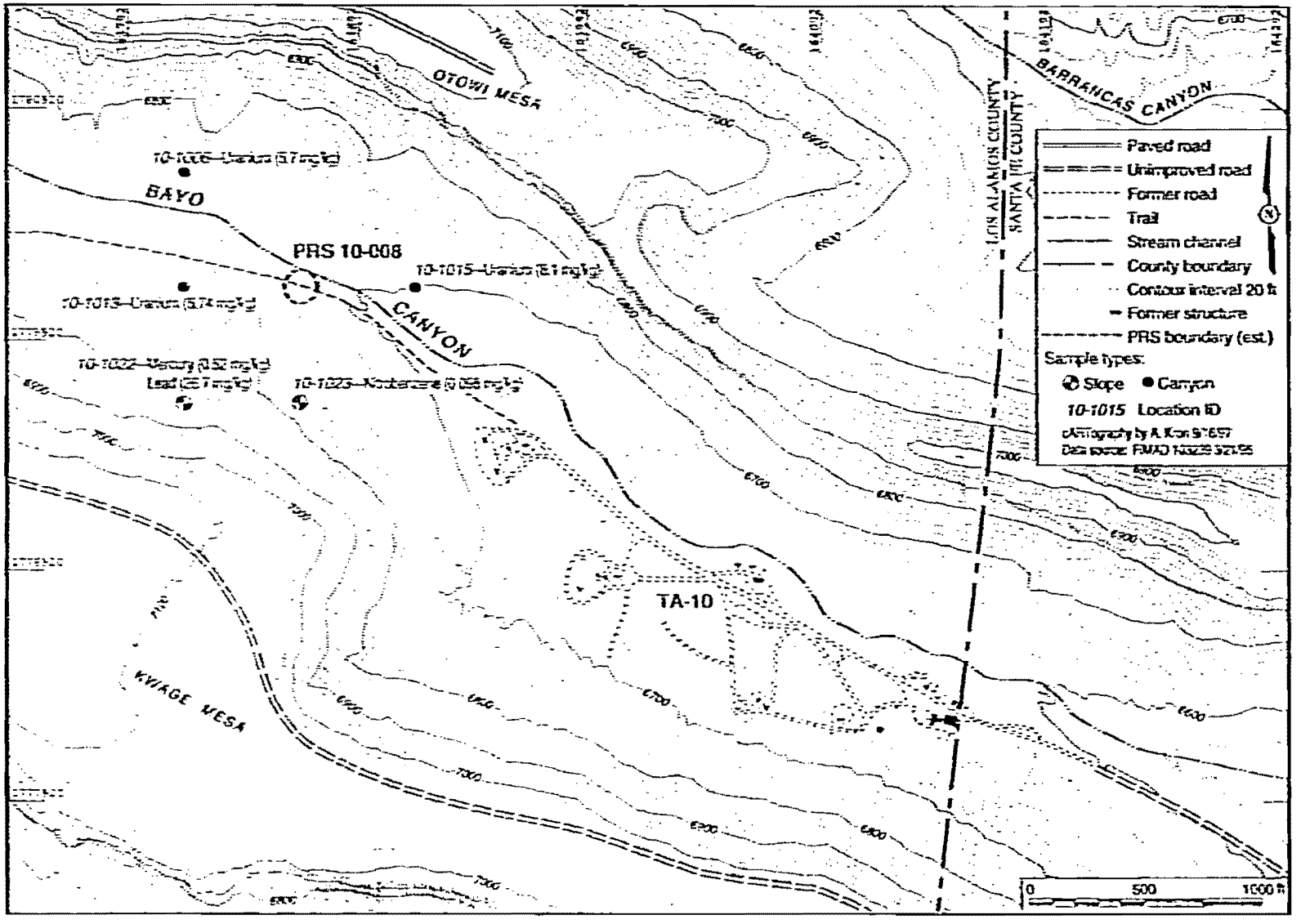


Fig. 5.1.5-1 Locations of detected organic analytes and inorganic analytes and radionuclides detected at levels exceeding background screening values at PRS 10-008.

