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9/29/97

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HSWA LANL 4/11 29/48 TG

Date: September 22, 1997
Refer to: EM/ER:97-377

RECEIVED SEP 1997

Mr. Benito Garcia
NMED-HRMB
P.O. Box 26110
Santa Fe, NM 87502

**SUBJECT: NFA STATUS FOR PRSs 48-002(e), 48-007(b,c,f) AND ADDENDUM TO THE RFI REPORT FOR PRSs AT TA-48**

Dear Mr. Garcia:

We are writing to request that the New Mexico Environment Department (NMED) aid in the resolution of no further action (NFA) status for Potential Release Sites (PRSs) 48-002(e) and 48-007(b,c,f). NFA was requested for these units in the RFI Report for PRS 48-001, 48-002(e), 48-003, 48-005, 48-007(a,b,c,f), 48-010, which was submitted to NMED in September 1995. On April 4, 1996, NMED issued a notice of deficiency (NOD) for this RFI Report. The NOD specified additional sampling activities for all PRSs presented in the RFI Report except for PRSs 48-002(e) and 48-007(b,c,f). The NOD document made no specific comments pertaining to these four PRSs including whether the NFA proposals for PRS 48-002(e) and 48-007(b,c,f) were approved by NMED. Because formal acknowledgement by NMED is required prior to submitting a Class III Permit Modification, we are requesting that you respond to this letter so that we will have the confirmation required to go forward with the NFA process for these units.

The enclosed document, Addendum to the RFI Report for PRSs at Technical Area 48, is provided to you for information purposes. The document contains the results of sampling for radiological constituents only at PRSs 48-002(e) and 48-007(b,c,f).

2657



TK

If you have any questions regarding this request or the attached document, please call Allyn Pratt at (505) 667-4308 or Bonnie Koch at (505) 665-7202.

Sincerely,

Jorg Jansen, Program Manager
LANL/ER Project

Sincerely,

Theodore J. Taylor, Program Manager
DOE/LAAO

JJ/TTss

Enclosures: (1) NFA Status for PRSs 48-002(e), 48-007(b,c,f) and Addendum to the RFI Report for PRSs at TA-48
(2) Certification

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# CERTIFICATION

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

Document Title: Addendum to the RFI Report for PRSs at TA-48

Name: _____ Date: 9/21/97

Jorg Jansen, Program Manager
Environmental Restoration Project
Los Alamos National Laboratory

or

Tom Baca, Program Director
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Joseph Vozella,
Acting Assistant Area Manager of
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DOE-Los Alamos Area Office

or

Theodore J. Taylor, Program Manager
Environmental Restoration Program
DOE-Los Alamos Area Office

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# Addendum to the RFI Report for Potential Release Sites at Technical Area 48

(Located in former Operable Unit 1129)

Field Unit 4

Environmental Restoration Project

September 1997

A Department of Energy Environmental Cleanup Program

Los Alamos
NATIONAL LABORATORY

LA-UR-97-3112

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## EXECUTIVE SUMMARY

This document is a radiological data and assessment addendum (hereafter referred to as "this addendum") to the *RFI Report for Potential Release Sites 48-001 48-002(e) 48-003 48-005 48-007(a) 48-007(b) 48-007(c) 48-007(d) 48-007(f) 48-010* (LANL 1995, 50295) (hereafter referred to as "the RFI report"). This addendum and the RFI report describe the results of the Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) to evaluate contamination at Technical Area (TA) -48. TA-48 was part of former Operable Unit 1129, which has been incorporated into Field Unit 4 of the Environmental Restoration Project at Los Alamos National Laboratory (the Laboratory). Included in this addendum are the results of additional investigations for Potential Release Site (PRS) Nos. 48-002(e) and 48-007(b, c, and f).

TA-48, the radiochemistry site, is located on Ten Site Mesa south of Mortandad Canyon. TA-48 is currently used for chemical and radiochemical analyses, radioactive waste disposal research, and radioisotope production for nuclear medicine. It was established in 1957 and is the site of current and former operational structures built to house radiochemistry and nuclear medicine research work (DOE 1987, 8663). Activities in the main radiochemistry building (TA-48-1) have included processing of high-level alpha and /or beta-gamma emitters, radiochemical analyses on spallation products from the Clinton P. Anderson Meson Physics Facility, and dissolution and radiochemical studies of samples from underground shot cavities at the Nevada Test Site. Additionally, TA-48 laboratories are used to study the nuclear properties of radioactive materials using techniques of analytical and physical chemistry.

Potential contaminant release routes from TA-48 included ventilation stacks, a sanitary sewer line, storm sewer lines, and industrial waste lines (Sattizahn 1971, 890). The chemicals that contributed to the list of potential contaminants for this addendum are limited to radionuclides.

The goal of the RFI was to confirm the presence or absence of chemicals of potential concern (COPCs) in the PRSs at TA-48. In January 1997 a sampling and analysis plan (SAP) (LANL 1997, 55326) was prepared and submitted, which described sampling activities that were proposed to satisfy the requirements of a New Mexico Environment Department (NMED) notice of deficiency for the RFI report (LANL 1996, 54448) and an NMED request for additional information about the RFI report (LANL 1996, 55064). In February, March, and June 1997 sampling activities were conducted in accordance with the SAP. Radionuclides were the only chemicals of concern investigated as part of the January 1997 SAP (LANL 1997, 55326) at PRS Nos. 48-002(e) and 48-007(b, c, and f). Therefore, only radionuclide results are presented and discussed in this addendum.

Although radionuclides are regulated by the Department of Energy and are not regulated under RCRA, it is more efficient and cost effective to investigate all types of potential contamination during a single site characterization.

The site decision process consisted of a series of qualitative and quantitative steps. First, analytical data were verified and validated, then the data underwent a data quality assessment, and finally the data were compared with appropriate site-specific background values. A human health screening assessment was performed to determine if COPCs were present. Finally, the adequacy of the data set to support a site decision was evaluated.

No significant concerns are associated with the quality of the data; data quality evaluation is presented in Chapter 4 of this addendum. Results of the organic and inorganic chemical analyses are not discussed or presented in this addendum; they were presented in the RFI report (LANL 1995, 50295).

All PRSs in this addendum (PRS Nos. 48-002[e] and 48-007[b, c, and f]) are recommended for no further action (NFA) based on human health concerns. The results of the RFI for each PRS are summarized in Table ES-1.

**TABLE ES-1**

**SUMMARY OF PROPOSED ACTIONS**

| PRS No. | HSWA[a] | Radionuclide Component[b] | Proposed Action | | | | Section No. |
|---|---|---|---|---|---|---|---|
| | | | NFA Criteria | Further Action | Add to HSWA Module | Rationale | |
| 48-002(e) | | X | 5 | | | RCRA chemicals[c] and radionuclides were determined to pose a negligible threat to human health | 4.4.4[d]<br>5.1.11[e] |
| 48-007(b) | X | X | 5 | | | RCRA chemicals[c] and radionuclides are below SALs | 4.5.4[d]<br>5.2.11[e] |
| 48-007(c) | X | X | 5 | | | RCRA chemicals[c] were determined to pose a negligible threat to human health and radionuclides are below SALs | 4.5.4[d]<br>5.3.11[e] |
| 48-007(f) | X | X | 5 | | | RCRA chemicals[c] and radionuclides are below SALs | 4.5.4[d]<br>5.4.11[e] |

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. Results of analyses for RCRA chemicals are presented in the RFI report (LANL 1995, 50295).

d. Section of RFI report (LANL 1996, 50295) where NFA recommendation for RCRA chemicals is located

e. Section of this addendum where NFA recommendation for the radionuclide component is located

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| COPC | chemical of potential concern |
| cpm | counts per minute |
| DOE | Department of Energy |
| EPA | Environmental Protection Agency |
| ER | Environmental Restoration |
| ESH | Environment, Safety, and Health (Laboratory Division) |
| FIMAD | Facility for Information Management, Analysis, and Display |
| FSS | Facilities, Security, and Safeguards (Laboratory Division) |
| H&S | health and safety |
| HSWA | Hazardous and Solid Waste Amendments |
| IWP | Installation Work Plan |
| J | The analyte was positively identified, and the associated numerical value is estimated to be more uncertain than would normally be expected for that analysis. |
| J+ | The analyte was positively identified, and the reported value is an estimate and likely to be biased high. |
| J– | The analyte was positively identified, and the reported value is an estimate and likely to be biased low. |
| LCS | laboratory control sample |
| LSC | liquid scintillation counting |
| MCE | multiple chemical evaluation |
| MDA | minimum detectable activity |
| NA | not analyzed |
| N/A | not applicable |
| N.A. | not available |
| NC | noncarcinogen |
| NFA | no further action |
| NMED | New Mexico Environment Department |
| NOD | notice of deficiency |
| NPDES | National Pollutant Discharge Elimination System |
| NR | not requested |
| OU | operable unit |
| P | Professional judgment should be applied to using the data in decision-making. |
| PCB | polychlorinated biphenyl |
| PE | performance evaluation |
| PM | Professional judgment should be applied to using the data in decision-making. A manual review of the raw data is recommended to determine if the defect impacts data use for decision-making. |
| PRS | potential release site |
| QAPP | Quality Assurance Project Plan |
| QA/QC | quality assurance/quality control |

| | |
|---|---|
| Qbt3 | cooling unit 3 of the Tshirege Member of the Bandelier Tuff |
| QC | quality control |
| R | The sample results are rejected because of serious deficiencies in the ability to analyze the sample and meet quality control criteria; presence or absence cannot be verified. |
| RCRA | Resource Conservation and Recovery Act |
| RFI | RCRA facility investigation |
| RPD | relative percent difference |
| RPM | 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. |
| SAL | screening action level |
| SAP | sampling and analysis plan |
| SVOC | semivolatile organic compound |
| TA | Technical Area |
| TPU | total propagated uncertainty |
| U | The analyte was analyzed for but not detected. Reported value is the sample-specific estimated quantitation limit or detection limit. |
| UJ | The analyte was analyzed for but not detected. Reported value is an estimate of the sample-specific quantitation limit or detection limit. |
| UTL | upper tolerance limit |
| VOC | volatile organic compound |
| XRF | x-ray fluorescence |

## 1.0 INTRODUCTION

This document is a radiological data and assessment addendum (hereafter referred to as "this addendum") to the *RFI Report for Potential Release Sites 48-001 48-002(e) 48-003 48-005 48-007(a) 48-007(b) 48-007(c) 48-007(d) 48-007(f) 48-010* (LANL 1995, 50295) (hereafter referred to as "the RFI report"). This addendum and the RFI report describe the results of the Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) to evaluate contamination of former Operable Unit 1129 in Technical Area (TA) -48 at Los Alamos National Laboratory (hereafter referred to as "the Laboratory"). Sampling activities were conducted under the guidelines described in the *Sampling and Analysis Plan for TA-48* (LANL 1997, 55326) (hereafter referred to as "the SAP"), which was prepared to conduct additional sampling at TA-48 in response to a New Mexico Environment Department (NMED) notice of deficiency (NOD) (LANL 1996, 54448) and an NMED request for additional information (LANL 1996, 55064). Included in this addendum are the results of investigations for Potential Release Site (PRS) Nos. 48-002(e) and 48-007(b, c, and f) at TA-48. Results of the investigations for the remaining PRSs addressed in the SAP will be presented in subsequent RFI reports.

### 1.1 General Site History

TA-48, the radiochemistry site, is currently used for chemical and radiochemical analyses, radioactive waste disposal research, and radioisotope production for nuclear medicine. The site was established in 1957 and is the location of current and former operational structures that were built to house radiochemistry and nuclear medicine research work (DOE 1987, 8663). Activities in the main radiochemistry building (TA-48-1) have included processing of high-level alpha and/or beta-gamma emitters, radiochemical analyses on spallation products from the Clinton P. Anderson Meson Physics Facility, and dissolution and radiochemical studies of samples from underground shot cavities at the Nevada Test Site. Additionally, TA-48 laboratories are used to study the nuclear properties of radioactive materials using techniques of analytical and physical chemistry. Figure 1.1-1 and Figure 1.1-2 show the location of TA-48.

Process effluent routes from TA-48 included ventilation stacks and industrial waste lines. Additional potential release routes include a sanitary sewer line and storm sewer lines. Waste was also removed by tank trucks (for special burial) and dumpsters (Sattizahn 1971, 890). Figure 1.1-3 shows the structures at TA-48 and the locations of the PRSs with respect to those structures. For more detailed information about the structures at TA-48 and related waste management activities, see Chapter 3 of the work plan (LANL 1992, 7666). Chemicals that contributed to the list of chemicals of potential concern (COPCs) include metals, volatile organic compounds, semivolatile organic compounds, and radionuclides.

### 1.2 RFI Overview

Phase I of the RFI site characterization at TA-48 started in July 1993. The results of the Phase I RFI were presented in the RFI report (LANL 1995, 50295). In January 1997 a SAP (LANL 1997, 55326) was prepared and submitted, which described sampling activities that were proposed to satisfy the requirements of an NMED NOD for the RFI report (LANL 1996, 54448) and an NMED request for additional information about the RFI report (LANL 1996, 55064). In March and June 1997 sampling activities were conducted in accordance with the SAP.