TABLE 5.1.5-1

INORGANICS WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT PRS 10-008[a]

CHEMICAL	LOCATION ID	SAMPLE ID	SAMPLE VALUE (mg/kg)	UTL (mg/kg)	SAL (mg/kg)	DEPTH (in.)
Uranium	10-1006	AAB5513	5.7 J	5.45	29	0-4
	10-1013	AAB5409	5.74 J	5.45	29	0-4
	10-1015	AAB5451	8.1	5.45	29	0-5
Lead	10-1022	AAB5485	20.7 J	23.3	400	0-4
Mercury	10-1022	AAB5485	0.52 J	0.1[b]	23	0-4

[a] Data collected during the Phase I RFI for PRS 10-001(a-d) were used to evaluate PRS 10-008.
[b] There were insufficient samples to calculate the UTL for mercury. Therefore, the maximum value in the background range was used as a background screening value (Longmire et al. 1995, 1142).

5.1.6 Evaluation of Radionuclides

Eleven samples collected from the area of PRS 10-008 were analyzed for strontium-90 and uranium, and one sample was analyzed for gamma emitting radionuclides by gamma spectroscopy. Uranium was the only radionuclide detected at levels exceeding the background screening value. As discussed in Section 5.1.5, uranium is carried forward to the screening assessment.

5.1.7 Evaluation of Organic Chemicals

Two samples collected from the area of PRS 10-008 were analyzed for HE. One organic chemical, nitrobenzene, was detected. The concentrations of nitrobenzene detected at PRS 10-008 are presented in Table 5.1.7-1. The location where this analyte was detected is shown on Fig. 5.1.5-1.

There were no data validation qualifiers associated with nitrobenzene. Nitrobenzene will be carried forward to the screening assessment.

TABLE 5.1.7-1

ORGANICS WITH CONCENTRATIONS EXCEEDING BACKGROUND SCREENING VALUES AT PRS 10-008[a]

CHEMICAL	LOCATION ID	SAMPLE ID	SAMPLE VALUE (mg/kg)	SAL (mg/kg)	DEPTH (in.)
Nitrobenzene	10-1023	AAB5608	0.098	18	0-4

[a] Data collected during the Phase I RFI for PRS 10-001(a-d) were used to evaluate PRS 10-008.

5.1.8 Human Health Screening Assessment

This subsection discusses the comparison with SALs for COPCs carried forward from the background comparison. Four COPCs were carried forward from the background screening: lead, mercury, nitrobenzene, and uranium.

Greater than SAL. No COPCs were detected at concentrations greater than their SALs.

No SAL. All of the COPCs had SALs.

Below SAL. Lead, mercury, nitrobenzene, and uranium were detected at concentrations below their SALs. These COPCs are addressed in a multiple chemical evaluation.

To evaluate multiple chemical effects for this data set, COPCs detected at levels below their SALs were divided into three classes: noncarcinogens, carcinogens, and radionuclides. SALs for all chemicals were normalized and summed as described in "Risk-Based Corrective Action Process" (Dorries 1996, 1297).

Lead, mercury, nitrobenzene, and uranium are all noncarcinogens. Uranium, a radionuclide, is evaluated for its radiocarcinogenicity as well as its noncarcinogenic toxicity. The result of the multiple chemical evaluation is 0.1, as shown in Table 5.1.8-1. This result is considerably less than one, indicating that adverse health effects are not associated with these COPC concentrations.

As discussed in Section 4.0 of this report, the mercury data included in the multiple constituent evaluation may be biased low. However, the mercury value is nearly two orders of magnitude below the SAL, and the data for uranium and lead included in the evaluation may be biased high. Therefore, a low bias in the mercury data would not affect the conclusion of the multiple chemical evaluation.

Only one radionuclide, uranium, was detected at a level below the SAL for radiological risk (20 mg/kg assuming it is natural uranium). Because uranium is the only radionuclide present above the background screening value and it is present at a concentration 0.3 times its radiological SAL, it is not associated with an unacceptable risk level.