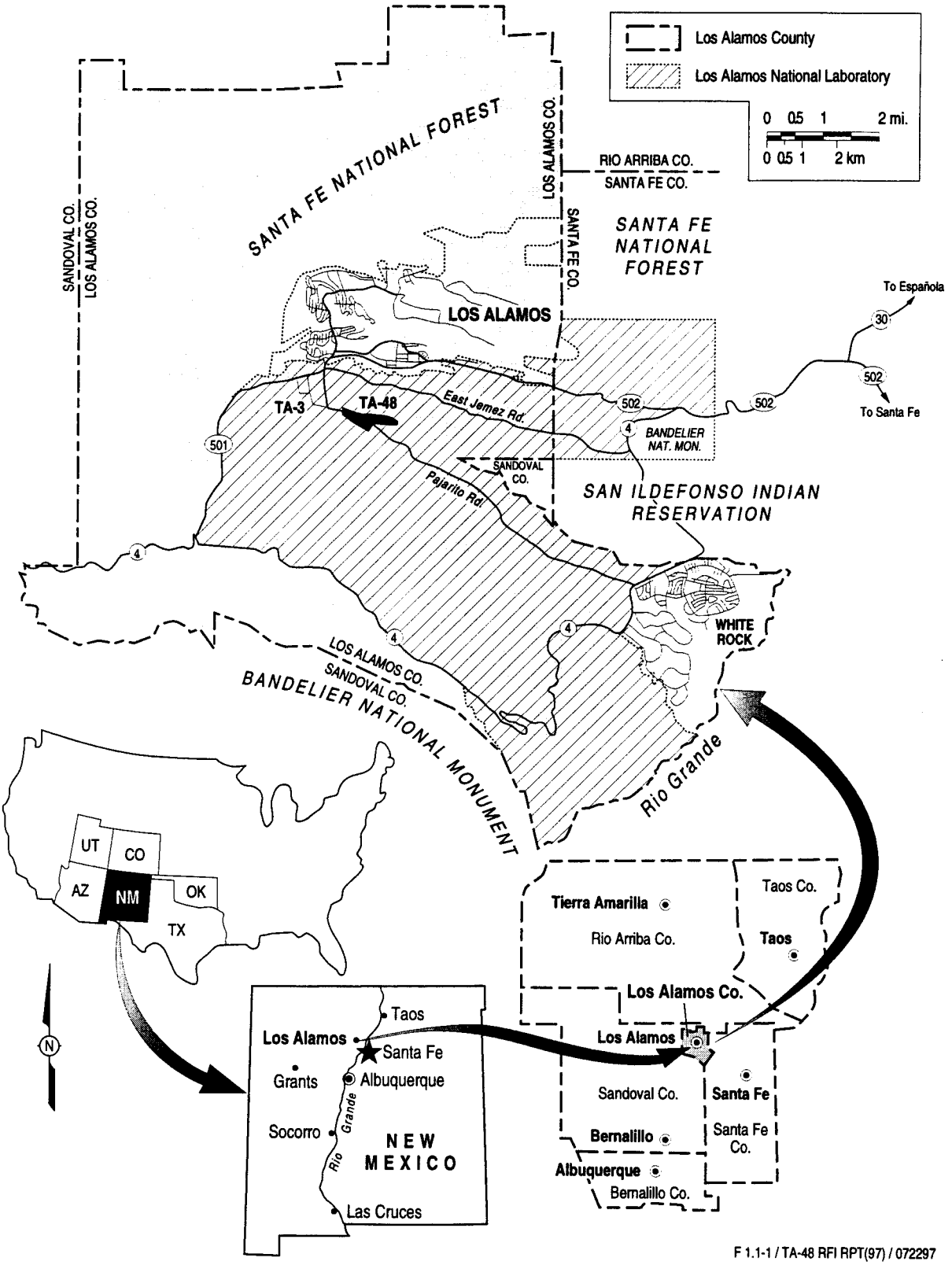


**Figure 1.1-1. Location of TA-48 within Los Alamos National Laboratory, Los Alamos County, New Mexico.**

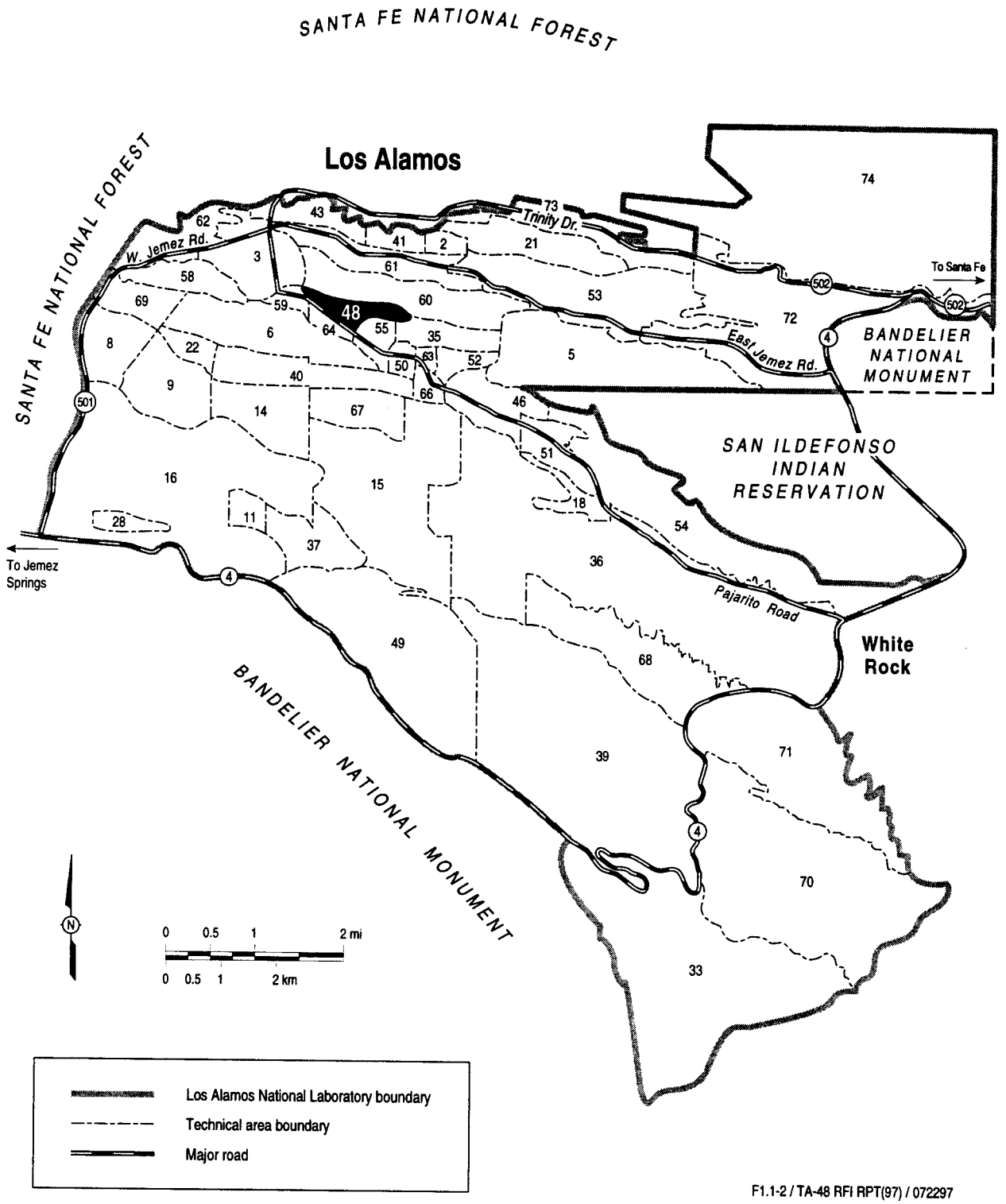


**Figure 1.1-2. Location of TA-48 with respect to Laboratory technical areas and surrounding land holdings.**

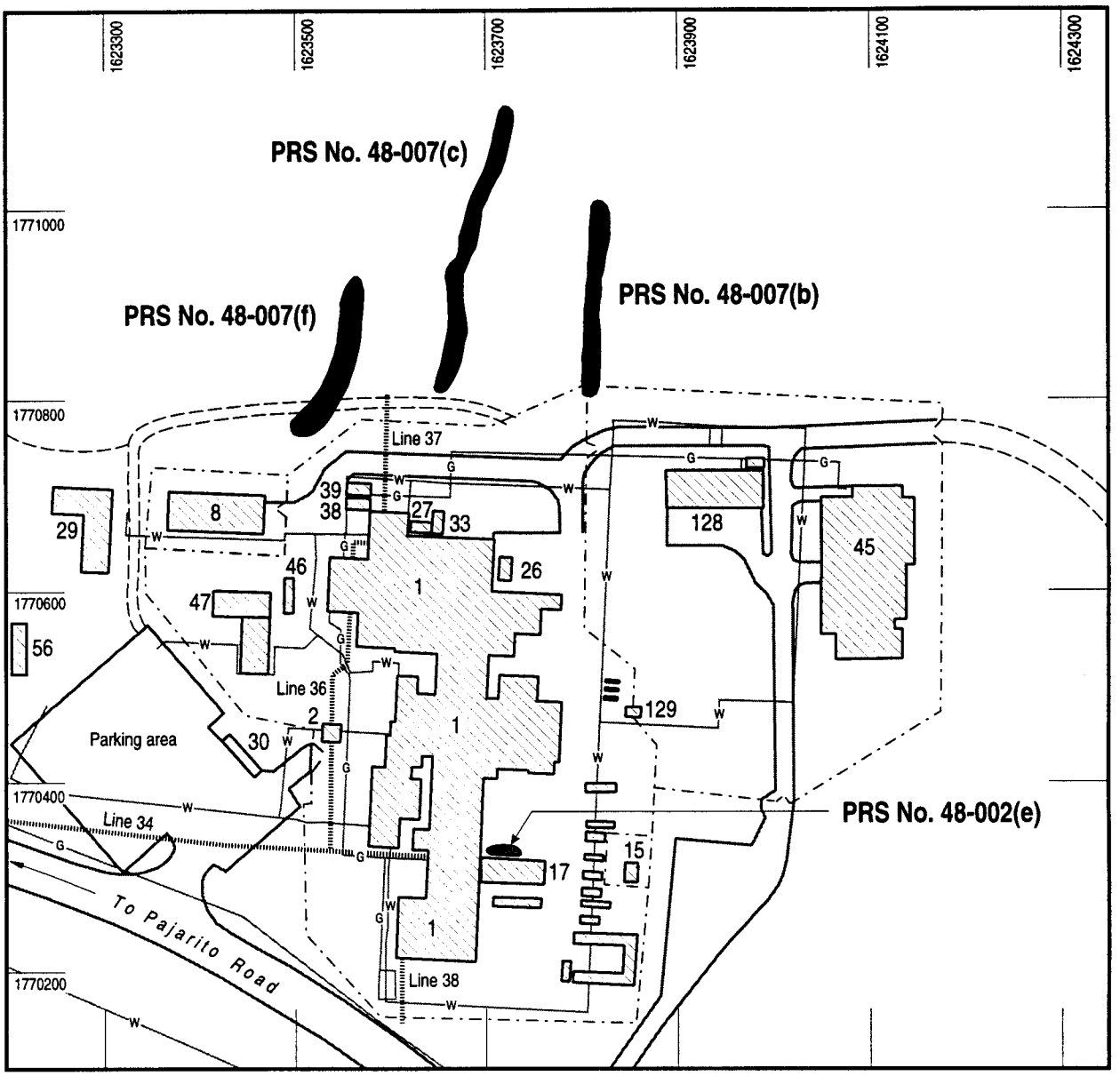


**Figure 1.1-3. Approximate locations of PRS Nos. 48-002(e) and 48-007(b, c, and f) at TA-48.**

A primary component of the SAP (LANL 1997, 55326) was the collection of additional gamma spectroscopy data at several of the PRSs. As described in the Laboratory/Department of Energy (DOE) response to NOD comment No. 16 (LANL 1996, 54448), mobile laboratory gamma spectroscopy data collected during the Phase I RFI were unusable for site decisions. Therefore, additional samples were collected and analyzed for gamma-emitting radionuclides, as necessary, to fulfill the objectives of the work plan (LANL 1992, 7666) and the addendum to the work plan (Pratt 1994, 43475). Although radionuclides present at TA-48 are regulated by 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 addendum. Additional inorganic or organic chemical data were not specified in the SAP. The results of previous sampling efforts at TA-48 that address these chemicals are evaluated in the RFI report (LANL 1995, 50295).

## 1.3 Field Activities

Engineering surveys and environmental surveys were completed for each PRS aggregate before Phase I sampling activities began. The engineering surveys, which were based on engineering drawings provided by the Laboratory Facilities Project Delivery group (FSS-6), archival aerial photographs and drawings, and field observations, were conducted by the field team geologist with support from the field team sampling technicians. Because environmental surveys were performed for the initial investigation, they were not repeated for the implementation of the SAP.

In February 1997 engineering surveys were performed to stake sample locations, which were based on the SAP (LANL 1997, 55326).

Field sampling activities began in February 1997 and ended in March 1997. In June 1997 additional samples were collected at PRS No. 48-007(c).

All applicable Laboratory Environmental Restoration standard operating procedures (LANL 1991, 21556) were followed, unless otherwise noted in Chapter 5. Soil samples were collected using a scoop (LANL-ER-SOP-06.09, R0) for surface soil samples and a hand auger (LANL-ER-SOP-06.10, R0) for near-surface soil samples.

Deviations from the SAP, if any, are discussed in the appropriate section of Chapter 5 for the respective PRS.

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## 2.0 ENVIRONMENTAL SETTING

The environmental setting is described in the *RFI Report for Potential Release Sites 48-001 48-002(e) 48-003 48-005 48-007(a) 48-007(b) 48-007(c) 48-007(d) 48-007(f) 48-010* (LANL 1995, 50295). Therefore, this chapter is excluded except Figure 2.2.1-1, which shows an updated cross section of the stratigraphy of Technical Area (TA) -48, and Figure 2.3.1-1, which shows the topography of TA-48 and physical features around the area.

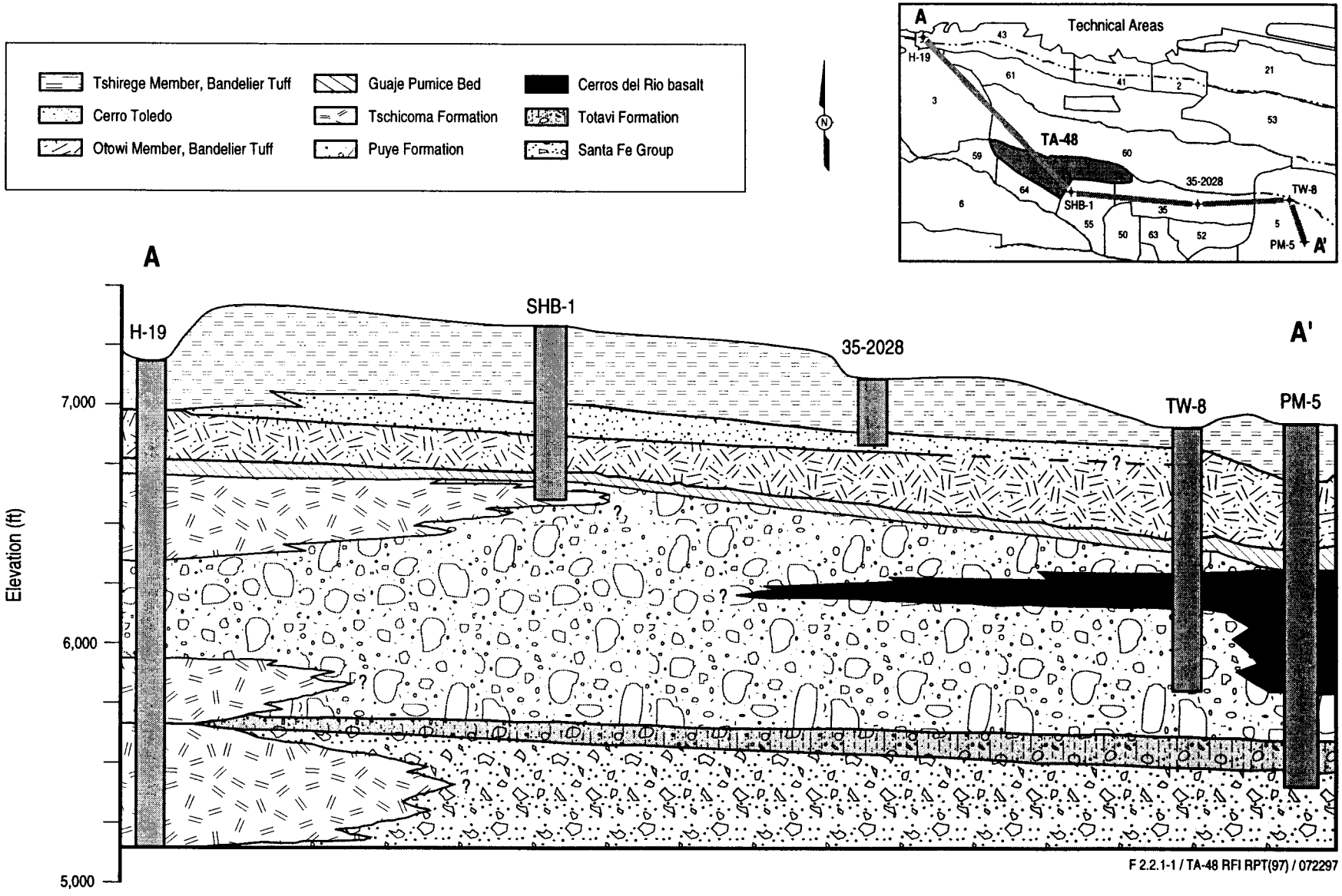


**Figure 2.2.1-1. Generalized stratigraphy of TA-48.**

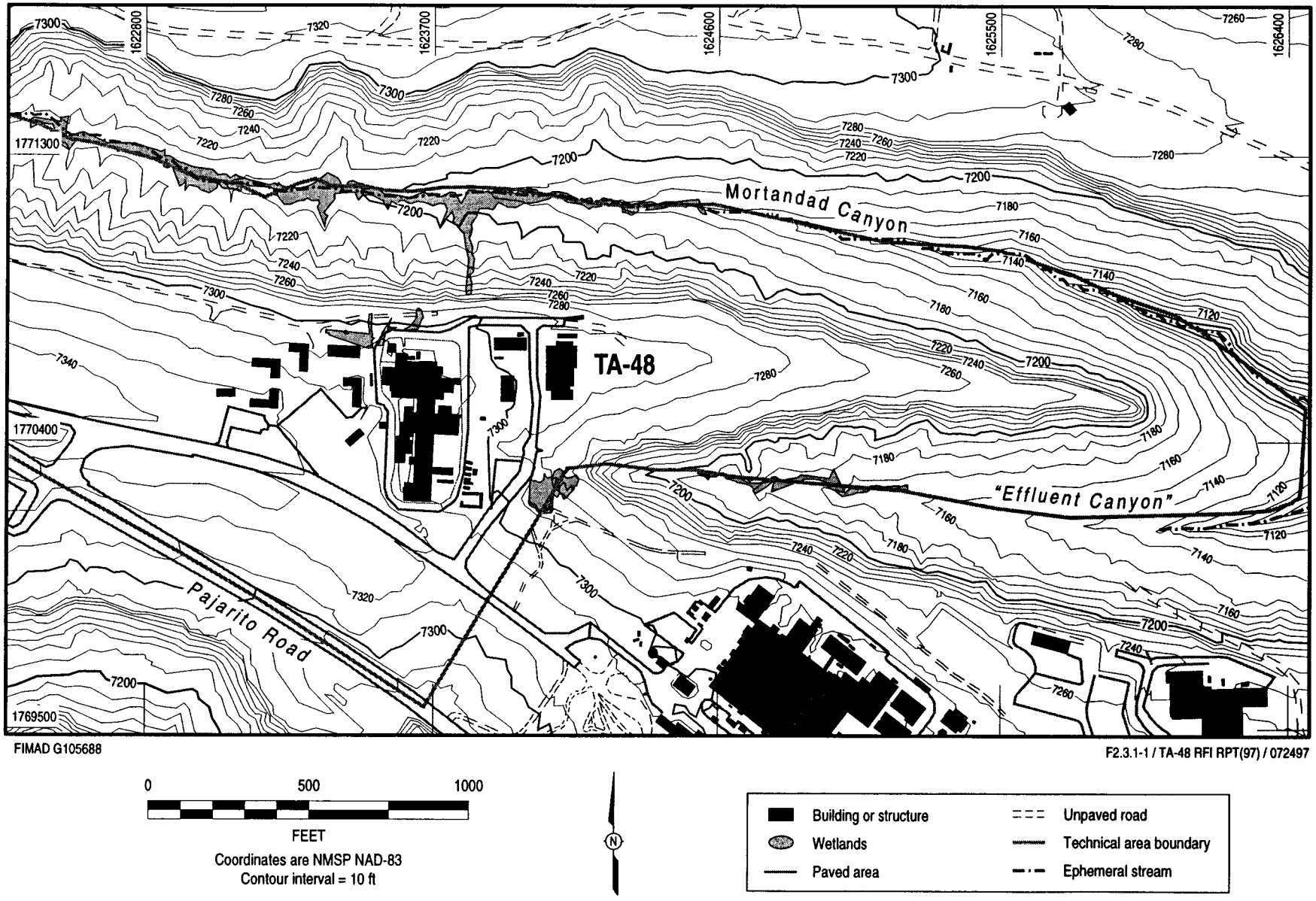


**Figure 2.3.1-1. Topography of TA-48.**

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## 3.0 APPROACH TO SAMPLE ANALYSES AND DATA ASSESSMENT

This chapter is included in this addendum because the approach to sample analyses and data assessment process has changed since the *RFI Report for Potential Release Sites 48-001 48-002(e) 48-003 48-005 48-007(a) 48-007(b) 48-007(c) 48-007(d) 48-007(f) 48-010* (LANL 1995, 50295) was published.

This chapter describes the analytical methods used for supplemental samples collected in accordance with the *Sampling and Analysis Plan for TA-48* (LANL 1997, 55326). This chapter also describes the screening methodology used.

The objective of the Technical Area (TA) -48 Phase I Resource Conservation and Recovery Act facility investigation (RFI) was to determine if any chemicals of potential concern (COPCs) are present at a potential release site (PRS). The Phase I decision criteria may be qualitatively stated as follows. If no COPCs are identified at a PRS as the result of a human health risk screening assessment and if the quality of the data set is adequate, then no further action (NFA) will be proposed. If any COPCs are determined to be present, or if the data are insufficient to support an NFA recommendation, the PRS will be considered for either accelerated corrective action or further investigation, as appropriate.

The approach to data assessment used by the Laboratory Environmental Restoration (ER) Project is described in the policy document *Risk-Based Corrective Action Process* (Dorries 1996, 55575). The approach includes the following steps:

- 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 Laboratory 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 addendum. Sample analyses and the analytical methods employed are discussed in Section 3.1 and Section 3.1.1, respectively. Before the data set for a PRS is assembled, analytical data are verified and validated according to the procedures described in Section 3.1.2. The verified and validated data set then undergoes a data assessment process, which begins with an exploratory data analysis. The exploratory data analysis facilitates the identification of suspect results that may require focused validation, which is described in Section 3.1.2.

After exploratory data analysis, site data are compared with the appropriate site-specific background data for radionuclides, as described in Section 3.2.2. A human health risk-based screening assessment is then performed to determine if COPCs are present, following the procedure outlined in Section 3.2.4. For this addendum, only radionuclide data are evaluated.

If no COPCs are identified during the screening assessment, the sufficiency of the data set to support an NFA recommendation is determined by examining certain attributes of the data for the decision set. For example, the sensitivity, bias, and precision of the analytical methods used should be adequate to detect COPCs at levels of concern and to accurately identify COPCs. Samples should have been analyzed for the appropriate analyte suites to determine the presence or absence of likely contaminants at the site based on the existing information. The degree of spatial characterization must be sufficient to support conclusions based on the data set. The assessment of the adequacy of the data set for decision-making purposes is a subjective process that requires the professional judgment of an interdisciplinary team comprising human health and ecological risk assessors, statisticians, geologists, and chemists.

## 3.1 Sample Analyses

Samples were collected in accordance with the sampling design specified in the *RFI Work Plan for Operable Unit 1129* (LANL 1992, 7666) and the *Sampling and Analysis Plan for TA-48* (LANL 1997, 55326). All samples requiring analyses and chain-of-custody documentation were submitted to the Sample Management Office for shipment to a fixed-site laboratory.

### 3.1.1 Analytical Methods

This addendum contains only the results for radiochemical analyses. A list of the target analytes for which analyses were performed can be found in Appendix A. Table 3.1.1-1 summarizes the analytical methods employed by the internal and external fixed-site laboratories for the radiological analytical suites.

**TABLE 3.1.1-1**

**ANALYTICAL METHODS**

| Analyte Suite | Fixed-Site Laboratory Analytical Method |
|---|---|
| $^{241}$Am | Alpha spectrometry |
| $^{238}$Pu, $^{239,240}$Pu | Alpha spectrometry |
| $^{234}$U, $^{235}$U, $^{238}$U | Alpha spectrometry |
| $^{228}$Th, $^{230}$Th, $^{232}$Th | Alpha spectrometry |
| Gamma spectroscopy analytes | Gamma spectroscopy |

The analytical protocols employed by the internal fixed-site laboratories are described in the Laboratory health and environmental chemistry manual (LANL 1993, 31794). Analyses performed by external subcontractor laboratories use methods specified in the ER Project Sample Management Office analytical subcontracts (LANL 1995, 49738). The analytical subcontracts specify Laboratory-approved methods for radiochemical analyses according to the technologies identified in the subcontract (for example, $^{241}$Am by alpha spectrometry, 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, 53450). For each analyte, quantitation or detection limits are specified as contract-required estimated quantitation limits for radionuclides. 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. The data verification procedure assured that

- analytical results had been received for all samples submitted for analysis,
- the correct analysis had been performed for each sample,
- the analytical data had been reported correctly, and
- all analytical data had been correctly transmitted to the Facility for Information Management, Analysis, and Display (FIMAD).

Appropriate corrective actions were initiated to obtain missing analytical data and to correct errors in the data reporting.

The baseline data validation procedure involves the comparison of quality indicators with clearly defined criteria or limits. For analytical data generated after April 1995, baseline data validation under the ER Project protocol is performed as described in the ER Project QAPP (LANL 1996, 53450). This procedure produces 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 addendum.

Data were qualified (that is, a flag was attached to the data results) for a variety of reasons during the baseline validation procedure. 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 solely to reject data but rather to ensure that the relative quality of the data is understood so that the data may be used appropriately.

For analytical data generated before April 1995, quality indicators (such as surrogate recoveries, method blank measurements, holding times, and the differences between duplicate measurements) were evaluated following Environmental Protection Agency (EPA) guidelines for inorganic data review (EPA 1994, 48639) and organic data review (EPA 1994, 48640), where applicable. Radiochemistry data were validated according to the acceptance criteria defined in the ER Project statement of work for analytical services (LANL 1995, 49738). During the validation procedure, data that did not meet quality criteria were designated by appropriate qualifier flags.

Qualifiers resulting from the baseline validation procedure are shown for the analytical data presented in the tables included in Chapter 5 of this addendum. An explanation of the data qualifiers is given in Table 3.1.2-1.

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 and 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.

- additional information is required about the
  - variability or uncertainty of the reported data or
  - data quality before making a data use decision because of anomalies detected in a data set.

**TABLE 3.1.2-1**

**EXPLANATION OF DATA QUALIFIERS USED IN THE BASELINE DATA VALIDATION PROCEDURE**

| Qualifier | Explanation |
|---|---|
| U | The analyte was analyzed for but not detected. Reported value is the sample-specific estimated quantitation limit or detection limit. |
| J | The analyte was positively identified, and the associated numerical value is estimated to be more uncertain than would normally be expected for that analysis. |
| J+ | The analyte was positively identified, and the reported value is an estimate and likely to be biased high. |
| J– | The analyte was positively identified, and the reported value is an estimate and likely to be biased low. |
| UJ | The analyte was analyzed for but not detected. Reported value is an estimate of the sample-specific quantitation limit or detection limit. |
| R | The sample results are rejected because of serious deficiencies in the ability to analyze the sample and meet quality control criteria; presence or absence cannot be verified. |
| RPM | 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. NOTE: Any results qualified as RPM must be evaluated for relevance to data use. |
| P | Professional judgment should be applied to using the data in decision-making. |
| PM | Professional judgment should be applied to using the data in decision-making. A manual review of the raw data is recommended to determine if the defect impacts data use for decision-making. |

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

## 3.2 Process for the Identification of COPCs

After the data validation procedure is complete and the site data are finalized, the next step in the process is to compare site data with available background data to determine whether detected chemicals may be of anthropogenic or natural origin. The results of a focused data validation should exclude from consideration for background comparison any contaminant that is identified as an artifact of an analytical laboratory or field contamination, analytical interference, or improper analyte identification or quantitation. The purpose of this decision step is to determine if chemicals for which natural or anthropogenic background distributions are available should be retained as COPCs or eliminated from further consideration.

### 3.2.1 Inorganic Chemicals

Inorganic chemical analyses were not performed for the investigations described in this addendum. Therefore, this section is not applicable.

### 3.2.2 Radionuclides

Comparing reported radiochemical results to minimum detectable activities (MDAs) 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 background levels.

The 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 and data assessment processes, 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 MDA if one is reported. When the MDA is not available or does not meet the data quality needs of the ER Project, the reported value will be tested against an estimated MDA. This estimated value is based on the instrument counting error. The counting error is typically reported as the analytical uncertainty at a value of 1-sigma (that is, one standard deviation around the measured value), and the estimated MDA is computed as 3-sigma around the measured value.

Detected radionuclides are retained as COPCs or eliminated from further consideration based on a comparison with natural or anthropogenic background distributions. As discussed in Section 4.2 in Chapter 4 of this addendum, short-lived isotopes included in the gamma spectroscopy suite for quality assurance purposes are not evaluated as possible contaminants. The radionuclide background data used in this addendum are from the following sources:

- tuff samples collected throughout Los Alamos County for which chemical analyses were performed for certain naturally occurring radioactive chemicals (Longmire et al. 1995, 52227) and

- background soil and sediment concentrations of radioactive chemicals associated with global fallout from atmospheric nuclear testing ($^{241}$Am, $^{137}$Cs, $^{238}$Pu, $^{239,240}$Pu, $^{90}$Sr, and tritium) and of certain naturally occurring radioactive chemicals (Ryti et al. 1997, 56186).

Soil samples were not collected from identifiable soil horizons at TA-48 and were often collected from backfill of unknown origin. As recommended in Ryti et al. (1997, 56186), upper tolerance limit (UTL) values calculated using data obtained from canyons sediments were used for background comparison of naturally occurring radionuclides ($^{228}$Th, $^{230}$Th, $^{232}$Th, $^{234}$U, $^{235}$U, and $^{238}$U) in soil media. The surface UTL values for fallout radionuclides ($^{241}$Am, $^{137}$Cs, $^{238}$Pu, $^{239,240}$Pu, $^{90}$Sr, and tritium) were used for soil samples collected in the 0 to 0.5-ft intervals. Fallout radionuclide concentrations in deeper sample intervals were not compared with the surface UTLs because fallout activity is limited to surface soils. However, any fallout radionuclide detected at depths below 0.5 ft is considered to be present above background levels.

The use of UTL values for fallout radionuclides is subject to two qualifications. First, the data set for fallout radionuclides must include data from sampling locations at the perimeter of the Laboratory, which have slightly higher radionuclide levels than regional observations away from the Laboratory. Therefore, these UTLs represent baseline levels that include some contribution from Laboratory operations in addition to atmospheric fallout. In particular, the difference between the perimeter and regional $^{239}$Pu concentrations is statistically significant.

Second, the UTLs for fallout radionuclides should apply only to the 0 to 6-in. interval of undisturbed soils. However, the UTLs have been applied to the 0 to 6-in. intervals of disturbed soils as well, including possible fill materials and sediments. Depending on the origin of current surface soils, fallout radionuclide concentrations below UTL values in the 0 to 6-in. interval could be the result of site processes or other Laboratory activities. Conversely, fallout radionuclide concentrations below UTL values in sediments deeper than 6 in. could be the result of redeposition of surface soils rather than site releases. Site-specific information regarding soil disturbance and sedimentary processes is generally either unavailable or inconclusive. Applying UTLs for fallout radionuclides to any surface soil is justified from a practical standpoint because the UTL comparison is performed within the context of risk-based decision-making. The origin of a particular radionuclide is not relevant if the concentration is below the baseline value.

The native tuff underlying TA-48 is capped by the Qbt3 cooling unit of the Tshirege Member of the Bandelier Tuff. For thorium isotopes analyzed by alpha spectrometry, background UTL values in tuff media are available only for $^{232}$Th. For background comparison of $^{228}$Th in tuff samples, the Qbt3 UTL value for $^{232}$Th was used as a surrogate value. For background comparison of $^{230}$Th in tuff samples, the Qbt3 UTL value for $^{234}$U was used as a surrogate value. Use of both surrogates is based on the assumption of secular equilibrium between the long-lived parents and the progeny radionuclides $^{228}$Th and $^{230}$Th.

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 concentration. These background screening values are derived from Laboratory-wide soil, sediment, and tuff background data, and details on the calculation of these values are presented in Longmire et al. (1995, 52227) and Ryti et al. (1997, 56186). Certain radionuclides in certain media have no Laboratory-wide background data. For these exceptions, PRS sample-specific MDAs are used as nominal background screening values. In this addendum, detected radionuclides that lack background data include $^{134}$Cs, $^{152}$Eu, $^{22}$Na, and $^{106}$Ru.

### 3.2.3 Organic Chemicals

Organic chemical analyses were not performed for the investigations described in this addendum. Therefore, this section is not applicable.

### 3.2.4 Risk-Based Screening Assessment

Inorganic chemicals and radionuclides that exceed background and organic chemicals positively identified in one or more samples are compared with SALs to evaluate the potential for adverse health impacts. SALs for nonradioactive chemicals are based on EPA Region 9 preliminary remediation goals for residential soil (EPA 1996, 54899). SALs for radionuclides are based on residential exposure assumptions and an annual dose limit of 10 mrem. The decision to identify a chemical as a COPC when a SAL is not available is made on a case-by-case basis, taking into account the availability of process knowledge and toxicological information.

If more than one COPC is present at the site, a multiple chemical evaluation (MCE) is performed to determine if the potentially additive effect of chemicals detected below SALs warrants additional investigation. The method for performing an MCE is summarized in the policy document *Risk-Based Corrective Action Process* (Dorries 1996, 55575). These comparisons are the last quantitative steps in the screening assessment process for human health concerns. If COPCs remain after this step, then further evaluation is required. If no COPCs remain after this step and the data set is adequate 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. Additional evaluation may lead to eliminating one or more COPCs without going into a formal risk assessment. The site may be proposed for further sampling to more completely characterize the nature and/or extent of site contamination. A risk assessment may be conducted to determine whether the remaining COPCs present an unacceptable human health risk. The site may be proposed for remediation if it is cost effective to proceed without additional evaluation.

## 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 occurring 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 (that is, 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 1996, 54899). 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.

The background risks based on the Laboratory 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 or UTL background concentrations result in hazard quotients greater than 1.

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).

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 | $1x10^{-5}$ | $2x10^{-5}$ |
| Barium | 130 | 315 | 0.03 | 0.06 | NC | NC |
| Beryllium | 0.895 | 1.95 | 0.003 | 0.006 | $6x10^{-6}$ | $1x10^{-5}$ |
| Cadmium[e] | 0.2 | 2.6[d] | 0.005 | 0.07 | $1x10^{-10}$ | $2x10^{-9}$ |
| 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 | 0.01 | 0.2 | 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 August 1996 (EPA 1996, 54899).
b. Background concentrations taken from the Longmire et al. all-soils horizon data set (1995, 48818)
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

No human health risk assessments were performed for the PRS decision sets included in this addendum.

## 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 will be deferred until the ecological exposure unit methodology being developed has been approved.

# 4.0 RESULTS OF QUALITY ASSURANCE/QUALITY CONTROL ACTIVITIES

The objective of the Technical Area (TA) -48 Resource Conservation and Recovery Act facility investigation (RFI) is to determine if any chemicals of potential concern (COPCs) are present at a potential release site (PRS) decision set. To meet this objective, the radiochemical analytical methods that are summarized in Table 3.1.1-1 in Chapter 3 of this addendum were applied; results for inorganic and organic chemicals are not included. Quality control (QC) procedures were implemented in the analytical laboratory to provide estimates of the bias and precision of the radiochemical measurements. The following specific QC samples and procedures were used to assess bias: laboratory blank samples, tracer recovery, performance evaluation (PE) samples, and laboratory control samples (LCSs). The specific QC samples and procedures used to assess precision were laboratory duplicate samples.

QC samples were also collected in the field to provide information regarding sampling procedure bias. Field QC samples included bottle blanks and equipment rinsate blanks. The results of analysis of the field QC samples indicated that no bias or false positive results were introduced because of field sampling procedures.