TABLE 5.1.8-1

MULTIPLE CHEMICAL EVALUATION FOR NONCARCINOGENIC EFFECTS AT PRS 10-008

CHEMICAL	LOCATION ID	SAMPLE ID	SAMPLE VALUE (mg/kg)	SAL (mg/kg)	RATIO OF CONCENTRATION TO SAL
Uranium	10-1015	AAB5451	8.1	230	0.04
Lead	10-1022	AAB5485	28.7	400	0.07
Mercury	10-1022	AAB5485	0.52	23	0.02
Nitrobenzene	10-1023	AAB5008	0.098	18	0.005
RATIO SUM					0.1

5.1.9 Human Health Risk Assessment

No human health risk assessment was performed for PRS 10-008 because no chemicals were retained as COPCs in the screening assessment for this site.

5.1.10 Preliminary Ecological Assessment

In consultation with the New Mexico Environment Department and EPA Region 6, the Laboratory ER Project is developing an approach for ecological risk assessment. Further ecological risk assessment at PRS 10-008 will be deferred until the site can be assessed as part of the ecological exposure unit methodology currently being developed.

5.1.11 Conclusions and Recommendations

Based on the results of the evaluations of inorganic chemicals, radionuclides, and organic chemicals and the risk-based screening assessment, no analytes are retained as COPCs at PRS 10-008. PRS 10-008 is proposed for NFA based on NFA Criterion 5. This criterion states that the PRS has been characterized or remediated in accordance with current applicable state or federal regulations, and the available data indicate that contaminants of concern are either not present or are present in concentrations that would pose an acceptable level of risk under the projected future land use.

6.0 REFERENCES

DOE (US Department of Energy), March 7, 1979. "Compliance with Floodplain/Wetlands Environmental Review Requirements," Final Rule, 10 CFR Part 1022, Vol. 44, No. 46, p. 12594. (DOE 1979, 0633)

DOE (US Department of Energy), November 9, 1988. "General Environmental Protection Program," DOE Order 5400.1, Washington, DC. (DOE 1988, 0075)

Dorries, A. M. (Ed.), June 1,1996. "Risk-Based Corrective Action Process," Revision 1, Los Alamos National Laboratory Report LA-UR-96-2811, Los Alamos, New Mexico. (Dorries 1996, 1297)

Environmental Protection Group, December 1990. "Environmental Surveillance at Los Alamos During 1989," Los Alamos National Laboratory Report LA-12000-ENV, Los Alamos, New Mexico. (Environmental Protection Group 1990, 0497)

Environmental Protection Group, March 1992. "Environmental Surveillance at Los Alamos During 1990," Los Alamos National Laboratory Report LA-12271-MS, Los Alamos, New Mexico. (Environmental Protection Group 1992, 0740)

EPA (US Environmental Protection Agency), March 8, 1990. "National Oil and Hazardous Substances Pollution Contingency Plan," Final Rule, 40 CFR Part 300, *Federal Register*, Vol. 55, No. 46, p. 8666. (EPA 1990, 0559)

EPA (US Environmental Protection Agency), July 1992. "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, Third Edition, Final Update 1, Office of Solid Waste and Emergency Response, Washington, DC. (EPA 1992, 1207)

EPA (US Environmental Protection Agency), February 1994. "USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, EPA540/R-94/012, Washington, DC. (EPA 1994, 1208)

EPA (US Environmental Protection Agency), September 1, 1995. "Region IX Preliminary Remediation Goals (PRGs) Second Half 1995," ER ID No. 53070, San Francisco, California. (EPA 1995, 1307)

ESG, May 1988. *Environmental Surveillance at Los Alamos During 1987*, Los Alamos National Laboratory Report LA-11306-ENV, Los Alamos, New Mexico. (ESG 1988, 0408)

ESG, June 1989. *Environmental Surveillance at Los Alamos During 1988*, Los Alamos National Laboratory Report LA-11628-ENV, Los Alamos, New Mexico. (ESG 1989, 0308)

LANL (Los Alamos National Laboratory). "Los Alamos National Laboratory Environmental Restoration Program Standard Operating Procedures," Los Alamos National Laboratory report, Los Alamos, New Mexico. (LANL, 0875)

LANL (Los Alamos National Laboratory), May 1992. "RFI Work Plan for Operable Unit 1079," Los Alamos National Laboratory Report LA-UR-92-850, Los Alamos, New Mexico. (LANL 1992, 0783)