Estimates of the precision and bias of the radiological analyte suites are presented by evaluating the specific quality indicators listed above, based on the QC data available for all soil samples collected at TA-48. Potential limitations in the analytical data that may impact their intended use are noted. A subset of the TA-48 sample results were evaluated for this addendum, and a specific discussion of the sample results presented in this addendum appears in Section 4.2. The results for individual samples were qualified by evaluation of the above listed QC parameters as described in Section 3.1.2 in Chapter 3 of this addendum. Qualifiers resulting from the validation process are defined in Table 3.1.2-1 and are shown in the analytical tables in Chapter 5 of this addendum.

Details regarding the qualification of analytical results for individual samples are given in Appendix B of this addendum.

## 4.1 Inorganic Analyses

Results for inorganic analyses are not presented in this addendum. A discussion of QC activities for organic analyses of TA-48 samples can be found in the RFI report (LANL 1995, 50295).

## 4.2 Radiochemical Analyses

Soil samples collected at TA-48 underwent one or more of the radiochemical analyses listed in Table 3.1.1-1 in Chapter 3 of this addendum. The results for the analysis of 12 soil samples by alpha spectrometry and 24 soil samples by gamma spectroscopy were evaluated for this addendum. Gamma spectroscopy and alpha spectrometry were performed at both internal and external fixed-site laboratories. The radionuclides analyzed by alpha spectrometry were $^{241}$Am, $^{238}$Pu, $^{239,240}$Pu (unresolved isotopes), $^{228}$Th, $^{230}$Th, $^{232}$Th, $^{234}$U, $^{235}$U, and $^{238}$U.

The analyte list, minimum detectable activities (MDAs), and analytical methods employed for the fixed-site laboratory radiochemical analyses are given in Table 4.2-1. A comparison of the MDAs and Laboratory soil screening action levels (SALs) indicates that the radiochemical methods employed were sufficiently sensitive to detect potential radiological contaminants in soil at concentrations below SAL values. The required QC procedures and acceptance criteria are given in the Environmental Restoration (ER) Project analytical services statement of work (LANL 1995, 49738). The analytical protocols used were either Laboratory internal protocols (LANL 1993, 31794) or external protocols, which have much in common with

the Laboratory radiochemistry methods. The radiochemistry procedures will vary somewhat from laboratory to laboratory because of the lack of promulgated radiological protocols. No holding time requirements exist for the radiochemical analyses.

**TABLE 4.2-1**

**ANALYTE LIST, MINIMUM DETECTABLE ACTIVITIES, AND ANALYTICAL METHODS FOR RADIONUCLIDE CONSTITUENTS IN TA-48 SOIL SAMPLES**

| Analyte | Half-Life (yr) | Detected Emission | MDA (pCi/g) | Soil SAL (pCi/g) | Analytical Method |
|---|---|---|---|---|---|
| $^{241}Am$ | 432.2 | α | 0.05 | 22 | α -Spectrometry |
| $^{238}Pu$ | 87.7 | α | 0.05 | 27 | α -Spectrometry |
| $^{239,240}Pu$[a] | $2.410 \times 10^4$ | α | 0.05 | 24 | α -Spectrometry |
| $^{228}Th$ | 1.913 | α | 0.05 | 1.7 | α -Spectrometry |
| $^{230}Th$ | $7.54 \times 10^4$ | α | 0.05 | 0.18 | α -Spectrometry |
| $^{232}Th$ | $1.40 \times 10^{10}$ | α | 0.05 | 0.77 | α -Spectrometry |
| $^{234}U$ | $2.46 \times 10^5$ | α | 0.05 | 13 | α -Spectrometry |
| $^{235}U$ | $7.04 \times 10^8$ | α | 0.05 | 10 | α -Spectrometry |
| $^{238}U$ | $4.47 \times 10^9$ | α | 0.05 | 67 | α -Spectrometry |
| Gamma spectroscopy analytes[b] | Varies[c] | γ | 0.2[d] | Varies[c] | γ -Spectroscopy |

a. The $^{239}Pu$ and $^{240}Pu$ isotopes cannot be distinguished by alpha spectrometry. The half-life of $^{239}Pu$ is given.

b. The gamma spectroscopy analyte list is given in the ER Project analytical services statement of work (LANL 1995, 49738) and in Appendix A of this addendum.

c. Gamma spectroscopy analytes detected in TA-48 soils are listed in Table 4.2.2-1.

d. The MDA for $^{241}Am$ and $^{137}Cs$ is 0.2 pCi/g; the value for other analytes will vary.

### 4.2.1 Determination of Detection Status

Reporting formats for radiochemical data vary from laboratory to laboratory. For data reported by the internal fixed-site laboratories, the uncertainties that are reported with the sample results are calculated using Poisson counting statistics and are based on both sample and background or blank counts. A longer count time results in a lower uncertainty. The reported analytical uncertainties take into account the chemical recovery of the tracer but do not reflect the variability arising from sample preparation or other sources of measurement error. The internal fixed-site laboratories do not report sample-specific MDA values. Therefore, the detection status of radiochemical results from the internal fixed-site laboratories was estimated from the reported uncertainty value. It was assumed that the reported uncertainty is the 1-sigma counting uncertainty, based on information contained in the Laboratory internal protocol document (LANL 1993, 31794). Following the recommendation given in Ryti et al. (1997, 56186), the MDA is estimated as three times the reported uncertainty value. Any result less than or equal to three times the uncertainty value is considered to be nondetected. Nondetected values are indicated by the U flag in the Chapter 5 data tables.

For data reported by the external fixed-site laboratories, the total propagated uncertainty (TPU), which includes all sources of variability arising from sample preparation and measurement error, is reported with the sample results. For data obtained before 1995, the 1-sigma TPU values are reported as the analytical uncertainty and can be used to estimate the detection status. Any result less than or equal to three times

the reported uncertainty value is considered to be nondetected. For data obtained after April 1995, sample-specific MDA values are reported and used to determine the detection status of the sample result. When the sample-specific MDA value is available, any result less than or equal to the MDA value is considered to be nondetected.

If the measured activity of a particular radionuclide is at or near background levels, the analytical results will exhibit a statistical distribution of both positive and negative numbers near zero activity. Negative values may result when the measured background value, usually determined by analysis of a blank sample, is subtracted from the measured value for the sample. Both the blank (background) value and the sample value have an associated uncertainty; therefore, a finite probability exists that a negative value may result when the background correction is performed. A negative value has no physical significance for an individual measurement but may be included in a larger data set to establish the distribution of values. The data set for TA-48 includes some negative activity values; however, in many cases negative values were simply reported as zero activity by the internal laboratories.

### 4.2.2 Gamma Spectroscopy Measurements

During the initial Phase I RFI sample collection effort, gamma spectroscopy measurements were performed at a mobile laboratory. A small percentage of the samples were also analyzed at a fixed-site laboratory. It was subsequently determined that the mobile laboratory gamma spectroscopy results are unusable to determine the nature of gamma-emitting radionuclide contamination (Pratt 1997, 55802). Additional samples were collected in 1997 and analyzed for gamma-emitting radionuclides at fixed-site laboratories to replace mobile laboratory data as necessary to fulfill the objectives of the Phase I RFI. No mobile laboratory data are presented in Chapter 5 of this addendum.

Gamma spectroscopy was performed at fixed-site laboratories for either a limited suite or a full suite of analytes, depending on the date of sample collection. Samples collected before 1995 were analyzed for the limited suite, and samples collected in 1995 or later were analyzed for the full suite of analytes. The limited suite consisted of the following five activation and fission products: $^{241}$Am, $^{144}$Ce, $^{60}$Co, $^{137}$Cs, and $^{106}$Ru. These five radionuclides were chosen to be representative of the activation and fission products that may be present as a result of the radiochemical processing that has been carried out at TA-48 since 1957. The full-suite analyte list, which is given in the ER Project analytical services statement of work (LANL 1995, 49738) and Appendix A of this addendum, includes the decay series of the naturally occurring radionuclides $^{235}$U, $^{238}$U, and $^{232}$Th as well as fission and activation products and their progeny. Measurements of naturally occurring radionuclides known to be present in Laboratory soils provide an indication of the quality of the gamma spectroscopy measurement. Note that $^{241}$Am and $^{235}$U emit both alpha and gamma radiation and can be detected by either emanation. Therefore, the data tables in Chapter 5 contain sample results for these two radionuclides measured by either alpha spectrometry or gamma spectroscopy.

The half-lives, emissions, and SAL values for radionuclides detected in TA-48 soil samples by gamma spectroscopy are listed in Table 4.2.2-1. Of the 19 radionuclides detected, 10 have half-lives less than 365 days and are not considered to be COPCs. Data for these short-lived radionuclides can be useful when evaluating values reported for a parent radionuclide because the relative activity concentration of parent and daughter isotopes is a known quantity. The shorter-lived radionuclides are usually included in the analyte list to verify the presence of longer-lived parent isotopes. The radionuclides $^{228}$Ac (6.13 hours), $^{212}$Pb (10.64 hours), and $^{208}$Tl (3.053 minutes) are in the decay series of the naturally occurring radionuclide $^{232}$Th. The radionuclides $^{211}$Bi (2.14 minutes) and $^{227}$Th (18.72 days) are in the decay series of the naturally occurring radionuclide $^{235}$U. The radionuclides $^{214}$Bi (19.9 minutes), $^{214}$Pb (26.8 minutes), and $^{234}$Th (24.10 days) are in the decay series of the naturally occurring radionuclide $^{238}$U. The radionuclide $^{233}$Pa (27.0 days)

is the short-lived progeny of the activation product $^{237}Np$. The fission product $^{144}Ce$ has a half-life of only 284.6 days. These short-lived radionuclides are not evaluated as primary radionuclides because they decay to unmeasurable concentrations within the span of several years or less.

**TABLE 4.2.2-1**

**RADIONUCLIDES IN TA-48 SOIL SAMPLES DETECTED BY GAMMA SPECTROSCOPY**

| Radionuclide | Half-Life* | Emissions | SAL (pCi/g) |
|---|---|---|---|
| **$^{232}Th$ decay series (Thorium series)** | | | |
| $^{228}Ac$ | 6.13 h | α,β,γ | N.A. |
| $^{212}Pb$ | 10.64 h | β,γ | N.A. |
| $^{208}Tl$ | 3.053 m | β,γ | N.A. |
| **$^{235}U$ decay series (Actinium series)** | | | |
| $^{211}Bi$ | 2.14 m | α,β,γ | N.A. |
| $^{227}Th$ | 18.72 d | α,γ | N.A. |
| $^{235}U$ | $7.04 \times 10^{8}$ y | α,γ | 10 |
| **$^{238}U$ decay series (Uranium series)** | | | |
| $^{214}Bi$ | 19.9 m | α,β,γ | N.A. |
| $^{214}Pb$ | 26.8 m | β,γ | N.A. |
| $^{234}Th$ | 24.10 d | β,γ | N.A. |
| **Activation products (and their decay products)** | | | |
| $^{241}Am$ | 432.7 y | α,γ | 22 |
| $^{60}Co$ | 5.271 y | β,γ | 1.1 |
| $^{22}Na$ | 2.605 y | β,γ | 1.3 |
| $^{233}Pa$ | 27.0 d | β,γ | N.A. |
| **Fission products** | | | |
| $^{144}Ce$ | 284.6 d | β,γ | 56 |
| $^{134}Cs$ | 2.065 y | β,γ | 1.9 |
| $^{137}Cs$ | 30.17 y | β,γ | 5.1 |
| $^{152}Eu$ | 13.48 y | β,γ | 2.6 |
| $^{106}Ru$ | 372.6 d | β | 13 |
| **Other** | | | |
| $^{40}K$ | $1.25 \times 10^{9}$ y | β,γ | 12 |

*m = minutes, h = hours, d = days, y = years

The naturally occurring radionuclide $^{40}K$ is present in Laboratory soils at concentrations ranging from 25 to 40 pCi/g and is always present in the gamma spectra of Laboratory soil samples. The $^{40}K$ gamma emission peak provides a qualitative indicator of the accuracy of the gamma spectroscopy measurement, but $^{40}K$ is not considered to be a potential contaminant at TA-48. The $^{40}K$ results for laboratory duplicate samples were also used to calculate the precision of the gamma spectroscopy measurement.

The gamma spectroscopy results were rejected for one sample collected at PRS No. 48-007(c), Sample ID No. 0448-97-0078. Because of sample loss during handling and preparation, the analytical laboratory analyzed an insufficient aliquot size to obtain a reliable measurement. The sample results for naturally

occurring radionuclides were anomalous and biased very high. Supplemental samples were collected to replace the rejected sample data.

### 4.2.3 Results of QC Activities

The accuracy of the radiochemical measurements was monitored for each analytical batch by the analysis of single-blind PE samples (submitted by the ER Project Sample Management Office for samples collected before 1995) or LCSs traceable to the National Institute of Standards and Technology (supplied by the analytical laboratory). The average recoveries of radiochemical analytes from the PE samples and LCSs, which are summarized in Table 4.2.3-1, indicate acceptable analytical bias for both the alpha spectrometry and gamma spectroscopy techniques. For individual samples, if the recovery from the LCS or PE sample was not within 20% of the true value, the associated sample results were qualified as estimated (J flag). For sample results included in this addendum, recoveries from both the PE samples and LCSs were all within 20% of the true value.

**TABLE 4.2.3-1**

**PERCENT RECOVERY FROM LABORATORY CONTROL SAMPLES AND PERFORMANCE EVALUATION SAMPLES FOR TA-48 RADIOCHEMICAL ANALYSES**

| Analyte | Number of Analyses | Percent Recovery | |
|---|---|---|---|
| | | Range | Average |
| **Alpha spectrometry** | | | |
| $^{241}$Am | 6 | 84–125 | 96 ± 15 |
| $^{238}$Pu | 12 | 82–110 | 100 ± 8 |
| $^{239,240}$Pu | 14 | 89–111 | 104 ± 6 |
| $^{228}$Th | 11 | 71–108 | 86 ± 13 |
| $^{230}$Th | 20 | 74–158 | 104 ± 20 |
| $^{232}$Th | 18 | 68–130 | 99 ± 17 |
| $^{234}$U | 19 | 63–134 | 97 ± 16 |
| $^{235}$U | 17 | 46–157 | 95 ± 36 |
| $^{238}$U | 21 | 43–142 | 97 ± 20 |
| **Gamma spectroscopy** | | | |
| $^{241}$Am | 6 | 91–103 | 100 ± 5 |
| $^{57}$Co | 6 | 94–104 | 100 ± 4 |
| $^{60}$Co | 6 | 97–102 | 100 ± 2 |
| $^{137}$Cs | 15 | 61–119 | 98 ± 15 |

The precision of the measurements was monitored by the analysis of laboratory duplicate samples. The Environmental Protection Agency (EPA) guidelines for inorganic data review (EPA 1994, 48639) were applied to the evaluation of the radiochemical duplicate samples. The EPA guidelines suggest a control criteria of ±35% relative percent difference (RPD) for the assessment of duplicate sample results because laboratory variability arising from the subsampling of heterogeneous soil samples is a common occurrence. Table 4.2.3-2 summarized the duplicate sample results for the TA-48 radiochemical data set. (RPD values were not calculated if a radionuclide was detected in either the regular or the duplicate sample.) The average RPD values for alpha spectrometry analytes and $^{40}$K measurement by gamma spectroscopy indicate acceptable precision for the radiochemical methods employed. If the RPD between the regular

and duplicate sample results exceeded 35%, the sample results were qualified as estimated (J flag). For sample results included in this addendum, RPD values for duplicate sample analyses were all in within acceptance criteria.

**TABLE 4.2.3-2**

**RELATIVE PERCENT DIFFERENCES FOR TA-48 DUPLICATE SAMPLE ANALYSES**

| Analyte | Number of Analyses | Relative Percent Difference | |
|---|---|---|---|
| | | Range | Average |
| **Alpha spectrometry** | | | |
| $^{238}Pu$ | 4 | 0–33 | 15 ± 14 |
| $^{239,240}Pu$ | 1 | N/A | 4 |
| $^{228}Th$ | 13 | 1–52 | 21 ± 18 |
| $^{230}Th$ | 14 | 1–107 | 24 ± 30 |
| $^{232}Th$ | 14 | 1–77 | 18 ± 22 |
| $^{234}U$ | 16 | 1–45 | 17 ± 15 |
| $^{235}U$ | 1 | N/A | 3 |
| $^{238}U$ | 16 | 1–78 | 17 ± 22 |
| **Gamma spectroscopy** | | | |
| $^{40}K$ | 9 | 1–49 | 10 ± 15 |

The accuracy of the alpha spectrometry measurements was monitored by the addition of tracer isotopes during the sample preparation steps. The reported sample results are corrected for the chemical yield of the tracer isotope to account for matrix effects and losses during sample preparation. Sample results were qualified as estimated and biased low (J- flag) if the tracer recovery was less than 30% because a very low tracer recovery may indicate an unusual occurrence during analysis. If the tracer recovery was less than 10%, the sample results were rejected (R flag). For two samples at PRS No. 48-007(b) (Sample ID Nos. AAA3517 and AAA3519) the thorium tracer recovery was less than 30% but greater than 10%. For one sample at PRS No. 48-007(c), the plutonium tracer recovery was less than 30% but greater than 10%. Therefore, the isotopic thorium or plutonium results for these samples should be regarded as estimates and potentially biased low (J- flag). Results for samples with low tracer recovery are usable for screening assessments of site data because the reported results reflect the chemical yield of the tracer, as required by the alpha spectrometry protocols.

The analytical protocols for measuring alpha-emitting radionuclides require that a method blank be prepared and analyzed concurrently with each analytical batch. Blank contamination should not exceed the MDA value. In keeping with guidance given in *Risk Assessment Guidance for Superfund, Volume I* (EPA 1989, 8021), the sample results were qualified as estimated and biased high (J+ flag) if blank contamination was present. For four samples at PRS No. 48-002(e) (Sample ID Nos. AAA3545, AAA3546, AAA3547, and AAA3782) the isotopic thorium method blank was contaminated due to tailing of the tracer peak into the peak regions of interest. Therefore, the isotopic thorium results for these four samples should be regarded as estimates and potentially biased high (J+ flag).

## 4.3 Organic Analyses

Results for organic analyses are not presented in this addendum. A discussion of QC activities for organic analyses of TA-48 samples can be found in the RFI report (LANL 1995, 50295).

## 5.0 SPECIFIC RESULTS, CONCLUSIONS, AND RECOMMENDATIONS

Although this document is an addendum to the *RFI Report For Potential Release Sites 48-001, 48-002(e) 48-003 48-005 48-007(a) 48-007(b) 48-007(c) 48-007(d) 48-007(f) 48-010* (LANL 1995, 50295) (hereafter referred to as "the RFI report"), Chapter 5 is included in its entirety following the guidance in the *Resource Conservation and Recovery Act Facility (RFI) Report Framework Policy* (LANL 1996, 56386). The RFI report (LANL 1995, 50295) followed previous guidance; however, to ensure compliance with current policy all applicable sections have been included in this addendum. The RFI report (LANL 1995, 50295) presents results (in Chapter 4) in potential release site (PRS) aggregates following the structure of the *RFI Work Plan for Operable Unit 1129* (LANL 1992, 7666) (hereafter referred to as "the work plan"). This addendum presents PRSs individually.

### 5.1 PRS No. 48-002(e)

PRS No. 48-002(e) was a small container storage area located on the east side of building TA-48-1.

No radionuclide chemicals of potential concern (COPCs) were identified during the human health risk-based screening assessment. PRS No. 48-002(e) is recommended for no further action (NFA) based on NFA Criterion 5 (LANL 1996, 54943).

#### 5.1.1 History

PRS No. 48-002(e) is discussed in detail in Section 3.5 of the *RFI Work Plan for Operable Unit 1129* (LANL 1992, 7666) (hereafter "the work plan") and in Section 7.28 of the June 1994 addendum to the work plan (Pratt 1994, 43475). Results of the Phase I investigation are presented in the RFI report (LANL 1995, 50295).

The area was listed in the 1988 Laboratory active container storage database. For many years the area was used to store solvents such as cutting oil; however, all containers and other material were removed from the area in 1989 or 1990. Since June 1992 the area has been used to store a liquid nitrogen tank and several compressed-gas cylinders.

The potential contaminants evaluated during the activities described in this addendum included alpha- and gamma-emitting radionuclides.

#### 5.1.2 Description

Nearly all of PRS No. 48-002(e) is covered with asphalt paving. There is a small area of exposed soil, and a small concrete pad (3 ft by 6 ft) is located to the east. The PRS is located east of building TA-48-1 and north of building TA-48-17. A stain, which appears to consist of cutting oil, was located 4 to 7 ft east of the concrete pad. Location ID No. 48-2037 was sampled in an area of exposed soil approximately halfway between the concrete pad and the visible oil stain. During the drilling of the hand-auger hole, careful markouts were needed because of safety concerns associated with nearby buried utility lines. A surface soil sample was collected at Location ID No. 48-2057 (the original sampling location) adjacent to the concrete pad where surface runoff sediment had collected.

#### 5.1.3 Previous Investigations

Phase I of the Resource Conservation and Recovery Act (RCRA) facility investigation (RFI) site characterization at PRS No. 48-002(e) was performed in July 1993. The results were presented in the RFI

report (LANL 1995, 50295), which was submitted to the Environmental Protection Agency (EPA) in September 1995. PRS No. 48-002(e) was recommended for NFA in the RFI report (LANL 1995, 50295). In January 1997 the *Sampling and Analysis Plan for TA-48* (LANL 1997, 55326) (hereafter referred to as "the SAP") was prepared and submitted to the Department of Energy (DOE); a copy was sent to the New Mexico Environment Department (NMED) for informational purposes. The SAP described sampling activities proposed to satisfy the requirements of a regulator notice of deficiency (NOD) for the RFI report (LANL 1996, 54448) and an NMED request for additional information about the RFI report (LANL 1996, 55064). During March and June 1997 sampling activities were performed in accordance with the SAP.

### 5.1.4 Field Investigation

The objective of the investigation, as described in the SAP (LANL 1997, 55326), was to determine the presence or absence of gamma-emitting radionuclides above background levels and, if present, whether they represent a potential threat to human health or the environment.

The general conceptual model of contaminant transport at TA-48 is described in Section 4.3 of the work plan (LANL 1992, 7666). If releases occurred at PRS No. 48-002(e), most have been isolated from the environment by the asphalt at the site. A small area of ground is exposed, which provides a localized potential pathway for vertical migration of contaminants. The sampling design assumes that soil at PRS No. 48-002(e) has not been replaced with clean fill material since the area was used for solvent and oil storage. If soil has been removed, residual contamination associated with past releases could remain in tuff even if contamination is absent in the soil.

Field screening during sample collection activities was performed using a Ludlum Model 139 alpha meter and an Eberline ESP-1 beta/gamma meter. Background radiation measurements taken at TA-48 using this instrumentation range from 200 to 500 counts per minute (cpm) beta/gamma radiation depending on the location and substrate rock type. Field screening measurements greater than 500 cpm beta/gamma radiation are generally considered to be above background levels. No beta/gamma radiation measurements above background levels were obtained during field screening at this site, and no alpha radiation was detected.

#### 5.1.4.1 Environmental and Engineering Surveys

A health and safety (H&S) radiation survey was performed on February 4, 1997. Beta/gamma measurements ranged from 180 to 202 cpm, which are within background levels.

On February 4, 1997, an engineering survey was also performed to stake sample locations. Based on the SAP (LANL 1997, 55326), Location ID No. 48-2135 was staked approximately 2 ft southwest of existing Location ID No. 48-2037 within the exposed soil area.

#### 5.1.4.2 Deviations from the Sampling and Analysis Plan

There were no deviations; samples were collected in accordance with the SAP (LANL 1997, 55326).

#### 5.1.4.3 Sampling Activities

Sampling was performed on February 21, 1997. Three soil samples were collected (not including field duplicates) from one hand-auger hole drilled to a depth of 3.3 ft. The sample collection intervals are shown in Table 5.1.4-1. Beta/gamma radiation measurements obtained during field screening of the samples ranged from 150 to 200 cpm, which are within background levels.

**TABLE 5.1.4-1**

**SUMMARY OF SAMPLES TAKEN AT PRS No. 48-002(e)[a]**

Part 1

| PRS | Location ID | Sample ID | Depth (ft) | Media | VOCs Fixed Lab | SVOCs Fixed Lab | PCBs Fixed Lab | XRF Mobile Lab | Inorganic Fixed Lab |
|---|---|---|---|---|---|---|---|---|---|
| 48-002(e) | 48-2037 | AAA3545 | 0–0.5 | Soil | 15292 | 15292 | 15292 | 15331 | NR |
| 48-002(e) | 48-2037 | AAA4431 | 0–0.5 (dup)[b] | Soil | 15292 | NR | NR | NR | NR |
| 48-002(e) | 48-2037 | AAA3546 | 0.5–1.5 | Soil | 15292 | 15292 | 15292 | 15331 | NR |
| 48-002(e) | 48-2037 | AAA4434 | 0.5–1.5 (dup)[b] | Soil | NR | 15292 | 15292 | NR | NR |
| 48-002(e) | 48-2037 | AAA3547 | 1.5–3 | Soil | 15292 | 15292 | 15292 | 15331 | 15332 |
| 48-002(e) | 48-2037 | AAA4433 | 1.5–3 (dup)[b] | Soil | 15292 | NR | NR | NR | NR |
| 48-002(e) | 48-2037 | AAA4432 | 1.5–3 (dup)[b] | Soil | NR | 15292 | NR | NR | NR |
| 48-002(e) | 48-2057 | AAA3782 | 0–0.5 | Soil | 15292 | 15292 | 15292 | 15331 | NR |
| 48-002(e) | 48-2135 | 0448-97-0032 | 0–1 | Soil | NR | NR | NR | NR | NR |
| 48-002(e) | 48-2135 | 0448-97-0033 | 1–2 | Soil | NR | NR | NR | NR | NR |
| 48-002(e) | 48-2135 | 0448-97-0034 | 2–3.3 | Soil | NR | NR | NR | NR | NR |
| 48-002(e) | 48-2135 | 0448-97-0035 | 2–3.3 (dup)[b] | Soil | NR | NR | NR | NR | NR |

Part 2

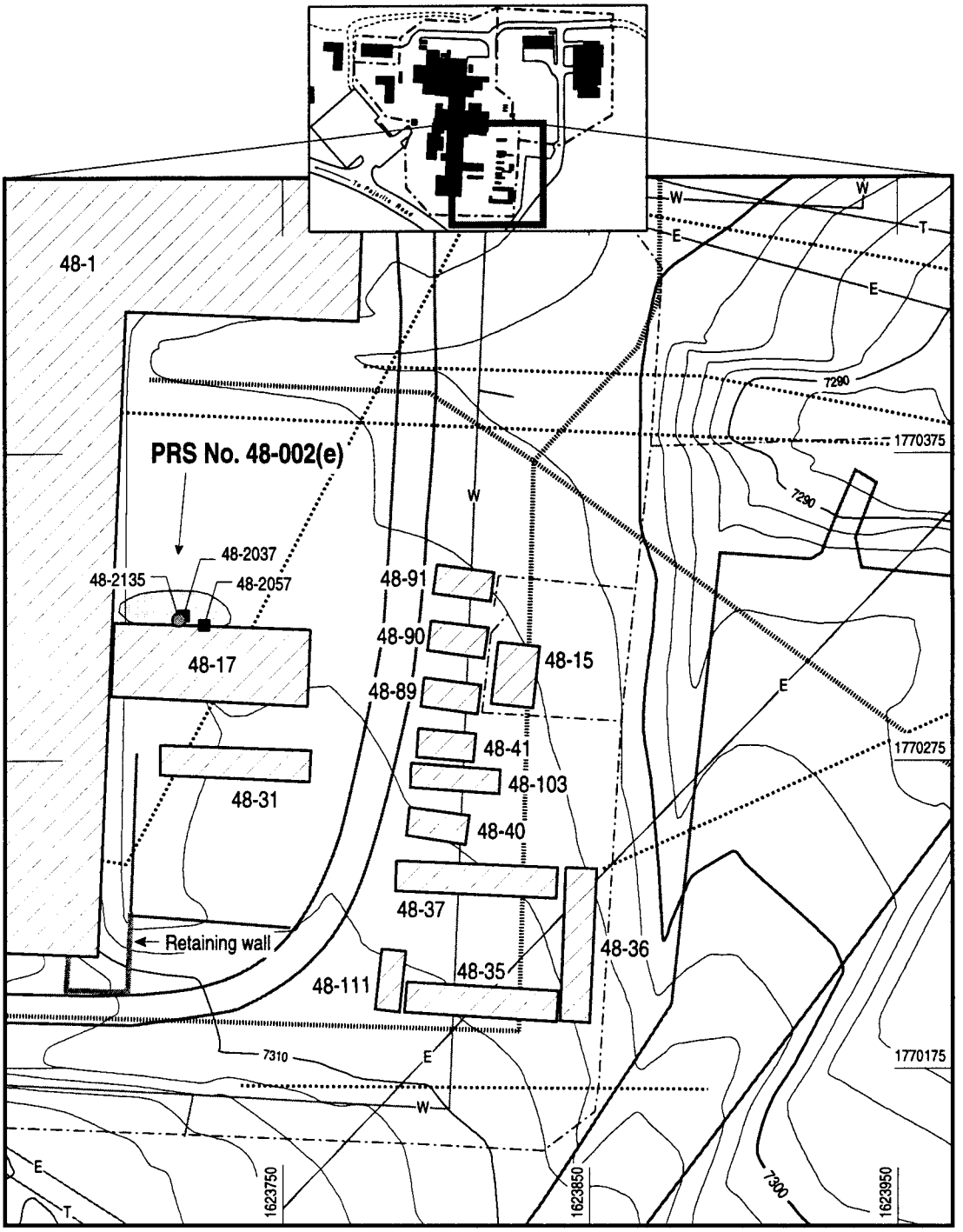
| PRS | Location ID | Sample ID | Depth (ft) | Media | Gamma Spec Fixed Lab | Am-241 | Iso-Pu | Iso-Th |
|---|---|---|---|---|---|---|---|---|
| 48-002(e) | 48-2037 | AAA3545 | 0–0.5 | Soil | 15333 | 15333 | 15333 | 15333 |
| 48-002(e) | 48-2037 | AAA4431 | 0–0.5 (dup)[b] | Soil | NR | NR | NR | NR |
| 48-002(e) | 48-2037 | AAA3546 | 0.5–1.5 | Soil | NR | 15333 | 15333 | 15333 |
| 48-002(e) | 48-2037 | AAA4434 | 0.5–1.5 (dup)[b] | Soil | NR | NR | NR | NR |
| 48-002(e) | 48-2037 | AAA3547 | 1.5–3 | Soil | NR | 15333 | 15333 | 15333 |
| 48-002(e) | 48-2037 | AAA4433 | 1.5–3 (dup)[b] | Soil | NR | NR | NR | NR |
| 48-002(e) | 48-2037 | AAA4432 | 1.5–3 (dup)[b] | Soil | NR | NR | NR | NR |
| 48-002(e) | 48-2057 | AAA3782 | 0–0.5 | Soil | NR | 15333 | 15333 | 15333 |
| 48-002(e) | 48-2135 | 0448-97-0032 | 0–1 | Soil | 2920 | NR | NR | NR |
| 48-002(e) | 48-2135 | 0448-97-0033 | 1–2 | Soil | 2920 | NR | NR | NR |
| 48-002(e) | 48-2135 | 0448-97-0034 | 2–3.3 | Soil | 2920 | NR | NR | NR |
| 48-002(e) | 48-2135 | 0448-97-0035 | 2–3.3 (dup)[b] | Soil | 2920 | NR | NR | NR |

a. The numbers in the analytical suite columns are analytical request numbers.
b. Field duplicate

Table 5.1.4-1 summarizes all sampling for PRS No. 48-002(e); Figure 5.1.4-1 shows the sample location.

### 5.1.5 Evaluation of Inorganic Chemicals

Inorganic chemicals were not analyzed for during this RFI sampling event. The results of inorganic chemical analyses for PRS No. 48-002(e) are presented in the RFI report (LANL 1995, 50295).

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F5.1.4-1 / TA-48 RFI RPT(97) / 090997

0 10 20 30 40 50

FEET

Coordinates are NMSP NAD-83
Contour interval = 2 ft

| | |
|---|---|
| Building or structure | Radioactive waste line |
| Sample collected before 1997 | —E— Power line |
| 1997 sample location | —G— Gas line |
| Fence | —T— Telephone line |
| Approx. location of PRS | —W— Water line |
| Paved area | Sewer or waste line/storm drain |

**Figure 5.1.4-1. Locations of PRS No. 48-002(e) samples.**

### 5.1.6 Evaluation of Radionuclides

Background comparisons were performed for radionuclides for which upper tolerance limit (UTL) values are available, as discussed in Section 3.2 in Chapter 3 of this addendum. A total of eight soil samples collected at three locations were analyzed for certain radionuclides using gamma spectroscopy and/or alpha spectrometry methods. Five soil samples from two locations, including one field duplicate, were analyzed by gamma spectroscopy in a fixed-site laboratory for an analyte suite that included $^{241}$Am, $^{60}$Co, $^{137}$Cs, $^{152}$Eu, $^{40}$K, $^{22}$Na, and $^{106}$Ru; the sample from Location ID No. 48-2037 was not analyzed for $^{152}$Eu, $^{40}$K, and $^{22}$Na. Four soil samples from two locations were analyzed by alpha spectrometry in a fixed-site laboratory for an analyte suite that included $^{241}$Am, $^{238}$Pu, $^{239,240}$Pu, $^{228}$Th, $^{230}$Th, $^{232}$Th, $^{234}$U, $^{235}$U, and $^{238}$U. Surface samples were collected in vertical intervals of 0.5 or 1.0 ft, and samples from the hand-auger holes were collected in 1-ft or 1.3-ft vertical intervals.