LANL (Los Alamos National Laboratory), April 5, 1995. "Shrapnel Removal Field Summary Report for Field Unit 1, Technical Area 10, Bayo Canyon," prepared by ERM Program Management Company and Golder Federal Services, Inc., ERM Project File G9454.7b, Los Alamos, New Mexico. (LANL 1995, 06-0134)

LANL (Los Alamos National Laboratory), May 1995. "Shrapnel Investigation at FU-1, TA-10, Bayo Canyon Firing Site," prepared by Geophex, Ltd., Geophex Job Number 437, Los Alamos, New Mexico. (LANL 1995, 06-0133)

LANL (Los Alamos National Laboratory), July 1995. "Statement of Work–Analytical Support," Revision 2, RFP No. 9-XS1-Q4257, ER ID No. 49738, Los Alamos, New Mexico. (LANL 1995, 1278)

LANL (Los Alamos National Laboratory), September 9, 1995. "RFI Report for PRSs 10-001(a-d), Field Unit 1," Los Alamos National Laboratory Report LA-UR-95-3643, Los Alamos, New Mexico. (LANL 1995, 06-0130)

LANL (Los Alamos National Laboratory), November 1995. "Installation Work Plan for Environmental Restoration," Revision 5, Los Alamos National Laboratory Report LA-UR-95-4048, Los Alamos, New Mexico. (LANL 1995, 1275)

LANL (Los Alamos National Laboratory), 1996. "RFI Report for PRSs 10-002(a-b), 10-003(a-o), 10-004(a-b), 10-005, and 10-007, Field Unit 1," Los Alamos National Laboratory Report LA-UR-96-1284, Los Alamos, New Mexico. (LANL 1996, 06-0131)

LANL (Los Alamos National Laboratory), December 1996. "Installation Work Plan for Environmental Restoration Program," Revision 6, Los Alamos National Laboratory Report LA-UR-96-4629, Los Alamos, New Mexico. (LANL 1996, 1379)

Longmire, P. A., D. E. Broxton, and S. L Reneau (Eds.), October 1995. "Natural Background Geochemistry and Statistical Analysis of Selected Soil Profiles, Sediments, and Bandelier Tuff,

Los Alamos, New Mexico," Los Alamos National Laboratory Report LA-UR-95-3486, Los Alamos, New Mexico. (Longmire et al. 1995, 1266)

Longmire, P., S. Reneau, P. Watt, L. McFadden, J. Gardner, C. Duffy, and R. Ryti, January 1995. "Natural Background Geochemistry, Geomorphology, and Pedogenesis of Selected Soil Profiles and Bandelier Tuff, Los Alamos, New Mexico," (draft) Los Alamos National Laboratory Report LA-12913-MS, Los Alamos, New Mexico. (Longmire et al. 1995, 1142)

Mayfield, D.L., A. K. Stoker, and A. J. Ahlquist 1979. "Radiological Survey of Bayo Canyon, Los Alamos, New Mexico," Department of Energy Report DOE/EV-0005/15, Los Alamos, New Mexico. (Mayfield et al. 1979, 0818)

Project Consistency Team. "Project Consistency Team (PCT) Policy Memo Notebook," (Controlled), Environmental Restoration Project, Los Alamos National Laboratory, Los Alamos, New Mexico. (Project Consistency Team, 1210)

Purtymun, W. D., R. J. Peters, T. E. Buhl, M. N. Maes, and F. H. Brown, November 1987. "Background Concentrations of Radionuclides in Soils and River Sediments in Northern New Mexico, 1974-1986," Los Alamos National Laboratory Report LA-11134-MS, Los Alamos, New Mexico. (Purtymun et al. 1987, 0211)

Ryti, R., P. Longmire, and E. McDonald, March 20, 1996. "Application of LANL Background Data to ER Project Decision-Making, Part I: Inorganics," Los Alamos National Laboratory Report LA-UR-96-1534, Los Alamos, New Mexico. (Ryti et al. 1996, 1298)

APPENDIX A APPENDIX A ANALYTICAL RESULTS

Analytical results for Potential Release Site 10-008 can be found in the Facility for Information Management, Analysis, and Display (FIMAD). 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 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 collected.