The highest detected value for each analyte was used for the background comparison. The sediment UTL values were used for background comparison of naturally occurring radionuclides ($^{228}$Th, $^{230}$Th, $^{232}$Th, $^{234}$U, $^{235}$U, and $^{238}$U) in soil (Ryti et al. 1997, 56186). For $^{228}$Th and $^{230}$Th in tuff, no UTL values are available. Because $^{228}$Th and $^{230}$Th are progeny of radionuclides with significantly longer half-lives ($^{232}$Th and $^{234}$U, respectively), the UTL values for these parent radionuclides are used as surrogates based on an assumption of secular equilibrium.

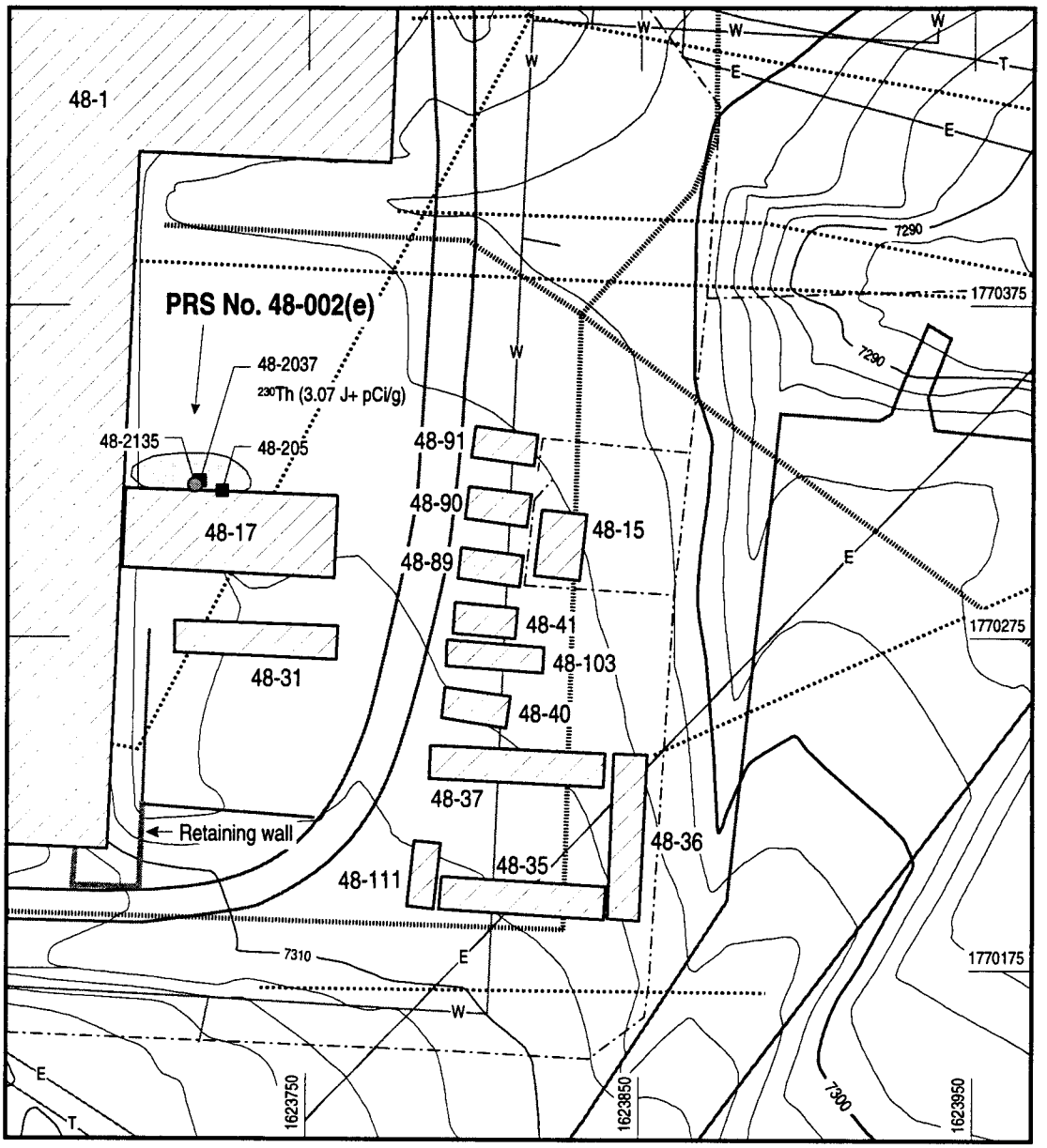
The surface UTL values for fallout radionuclides ($^{241}$Am, $^{137}$Cs, $^{238}$Pu, $^{239,240}$Pu, $^{90}$Sr, and tritium) were used for soil samples collected in the 0 to 0.5-ft intervals. Fallout radionuclide concentrations in deeper sample intervals were not compared with the surface UTL values because fallout activity is limited to surface soils. However, any fallout radionuclide detected at depths below 0.5 ft is considered to be present above background level. In Table 5.1.6-1, the value in the shaded box indicates radionuclide soil concentration greater than or equal to the UTL value. The concentration above the UTL value is shown in Figure 5.1.6-1.

**TABLE 5.1.6-1**

**RADIONUCLIDES WITH CONCENTRATIONS AT OR ABOVE BACKGROUND SCREENING VALUES FOR PRS No. 48-002(e)[a]**

| Location ID | Sample ID | Depth (ft) | Media | Th-230 (pCi/g) |
|---|---|---|---|---|
| Soil SAL | N/A | N/A | N/A | 0.18 |
| Sediment UTL | N/A | N/A | N/A | 2.29 |
| 48-2037 | AAA3545 | 0–0.5 | Soil | 1.72 J+ |
| 48-2037 | AAA3546 | 0.5–1.5 | Soil | 1.75 J+ |
| 48-2037 | AAA3547 | 1.5–3 | Soil | 3.07 J+ |
| 48-2057 | AAA3782 | 0–0.5 | Soil | 1.8 J+ |
| 48-2135 | 0448-97-0032 | 0–1 | Soil | NA |
| 48-2135 | 0448-97-0033 | 1–2 | Soil | NA |
| 48-2135 | 0448-97-0034 | 2–3.3 | Soil | NA |
| 48-2135 | 0448-97-0035 | 2–3.3 (dup)[b] | Soil | NA |

a Qualifiers used in table are defined in Section 3.1.2.
b. Field duplicate

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0 10 20 30 40 50
FEET
Coordinates are NMSP NAD-83
Contour interval = 2 ft

| | |
|---|---|
| Building or structure | Radioactive waste line |
| Sample collected before 1997 | —E— Power line |
| 1997 sample location | —G— Gas line |
| Fence | —T— Telephone line |
| Approx. location of PRS | —W— Water line |
| Paved area | Sewer or waste line/storm drain |

**Figure 5.1.6-1. Locations of analytes that exceed background UTLs at PRS No. 48-002(e).**

The isotopic thorium results for four samples from Location ID Nos. 48-2037 and 48-2057 have been qualified as estimated and biased high (J+ flag) because of contamination in the method blank. These data are usable for the screening assessment because the thorium isotope concentrations may be overestimated; therefore, a false negative result is not likely.

Detected radionuclides with one or more measured soil concentrations equal to or exceeding UTL values, or present above background levels, are summarized in the following list.

- The radionuclide $^{230}$Th was detected above its sediment UTL value of 2.29 pCi/g in one sample at a concentration of 3.07(J+) pCi/g.

### 5.1.7 Evaluation of Organic Chemicals

Organic chemicals were not analyzed for during this RFI sampling event. The results of organic chemical analyses for PRS No. 48-002(e) are presented in the RFI report (LANL 1995, 50295).

### 5.1.8 Risk-Based Screening Assessment

The only radionuclide detected above its screening action level (SAL) at PRS No. 48-002(e) was $^{230}$Th, which exceeded its sediment UTL value in one sample. The estimated value of 3.07 pCi/g for this sample is also higher than the $^{230}$Th SAL of 0.18 pCi/g. However, $^{230}$Th was not identified as a COPC for the following reasons.

- PRS No. 48-002(e) is associated with a small container storage area that was used before 1989 or 1990 to store solvents and oils and subsequently to store compressed gases. The area is not known to have been used for storing or processing radioactive materials, which is substantiated by the fact that few other radionuclides were identified in site samples. Those few radionuclides were measured at very low concentrations. Furthermore, the highest observed value of $^{230}$Th, and the only one that exceeded its sediment UTL value, was in the deepest sampling interval of the hand-auger hole, which is inconsistent with a surface release that would be associated with a container storage area.

- The radionuclide $^{230}$Th and thorium isotopes in general are not known to have been used at TA-48. A statistical assessment (Attachment 1) supports a statement based on process knowledge that $^{230}$Th contamination is not expected to be present at TA-48. Although the range of the $^{230}$Th distribution at TA-48 is greater than the range of the sediment background data set, the quartiles of the TA-48 data set are less then the quartiles of the sediment background data set. TA-48-wide $^{230}$Th concentrations were statistically compared with the Laboratory sediment background data set and found to be consistent (see Attachment 1). Because only four $^{230}$Th observations from two locations are available for PRS No. 48-002(e), a statistical comparison of site-specific and Laboratory background could not be performed.

- Because of $^{230}$Th contamination observed in the analytical laboratory blank sample, the $^{230}$Th values are qualified as estimates and biased high (J+ flag). A laboratory duplicate analysis performed on the sample with a reported concentration of 3.07 pCi/g returned a $^{230}$Th value of only 2.0 pCi/g, which is less than the sediment UTL value.

- The measured values of both $^{234}$U and $^{238}$U were higher in the sample with the $^{230}$Th value of 3.07 pCi/g than in the remaining three samples that were analyzed by alpha spectrometry. This suggests that natural variability has contributed to the relatively high measured values of $^{230}$Th (3.07 and 2.0 pCi/g) because $^{234}$U and $^{238}$U are parents of $^{230}$Th, and many millennia are required to achieve equilibrium among these radionuclides.

Therefore, it is concluded that a combination of analytical uncertainty and natural heterogeneity are the likely causes of the generally high concentrations of the $^{238}U$ decay chain radionuclides observed in Sample ID No. AAA3547 and in particular the value of $^{230}Th$ reported above its sediment UTL value. Because there is ample reason to conclude that an anthropogenic release of $^{230}Th$ has not occurred at this PRS, $^{230}Th$ was not identified as a COPC during this screening assessment.

### 5.1.9 Human Health Risk Assessment

No human health risk assessment was performed for PRS No. 48-002(e). The radionuclide $^{230}Th$ was measured at an estimated concentration of 3.07 pCi/g in one sample, which is 35% higher than the UTL value of 2.29 pCi/g. Although this value exceeds the $^{230}Th$ SAL of 0.18 pCi/g, it was not identified as a COPC at PRS No. 48-002(e) for reasons provided in Section 5.1.8.

### 5.1.10 Preliminary Ecological Assessment

In cooperation with the NMED and EPA Region 6, the Laboratory Environmental Restoration (ER) Project is developing an approach for ecological risk assessment. Further ecological risk assessment at this site 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 objective of the Phase I RFI at PRS No. 48-002(e) was to determine the presence or absence of contamination associated with a container storage area. The Phase I RFI results for inorganic and organic chemicals are presented in the RFI report (LANL 1995, 50295). As described in the *Response to the Notice of Deficiency (NOD) for Technical Area (TA) 48 Resource Conservation and Recovery Act Facility Investigation (RFI) Report* (LANL 1996, 54448) (hereafter "the NOD response"), additional gamma spectroscopy data were required to evaluate the presence or absence of radionuclides at several PRSs at TA-48, including PRS No. 48-002(e).

The sampling design for characterizing potential radionuclide contamination at this PRS was based on professional judgment. Sample locations were chosen to maximize the likelihood of observing residual contamination with only a few samples. The area near PRS No. 48-002(e) is covered extensively with asphalt, which was assumed to have isolated underlying soil from contamination associated with surface spills. Samples were collected from a small area of exposed soil that remains at the approximate location of the PRS. Because any contamination was assumed to have resulted from surface releases, samples were not collected below the 3-ft depth.

No radionuclide COPCs were identified during the human health risk-based screening assessment. Radionuclide contamination at this site is not likely to result in unacceptable dose rates now or in the future. Additional sampling or further assessment activities for evaluating contamination at this PRS is not proposed. PRS No. 48-002(e) is proposed for NFA based on NFA Criterion 5 (LANL 1996, 54943). A Class III permit modification will be requested to remove this site from the Hazardous and Solid Waste Amendments (HSWA) Module of the Laboratory's RCRA operating permit.

## 5.2 PRS No. 48-007(b)

PRS No. 48-007(b) is an outfall that discharges up to 4300 gal. of noncontact cooling water per day from a magnet and a laser housed in building TA-48-1 into Mortandad Canyon (Santa Fe Engineering 1994,

56204). The outfall was "grandfathered" into the National Pollutant Discharge Elimination System (NPDES) permit (LANL 1985, 853) with Permit No. EPA 04A 016.

No radionuclide COPCs were identified during the human health risk-based screening assessment. PRS No. 48-007(b) is recommended for NFA based on NFA Criterion 5 (LANL 1996, 54943).

### 5.2.1 History

PRS No. 48-007(b) is discussed in detail in Section 3.5 of the work plan (LANL 1992, 7666) and in Section 7.29 of the June 1994 addendum to the work plan (Pratt 1994, 43475). Results of the Phase I investigation are presented in the RFI report (LANL 1995, 50295).

Information that became available after the work plan was written includes the wastewater stream characterization for TA-48, which was conducted in 1993 by Santa Fe Engineering (Santa Fe Engineering 1994, 56204). This study was conducted to identify building drain pipes and characterize the wastewater flows and sources that existed in 1993. Drain pipes were verified by dye tracing. Site visits were performed to verify drain schematics and identify potential outfall pipes that exit the buildings. PRS No. 48-007(b) is identified as outfall 48-1-OPN-2. The report (Santa Fe Engineering 1994, 56204) states that the sources of flow to this outfall are noncontact cooling water from a magnet and a laser in Room 4 of building TA-48-1. The report indicates that the flow rate is 6.5 gal. per min., 7 days per week and that during the dye test, the dye reached the expected destination.

The potential contaminants evaluated during the activities described in this addendum included alpha- and gamma-emitting radionuclides.

### 5.2.2 Description

The point of discharge for the outfall that comprises this PRS is on the mesa edge. The drainage channel originating from the discharge point is on a steep section of the slope into Mortandad Canyon. The canyon slope is north facing and heavily vegetated; the vegetation appears normal and healthy.

### 5.2.3 Previous Investigations

Phase I of the RFI site characterization at PRS No. 48-007(b) was performed in July 1993. The results were presented in the RFI report (LANL 1995, 50295), which was submitted to the EPA in September 1995. PRS No. 48-007(b) was recommended for NFA (for the RCRA component) in the RFI report. In January 1997 a SAP (LANL 1997, 55326) was prepared and submitted to DOE; a copy was sent to NMED for informational purposes. The SAP describes sampling activities proposed to satisfy the requirements of an NMED NOD for the RFI report (LANL 1996, 54448) and an NMED request for additional information about the RFI report (LANL 1996, 55064). In March 1997 sampling activities were performed in accordance with the SAP.

### 5.2.4 Field Investigation

The objective of the investigation was to determine the presence or absence of radionuclides above background levels in soils and sediments within the drainage channel below the outfall and to fulfill the Phase I RFI data objectives as described in the SAP (LANL 1997, 55326).

The general conceptual model of contaminant transport at TA-48 is described in Section 4.3 of the work plan (LANL 1992, 7666). Outfall discharge provides a mechanism for infiltration of contaminants into the

vadose zone and transport of contaminants with surface water in either a dissolved state or adhering to eroded soil.

Field screening during sample collection activities was performed using a Ludlum Model 139 alpha meter and an Eberline ESP-1 beta/gamma meter. Background radiation measurements taken at TA-48 using this instrumentation range from 200 to 500 cpm beta/gamma radiation depending on the location and substrate rock type. Field screening measurements greater than 500 cpm beta/gamma radiation are generally considered to be above background levels. No beta/gamma radiation measurements above background levels were obtained during field screening at this site, and no alpha radiation was detected.

#### 5.2.4.1 Environmental and Engineering Surveys

An H&S radiation survey was performed before field activities began in 1993, as described in the RFI report (LANL 1995, 50295). No radioactivity was detected above background levels; therefore, no additional radiation surveys were performed.

On February 4, 1997, an engineering survey was performed to stake sample locations. Based on the SAP (LANL 1997, 55326), two hand-auger holes were located in sediment accumulation areas within the drainage channel below the outfall.

#### 5.2.4.2 Deviations from the Sampling and Analysis Plan

There were no deviations; samples were collected in accordance with the SAP (LANL 1997, 55326).

#### 5.2.4.3 Sampling Activities

Sampling was performed on March 11 and March 24, 1997. Four soil samples (not including field duplicates) were collected from two locations (Location ID Nos. 48-2167 and 48-2168). Hand-auger holes were drilled to the soil/tuff interface. Two hand-auger holes were drilled to a depth of 2 ft to the soil/tuff interface, and two samples were collected from each hole. The sample collection intervals are shown in Table 5.2.4-1. Beta/gamma radiation measurements obtained during field screening of the samples ranged from 150 to 250 cpm, which are within background levels.

Table 5.2.4-1 summarizes all sampling for PRS No. 48-007(b); Figure 5.2.4-1 shows the sample locations.

### 5.2.5 Evaluation of Inorganic Chemicals

Inorganic chemicals were not analyzed for during this RFI sampling event. The results of inorganic chemical analyses for PRS No. 48-007(b) are presented in the RFI report (LANL 1995, 50295).

### 5.2.6 Evaluation of Radionuclides

Background comparisons were performed for radionuclides for which UTL values are available, as discussed in Section 3.2 in Chapter 3 of this addendum. Four soil samples collected from two locations were analyzed by alpha spectrometry at a fixed-site laboratory for an analyte suite that included $^{238}$Pu, $^{239,240}$Pu, $^{228}$Th, $^{230}$Th, $^{232}$Th, $^{234}$U, $^{235}$U, and $^{238}$U. Four soil samples from two locations were analyzed by gamma spectroscopy at a fixed-site laboratory for an analyte suite that included gamma-emitting fission and activation products as well as naturally occurring radionuclides.

## TABLE 5.2.4-1

### SUMMARY OF SAMPLES TAKEN AT PRS No. 48-007(b)[a]

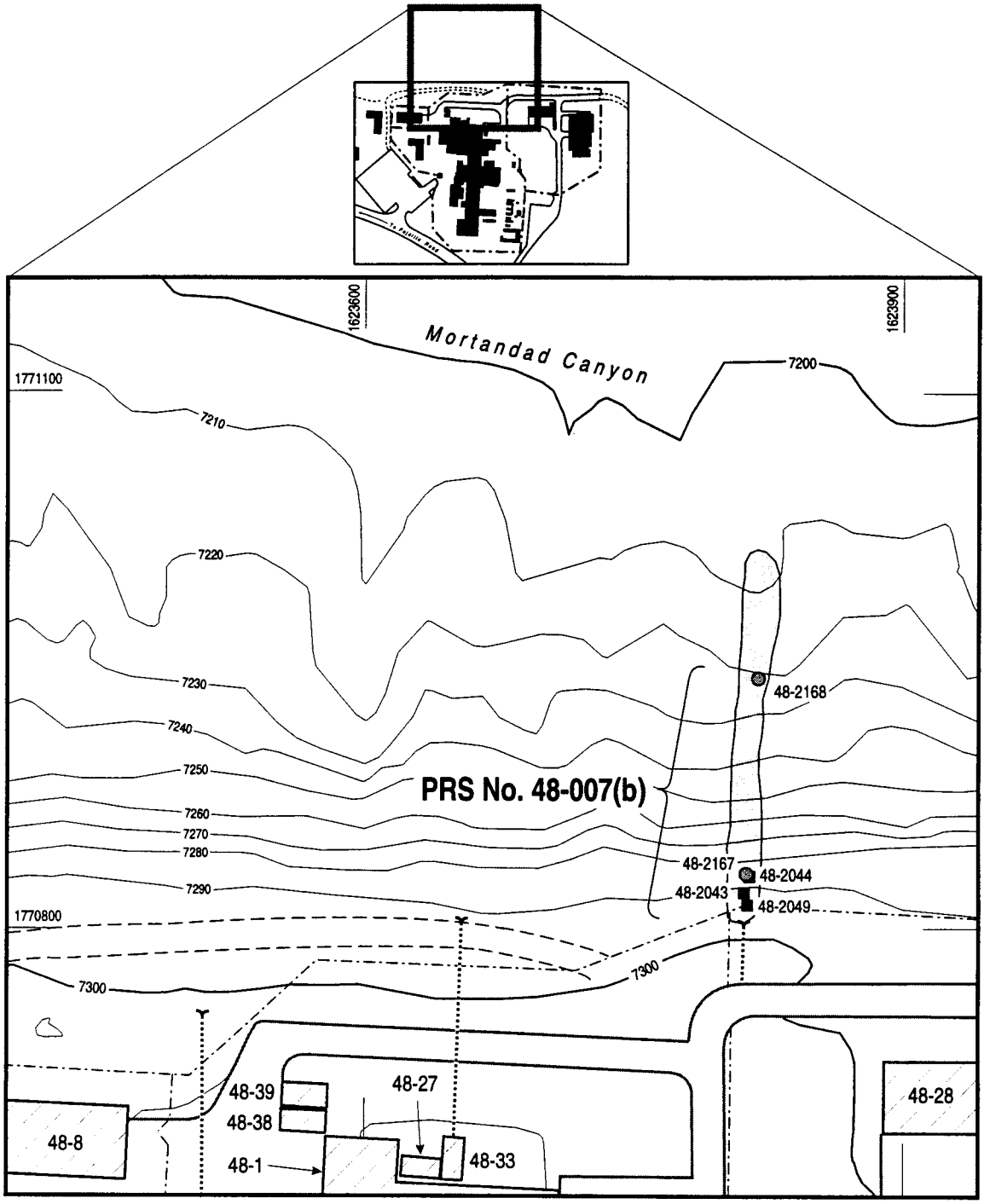
**Part 1**

| PRS | Location ID | Sample ID | Depth | Media | VOCs Fixed Lab | SVOCs Fixed Lab | PCBs Fixed Lab | XRF Mobile Lab |
|---|---|---|---|---|---|---|---|---|
| 48-007(b) | 48-2043 | AAA3517 | 0–0.5 | Soil | NR | NR | NR | 15142 |
| 48-007(b) | 48-2044 | AAA3489 | 0–0.5 (dup)[b] | Soil | NR | NR | NR | NR |
| 48-007(b) | 48-2044 | AAA3518 | 0–0.5 (dup)[b] | Soil | NR | NR | NR | 15142 |
| 48-007(b) | 48-2044 | AAA3490 | 0.5–1.5 | Soil | 15136 | NR | NR | NR |
| 48-007(b) | 48-2044 | AAA3491 | 0.5–1.5 (dup)[b] | Soil | NR | 15136 | 15136 | NR |
| 48-007(b) | 48-2044 | AAA3492 | 0.5–1.5 (dup)[b] | Soil | 15136 | NR | NR | NR |
| 48-007(b) | 48-2044 | AAA3519 | 0.5–1.5 (dup)[b] | Soil | 15136 | 15136 | 15136 | 15142 |
| 48-007(b) | 48-2044 | AAA3520 | 1.5–2.5 | Soil | NR | NR | NR | 15142 |
| 48-007(b) | 48-2167 | 0448-97-0071 | 0–1 | Soil | NR | NR | NR | NR |
| 48-007(b) | 48-2167 | 0448-97-0072 | 1–2 | Soil | NR | NR | NR | NR |
| 48-007(b) | 48-2168 | 0448-97-0081 | 0–0.8 | Soil | NR | NR | NR | NR |
| 48-007(b) | 48-2168 | 0448-97-0082 | 0.8–1.7 | Qbt3 | NR | NR | NR | NR |

**Part 2**

| PRS | Location ID | Sample ID | Depth | Media | Inorganic Fixed Lab | Gamma Spec Fixed Lab | Iso-Pu | Iso-Th | Iso-U |
|---|---|---|---|---|---|---|---|---|---|
| 48-007(b) | 48-2043 | AAA3517 | 0–0.5 | Soil | NR | NR | 15146 | 15146 | 15146 |
| 48-007(b) | 48-2044 | AAA3489 | 0–0.5 (dup)[b] | Soil | NR | NR | NR | NR | NR |
| 48-007(b) | 48-2044 | AAA3518 | 0–0.5 (dup) | Soil | NR | NR | 15146 | 15146 | 15146 |
| 48-007(b) | 48-2044 | AAA3490 | 0.5–1.5 | Soil | NR | NR | NR | NR | NR |
| 48-007(b) | 48-2044 | AAA3491 | 0.5–1.5 (dup)[b] | Soil | NR | NR | NR | NR | NR |
| 48-007(b) | 48-2044 | AAA3492 | 0.5–1.5 (dup)[b] | Soil | NR | NR | NR | NR | NR |
| 48-007(b) | 48-2044 | AAA3519 | 0.5–1.5 (dup)[b] | Soil | NR | NR | 15146 | 15146 | 15146 |
| 48-007(b) | 48-2044 | AAA3520 | 1.5–2.5 | Soil | NR | NR | 15146 | 15146 | 15146 |
| 48-007(b) | 48-2167 | 0448-97-0071 | 0–1 | Soil | NR | 2955 | NR | NR | NR |
| 48-007(b) | 48-2167 | 0448-97-0072 | 1–2 | Soil | NR | 2955 | NR | NR | NR |
| 48-007(b) | 48-2168 | 0448-97-0081 | 0–0.8 | Soil | NR | 2977 | NR | NR | NR |
| 48-007(b) | 48-2168 | 0448-97-0082 | 0.8–1.7 | Qbt3 | NR | 2977 | NR | NR | NR |

a. The numbers in the analytical suite columns are analytical request numbers.
b. Field duplicate

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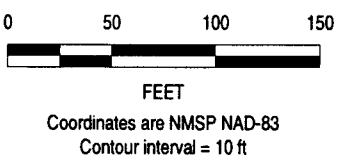



Coordinates are NMSP NAD-83
Contour interval = 10 ft

| | |
|---|---|
| Building or structure | Paved area |
| Sample collected before 1997 | Unpaved road |
| 1997 sample location | Fence |
| Approx. location of PRS | Outfall |
| Sewer or waste line/ storm drain | |

**Figure 5.2.4-1. Locations of PRS No. 48-007(b) samples.**

The highest detected value for each analyte was used for the background comparison. The sediment UTL values were used for background comparison of naturally occurring radionuclides ($^{228}$Th, $^{230}$Th, $^{232}$Th, $^{234}$U, $^{235}$U, and $^{238}$U) in soil (Ryti et al. 1997, 56186). The surface UTL values for fallout radionuclides ($^{241}$Am, $^{137}$Cs, $^{238}$Pu, and $^{239,240}$Pu) were used for soil samples collected in the 0 to 0.5-ft interval. Fallout radionuclide concentrations in deeper sample intervals were not compared with the surface UTL values because fallout activity is limited to surface soils. However, any fallout radionuclide detected at depths below 0.5 ft is considered to be present above background level. In Table 5.2.6-1, the values in the outlined boxes indicate radionuclides that were detected in soil at concentrations greater than or equal to their respective UTL values, or, in the case of fallout radionuclides, those that were detected below 0.5 ft. Table 5.2.6-1 also includes detected radionuclides for which there are no UTL values for comparison. The radionuclides that exceed background levels at each location are shown in Figure 5.2.6-1.

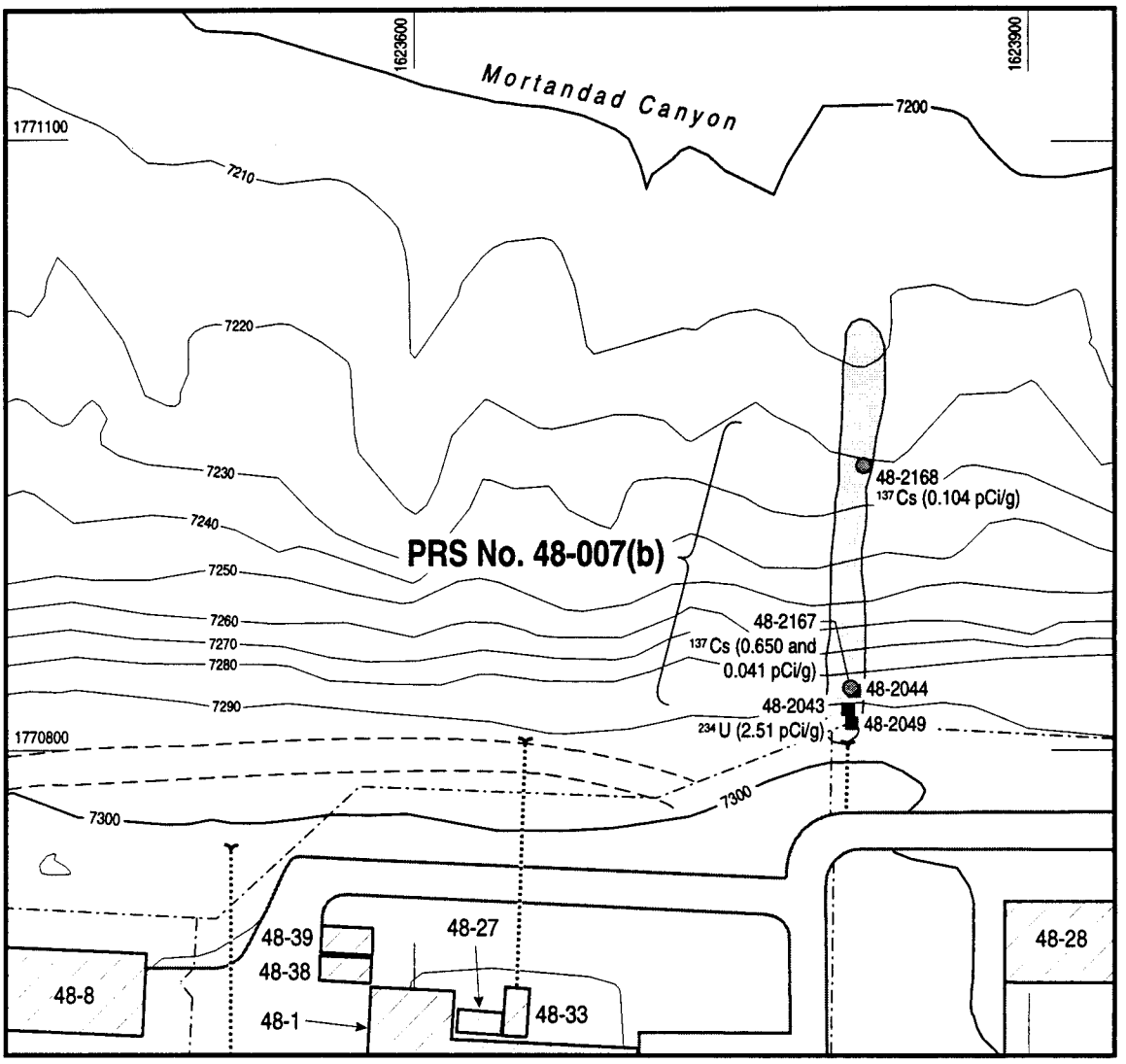
**TABLE 5.2.6-1**

**RADIONUCLIDES WITH CONCENTRATIONS AT OR ABOVE BACKGROUND SCREENING VALUES FOR PRS No. 48-007(b)[a]**

| Location ID | Sample ID | Depth (ft) | Media | Cs-137 (pCi/g) | Eu-152 (pCi/g) | Na-22 (pCi/g) | U-234 (pCi/g) |
|---|---|---|---|---|---|---|---|
| Soil SAL | N/A | N/A | N/A | 5.1 | 2.6 | 1.3 | 13 |
| Surface UTL | N/A | N/A | N/A | 1.65 | N/A | N/A | N/A |
| Sediment UTL | N/A | N/A | N/A | N/A | N.A. | N.A. | 2.39 |
| Qbt3 UTL | N/A | N/A | N/A | N/A | N.A. | N.A. | 1.55 |
| 48-2043 | AAA3517 | 0–0.5 | Soil | NA | NA | NA | 2.51 |
| 48-2044 | AAA3518 | 0–0.5 | Soil | NA | NA | NA | 0.087 U |
| 48-2044 | AAA3519 | 0.5–1.5 | Soil | NA | NA | NA | 0.841 |
| 48-2044 | AAA3520 | 1.5–2.5 | Soil | NA | NA | NA | 0.025 U |
| 48-2167 | 0448-97-0071 | 1–2 | Soil | 0.650 | -0.052 U | 0.024 | NA |
| 48-2167 | 0448-97-0072 | 1–2 (dup)[b] | Soil | 0.041 | 0.009 U | 0.003 U | NA |
| 48-2168 | 0448-97-0081 | 0–0.8 | Soil | 0.104 | 0.092 | 0.035 U | NA |
| 48-2168 | 0448-97-0082 | 0.8–1.7 | Qbt3 | -0.0025 U | -0.025 U | -0.022 U | NA |

a. Qualifiers used in table are defined in Section 3.1.2.
b. Field duplicate

The isotopic thorium results for two samples from Location ID Nos. 48-2043 and 48-2044 have been qualified as estimated and potentially biased low (J- flag) because of poor tracer recovery (less than 30% recovery but greater than 10%). A low tracer recovery indicates that problems may have occurred during the analytical procedure. These data are usable for the screening assessment because the reported sample concentrations reflect the chemical yield of the tracer isotope, as required by the alpha spectrometry analytical procedure. The thorium results for these two samples are not lower than the results for two other samples that were within acceptance criteria and not qualified. The sample results for isotopic thorium do not appear in Table 5.2.6-1 because all data were less than background UTL values.