The complete data used for the evaluations in this report are included in Tables A-1 through A-3.

Inorganic Suite (Metals)

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

High Explosives

2-Amino-4,6-dinitrotoluene (2-AM-DNT)

4-Amino2,6-dinitrotoluene 4-Am-DNT)

2,6-Dinitrobenzene (1,3-DNB)

2,4- Dinitrotoluene(2,4-DNT)

2,6-Dinitrotoluene (2,6-DNT)

Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)

Methyl-2,4,6-trinitrophenylnitramine (Tetryl)

Nitrobenzene (NB)

Nitrocelluose

Nitroguanidine

Nitroglycerine (NG)

2-Nitrotoluene (2-NT)

3-Nitrotoluene (3-NT)

4-Nitrotoluene (4-NT)

Octahydro-2,3,5,7-tetranitro-2,3,5,7-tetrazocine (HMX)

Pentaerythritol tetranitrate (PETN)

Tetrazene

1,3,5-Trinitrobenzene (1,3,5-TNB)

2,4,6-Trinitrotoluene (2,4,6-TNT)

Radiochemical Suite

Actinium-228
Americium-241
Annihilation radiation
Barium-140
Bismuth-211
Bismuth-212
Bismuth-214
Cadmium-109
Cerium-139
Cerium-144
Cesium-134
Cesium-137
Cobalt-57
Cobalt-60
Europium-152
Iodine-129
Lanthanum-140
Lead-210
Lead-211
Lead-212
Lead-214
Manganese-54
Mercury-203
Neptunium-237
Plutonium-238
Plutonium-239/240
Potassium-40
Protactinium-214m
Protactinium-231
Protactinium-233
Radium-223
Radium-224
Radium-226
Radium-228
Radon-219
Ruthenium-106
Selenium-75
Sodium-22
Strontium-85
Strontium-90
Thallium-208
Thorium-227
Thorium-228, 230, & 232
Thorium-234
Tin-113
Tritium
Uranium-234, 235, & 238
Yttrium-88
Zinc-65

TABLE A-1

ANALYTICAL RESULTS FOR INORGANIC ANALYTES DETECTED AT PRS 10-008

LOCATION ID	SAMPLE ID	DEPTH (in.)	ALUMINIUM	ARSENIC	BARIUM	BERYLLIUM	CADMIUM	CALCIUM	CHROMIUM	COBALT	COPPER	IRON	LEAD
		UTL											
		SAL											
10-1014	AAB5467		5 310	<1.4	62.1	<0.7	<0.42	1 800	4	<2.4	8	5 750	17
10-1006	AAB5513		3 510	<0.58	55.4	<0.6	<0.4	<933	<1.6	<0.63	<3	4 090	7.8
10-1007	AAB5515		1 950	<0.55	<21.9	<0.53	<0.42	<687	<1.1	<0.7	<2.2	4 770	6.6
10-1008	AAB5460		1 420	<0.54	<12.7	<0.33	<0.34	<632	<1.1	<0.7	<1.1	3 340	6.8
10-1013	AAB5469		5 600	<1.3	61.2	<0.69	<0.36	2 290	3.2	<2.5	<4.4	5 360	20
10-1015	AAB5451		2 420	<0.38	<21.2	<0.53	<0.04	<861	<0.93	<0.78	<0.96	2 720	5.7
10-1022	AAB5461		4 580	<1.8	53.7	<0.64	<0.64	2 110	3.7	<2.3	5.2	6 640	4.5
10-1022	AAB5465		5 220	<1.8	54.8	<0.72	1.1	2 060	4.6	<2.7	5.7	7 080	27
10-1023	AAB5462		6 690	<1	62.4	<0.83	<0.37	2 380	4.2	<2.2	<4	5 650	14
10-1023	AAB5462R		—	—	—	—	—	—	—	—	—	—	—
10-1023	AAB5608		—	—	—	—	—	—	—	—	—	—	—
10-1024	AAB5456		6 040	2.6	107	<0.98	<0.49	2 410	6.9	<5.1	6.4	11 600	13
10-1623	AAB5465		5 330	2.6	49.3	<0.69	<0.35	1 470	3.4	<2	<4.2	4 720	11

TABLE A-2

ANALYTICAL RESULTS FOR RADIONUCLIDES DETECTED AT PRS 10-008

LOCATION ID	SAMPLE ID	DEPTH (In.)	AMERICIUM-241	CESIUM-137	STRONTIUM-90
		UTL			
		SAL			
10-1014	AAB5467		—	—	-0.13
10-1006	AAB5513		—	—	0.62
10-1007	AAB5515		—	—	-0.01
10-1008	AAB5460		—	—	-0.16
10-1013	AAB5469		—	—	0.61
10-1015	AAB5451		—	—	0.28
10-1022	AAB5481		—	—	0.43
10-1022	AAB5485		—	—	0.47
10-1023	AAB5482		—	—	-0.03
10-1023	AAB5482R		—	—	-0.2
10-1023	AAB5008		0.025	0.019	—
10-1024	AAB5456		—	—	0.35
10-1023	AAB5465		—	—	-0.36

TABLE A-3

ANALYTICAL RESULTS FOR HIGH EXPLOSIVE ANALYTES DETECTED AT PRS 10-008

LOCATION ID	SAMPLE ID	DEPTH (ft.)	AMINO-2,6-DINITROTOLUENE [4-]	DINITROTOLUENE [2,6-]	HMX	NITROBENZENE	NITROTOLUENE [M-]	NITROTOLUENE [O-]	NITROTOLUENE [P-]
		UTL							
10-1014	AAB5467		—	—	—	—	—	—	—
10-1006	AAB5513		—	—	—	—	—	—	—
10-1007	AAB5515		—	—	—	—	—	—	—
10-1008	AAB5460		—	—	—	—	—	—	—
10-1013	AAB5469		—	—	—	—	—	—	—
10-1015	AAB5451		—	—	—	—	—	—	—
10-1022	AAB5461		—	—	—	—	—	—	—
10-1022	AAB5465		—	—	—	—	—	—	—
10-1023	AAB5462		—	—	—	—	—	—	—
10-1023	AAB5462R		—	—	—	—	—	—	—
10-1023	AAB5608		<0.092	<0.094	<0.168	0.098	<0.163	<0.141	<0.189
10-1024	AAB5456		—	—	—	—	—	—	—
10-1623	AAB5465		<0.09	<0.092	<0.164	<0.075	<0.16	<0.138	<0.185

APPENDIX B DATA VALIDATION

TABLE B-1

SUMMARY TABLE OF QUALITY CONTROL RESULTS FOR TA-10 SURFACE SAMPLES

LOCATION ID	SAMPLE ID	MATRIX	ANALYTE SUITE	REQUEST NUMBER	QUALITY CONTROL (QC) COMMENTS
10-1023	AAB5508	Soil	Gamma spectroscopy	19700	All data are valid and usable. No qualifiers were added.
10-1023	AAB5527	Soil	High explosives	17913	Samples missed holding times, but no qualifiers needed to be added to the data. All data are valid and usable.
10-1023	AAB5508	Soil	High explosives	17916	Samples missed holding times, but no qualifiers needed to be added to the data. All data are valid and usable.
10-1008	AAB5480	Soil	TAL metals	19518	Mercury and cyanide data are qualified J or UJ for missed holding times. Arsenic and chromium data are qualified or UJ because there were low recoveries for these analytes in two blind QC samples. All data are valid and usable as qualified.
10-1023	AAB5482	Soil	TAL metals	19518	Mercury and cyanide data are qualified J or UJ for missed holding times. Arsenic and chromium data are qualified or UJ because there were low recoveries for these analytes in two blind QC samples. All data are valid and usable as qualified.
10-1023	AAB5485	Soil	TAL metals	19518	Mercury and cyanide data are qualified J or UJ for missed holding times. Arsenic and chromium data are qualified or UJ because there were low recoveries for these analytes in two blind QC samples. All data are valid and usable as qualified.
10-1014	AAB5487	Soil	TAL metals	19518	Mercury and cyanide data are qualified J or UJ for missed holding times. Arsenic and chromium data are qualified or UJ because there were low recoveries for these analytes in two blind QC samples. All data are valid and usable as qualified.
10-1013	AAB5489	Soil	TAL metals	19518	Mercury and cyanide data are qualified J or UJ for missed holding times. Arsenic and chromium data are qualified or UJ because there were low recoveries for these analytes in two blind QC samples. All data are valid and usable as qualified.
10-1022	AAB5491	Soil	TAL metals	19759	Mercury data are qualified J or UJ because the holding time was grossly exceeded. Lead and chromium data a qualified J or UJ because there were recoveries for thos analytes in the blind QC sample that were outside acceptable limits. All data are valid and usable as qualifi
10-1022	AAB5485	Soil	TAL metals	19759	Mercury data are qualified J or UJ because the holding time was grossly exceeded. Lead and chromium data a qualified J or UJ because there were recoveries for thos analytes in the blind QC sample that were outside acceptable limits. All data are valid and usable as qualifi
10-1009	AAB5513	Soil	TAL metals	19785	Mercury data are qualified J or UJ because the holding time was grossly exceeded. All data are valid and usabl qualified.
10-1007	AAB5515	Soil	TAL metals	19785	Mercury data are qualified J or UJ because the holding time was grossly exceeded. All data are valid and usabl qualified.
10-1015	AAB5451	Soil	TAL metals	19792	Mercury data are qualified J or UJ because the holding time was grossly exceeded. Aluminum and chromium were outside the allowed limits in one of two blind QC sample. There is up to 20% uncertainty in QC value, so qualifiers did not need to be added for these analytes. A data are valid and usable as qualified.

TABLE B-1 (continued)

SUMMARY TABLE OF QUALITY CONTROL RESULTS FOR TA-10 SURFACE SAMPLES

LOCATION ID	SAMPLE ID	MATRIX	ANALYTE SUITE	REQUEST NUMBER	QUALITY CONTROL (QC) COMMENTS
10-1024	AAB56456	Soil	TAL metals	19702	Mercury data are qualified J or UJ because the holding time was grossly exceeded. Aluminum and chromium were outside the allowed limits in one of two blind QC sample. There is up to 20% uncertainty in QC value, so qualifiers did not need to be added for these analytes. A data are valid and usable as qualified.
10-1006	AAB56513	Soil	Total uranium strontium-90	19705	Strontium-90 and uranium data were qualified J for high recoveries in the blind QC samples. All data are valid an usable as qualified.
10-1007	AAB56516	Soil	Total uranium strontium-90	19705	Strontium-90 and uranium data were qualified J for high recoveries in the blind QC samples. All data are valid an usable as qualified.
10-1022	AAB56401	Soil	Total uranium strontium-90	19762	Uranium data were qualified J because of a low recovery the blind QC sample . All data are valid and usable as qualified.
10-1022	AAB56465	Soil	Total uranium strontium-90	19762	Uranium data were qualified J because of a low recovery the blind QC sample . All data are valid and usable as qualified.
10-1015	AAB56451	Soil	Total uranium strontium-90	19765	All data are valid and usable. No qualifiers were added.
10-1024	AAB56459	Soil	Total uranium strontium-90	19765	All data are valid and usable. No qualifiers were added.
10-1008	AAB56460	Soil	Total uranium strontium-90	19768	Uranium data were qualified J because of a high recove in the blind QC sample. All data are valid and usable as qualified.
10-1023	AAB56462	Soil	Total uranium strontium-90	19768	Uranium data were qualified J because of a high recove in the blind QC sample. All data are valid and usable as qualified.
10-1023	AAB56466	Soil	Total uranium strontium-90	19768	Uranium data were qualified J because of a high recove in the blind QC sample. All data are valid and usable as qualified.
10-1014	AAB56467	Soil	Total uranium strontium-90	19768	Uranium data were qualified J because of a high recove in the blind QC sample. All data are valid and usable as qualified.
10-1013	AAB56469	Soil	Total uranium strontium-90	19768	Uranium data were qualified J because of a high recove in the blind QC sample. All data are valid and usable as qualified.

THIS PAGE LEFT INTENTIONALLY BLANK

APPENDIX C RISK ASSESSMENT CALCULATIONS

No risk assessment was conducted for PRS 10-008.

THIS PAGE LEFT INTENTIONALLY BLANK