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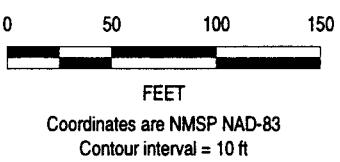


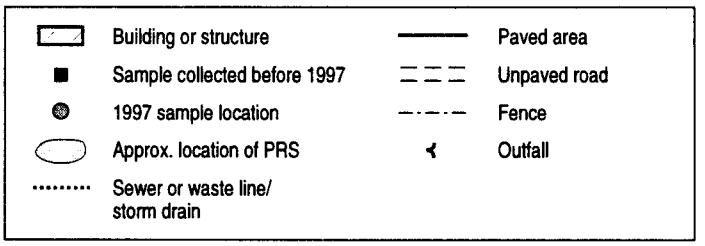



**Figure 5.2.6-1. Locations of analytes that exceed background UTLs at PRS No. 48-007(b).**

Detected radionuclides with one or more measured soil concentrations equal to or exceeding UTL values, or present above background levels, are summarized in the following list.

- The fallout radionuclide $^{137}Cs$ was detected in three samples collected from two locations at a maximum concentration of 0.650 pCi/g. The samples were collected at the following depth intervals: 0 to 0.8 ft, 0 to 1 ft, and 1 to 2 ft.

- The radionuclide $^{234}U$ was detected above its sediment UTL value of 2.39 pCi/g in one sample at a concentration of 2.51 pCi/g.

The following radionuclides were detected in one or more samples, but UTL values are not available.

- The radionuclide $^{152}Eu$ was detected in one sample at a concentration of 0.092 pCi/g.

- The radionuclide $^{22}Na$ was detected in one sample at a concentration of 0.024 pCi/g.

### 5.2.7 Evaluation of Organic Chemicals

Organic chemicals were not analyzed for during this RFI sampling event. The results of organic chemical analyses for PRS No. 48-007(b) are presented in the RFI report (LANL 1995, 50295).

### 5.2.8 Risk-Based Screening Assessment

A total of four radionuclides (with one or more measured concentrations above background values) were carried forward from the background comparison. All COPCs carried forward from the background comparison in Section 5.2.6 have soil SAL values for comparison. All detected radionuclides were measured at concentrations below their respective SAL values. The multiple chemical evaluation (MCE) calculation for $^{137}Cs$, $^{152}Eu$, $^{22}Na$, and $^{234}U$ yielded a result of 0.4, well below the threshold of 1.0 at which additive effects may be a concern. The normalized values for the MCE are shown in Table 5.2.8-1.

**TABLE 5.2.8-1**

**MULTIPLE CHEMICAL EVALUATION FOR SOIL SAMPLES AT PRS No. 48-007(b)**

| Carcinogenic Effects of Radionuclides (pCi/g) | | | | | | |
|---|---|---|---|---|---|---|
| Chemical | Location ID | Sample ID | Depth (ft) | Maximum Sample Value | Soil SAL | Normalized Value |
| Cesium-137 | 48-2167 | 0448-97-0071 | 0–1 | 0.650 | 5.1 | 0.127 |
| Europium-152 | 48-2168 | 0448-97-0081 | 0–0.8 | 0.092 | 2.6 | 0.035 |
| Sodium-22 | 48-2167 | 0448-97-0071 | 0–1 | 0.024 | 1.3 | 0.018 |
| Uranium-234 | 48-2043 | AAA3517 | 0–0.5 | 2.51 | 13 | 0.193 |
| | | | | | Total* | 0.4 |

*Total may not equal sum of normalized values due to rounding.

No radionuclide COPCs were identified as a result of the human health risk-based screening assessment.

### 5.2.9 Human Health Risk Assessment

No human health risk assessment was performed for PRS No. 48-007(b). No radionuclide COPCs were identified during the human health risk-based screening assessment.

### 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 site 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 objective of the Phase I RFI at PRS No. 48-007(b) was to determine the presence or absence of contamination associated with the outfall. The Phase I RFI results for inorganic and organic chemicals are presented in the RFI report (LANL 1995, 50295). As described in the NOD response (LANL 1996, 54448), additional gamma spectroscopy data were required to evaluate the presence or absence of radionuclides at several PRSs at TA-48, including PRS No. 48-007(b).

The sampling design for characterizing potential radionuclide contamination at this PRS was based on professional judgment. To maximize the likelihood of observing residual contamination associated with historical releases from the outfall by collecting only a few samples, sample locations were biased to areas of significant sediment accumulation. Because contaminants associated with historical releases may have been carried in water or sediments from the outfall location and deposited lower in the drainage channel, samples were collected at depth as well as on the surface to determine whether historical contamination may have been covered by later sedimentary deposits. Seven soil samples and one tuff sample were collected from four locations at depths ranging from surface to 2.5 ft and submitted for radiological analysis.

No radionuclide COPCs were identified during the human health risk-based screening assessment. Radionuclide contamination at this site is not likely to result in unacceptable dose rates now or in the future. Additional sampling or further assessment activities for evaluating contamination at this PRS is not proposed. PRS No. 48-007(b) is proposed for NFA based on NFA Criterion 5 (LANL 1996, 54943). A Class III permit modification will be requested to remove this site from the HSWA Module of the Laboratory's RCRA operating permit.

## 5.3 PRS No. 48-007(c)

PRS No. 48-007(c) is an outfall to daylight; flow into this outfall includes floor drains, a trench drain, and roof drains in building TA-48-1. The outfall was submitted to the EPA in 1987 for inclusion under the NPDES permit (LANL 1991, 21557); it has Permit No. EPA 04A 131.

No radionuclide COPCs were identified during the human health risk-based screening assessment. PRS No. 48-007(c) is recommended for NFA based on NFA Criterion 5 (LANL 1996, 54943).

### 5.3.1 History

PRS No. 48-007(c) is discussed in detail in Section 3.5 of the work plan (LANL 1992, 7666) and in Section 7.29 of the June 1994 addendum to the work plan (Pratt 1994, 43475). Results of the Phase I investigation are presented in the RFI report (LANL 1995, 50295).

The work plan (LANL 1992, 7666) states that this PRS discharges noncontact cooling water used for vacuum pumps housed in building TA-48-1. Information that became available after the work plan was written includes the wastewater stream characterization for TA-48, which was conducted in 1993 by Santa Fe Engineering (Santa Fe Engineering 1994, 56204). This study was conducted to identify building drain pipes and characterize the wastewater flows and sources that existed in 1993. Drain pipes were verified by dye tracing. Site visits were performed to verify drain schematics and identify potential outfall pipes that exit the buildings. PRS No. 48-007(c) is identified as outfall 48-1-OPN-21. The report (Santa Fe Engineering 1994, 56204) states that the sources of flow to this outfall include nine floor drains, a trench drain, and six roof drains. The sources for the floor drains include floor washings, back flow preventers, a vacuum pump drain, a vacuum pump condensate, a steam condensate, a boiler drain, a fire drain, and a water heater pressure relief valve. The report states that there were no sources of noncontact cooling water, as indicated by the 04A category permit. The floor drains are located in Rooms 244, 322, 324, and 344 in TA-48-1. The report indicates that the flow rate is nil and that during the dye test, the dye reached the expected destination.

The potential contaminants evaluated during the activities described in this addendum included alpha- and gamma-emitting radionuclides.

### 5.3.2 Description

The point of discharge for the outfall that comprises this PRS is on the mesa edge. The drainage channel originating from the discharge point is on a steep section of the slope into Mortandad Canyon. The canyon slope is north facing and heavily vegetated; the vegetation appears normal and healthy.

### 5.3.3 Previous Investigations

Phase I of the RFI site characterization at PRS No. 48-007(c) was performed in July 1993. The results were presented in the RFI report (LANL 1995, 50295), which was submitted to EPA in September 1995. PRS No. 48-007(c) was recommended for NFA (for the RCRA component) in the RFI report. In January 1997 a SAP (LANL 1997, 55326) was prepared and submitted to the DOE; a copy was sent to NMED for informational purposes. The SAP describes sampling activities proposed to satisfy the requirements of a regulator NOD for the RFI report (LANL 1996, 54448) and an NMED request for additional information about the RFI report (LANL 1996, 55064). In March and June 1997 sampling activities were performed in accordance with the SAP.

### 5.3.4 Field Investigation

The objective of the investigation was to determine the presence or absence of radionuclides above background levels in soils and sediments within the drainage channel below the outfall and to fulfill the Phase I RFI data objectives as described in the SAP (LANL 1997, 55326).

The general conceptual model of contaminant transport at TA-48 is described in Section 4.3 of the work plan (LANL 1992, 7666). Outfall discharge provides a mechanism for infiltration of contaminants into the vadose zone and transport of contaminants with surface water in either a dissolved state or adhering to eroded soil.

Field screening during sample collection activities was performed using a Ludlum Model 139 alpha meter and an Eberline ESP-1 beta/gamma meter. Background radiation measurements taken at TA-48 using this instrumentation range from 200 to 500 cpm beta/gamma radiation depending on the location and substrate rock type. Field screening measurements greater than 500 cpm beta/gamma radiation are

generally considered to be above background levels. No beta/gamma radiation measurements above background levels were obtained during field screening at this site, and no alpha radiation was detected.

#### 5.3.4.1 Environmental and Engineering Surveys

An H&S radiation survey was performed before field activities began in 1993, as described in the RFI report ( LANL 1995, 50295). No radioactivity was detected above background levels; therefore, no additional radiation surveys were performed.

On February 4, 1997, an engineering survey was performed to stake sample locations. Based on the SAP (LANL 1997, 55326), two hand-auger holes were located in sediment accumulation areas within the drainage channel below the outfall.

#### 5.3.4.2 Deviations from the Sampling and Analysis Plan

Samples were collected in accordance with the SAP (LANL 1997, 55326). Two additional hand-auger holes (Location ID Nos. 35-2169 and 35-2170) were drilled to collect samples to verify an anomalous result for gamma-emitting radionuclides (Pratt 1997, 56051). Focused validation of the hard copy data package indicated that, for unreported reasons, the analytical laboratory used an 8-g sample aliquot instead of the usual 100-g aliquot. The laboratory had insufficient sample remaining to repeat the analysis. Therefore, additional samples were collected to fulfill the objectives of the SAP.

#### 5.3.4.3 Sampling Activities

On March 11 and March 24, 1997, initial sampling was performed in accordance with the SAP (LANL 1997, 55326). Five soil samples (not including field duplicates) were collected from two locations. Hand-auger holes were drilled to the soil/tuff interface. One hand-auger hole (Location ID No. 48-2165) was drilled to a depth of 2.8 ft, and three samples were collected. One hand-auger hole (Location ID No. 48-2166) was drilled to a depth of 2 ft, and two samples were collected. The sample collection intervals are shown in Table 5.3.4-1. Beta/gamma radiation measurements obtained during field screening of the samples ranged from 190 to 230 cpm, which are within background levels.

Supplemental sampling was performed on June 11, 1997, to resample Location ID No. 48-2166 because anomalous results for gamma-emitting radionuclides were reported for the sample collected from the 0 to 1-ft interval (Pratt 1997, 56051) (see Section 5.3.4.2 and 5.3.6 for the rationale for rejecting anomalous results). One hand-auger hole (Location ID No. 48-2169) was drilled to a depth of 2 ft adjacent to Location ID No. 48-2166, and two samples were collected. A second hand-auger hole (Location ID No. 2170) was drilled to a depth of 1.2 ft in the outfall drainage channel downgradient from Location ID No. 48-2166, and two samples were collected. The second hand-auger hole was included to bound extent if the reanalysis indicated that elevated levels of radionuclides are present in the drainage channel. Beta/gamma measurements obtained during field screening of the samples ranged from 150 to 270 cpm, which are within background levels.

Table 5.3.4-1 summarizes all sampling for PRS No. 48-007(c); Figure 5.3.4-1 shows the sample locations.

### 5.3.5 Evaluation of Inorganic Chemicals

Inorganic chemicals were not analyzed for during this RFI sampling event. The results of inorganic chemical analyses for PRS No. 48-007(c) are presented in the RFI report (LANL 1995, 50295).

## TABLE 5.3.4-1

## SUMMARY OF SAMPLES TAKEN AT PRS No. 48-007(c)[a]

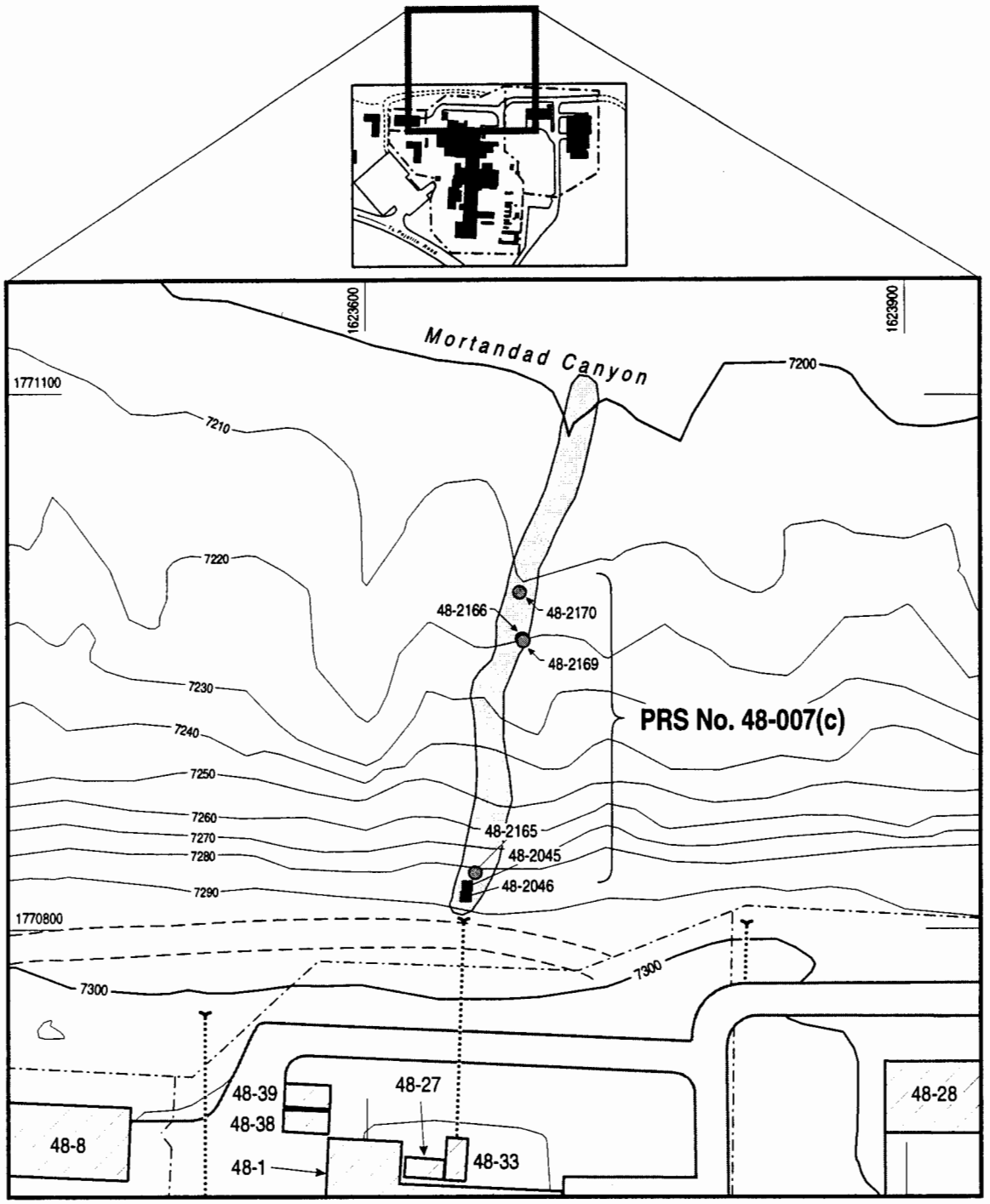
**Part 1**

| PRS | Location ID | Sample ID | Depth | Media | VOCs Fixed Lab | SVOCs Fixed Lab | PCBs Fixed Lab | XRF Mobile Lab |
|---|---|---|---|---|---|---|---|---|
| 48-007(c) | 48-2045 | AAA3521 | 0–0.5 | Soil | NR | NR | NR | 15142 |
| 48-007(c) | 48-2046 | AAA3522 | 0–0.5 | Soil | NR | NR | NR | 15142 |
| 48-007(c) | 48-2046 | AAA3523 | 0.5–1.5 | Soil | 15136 | 15136 | 15136 | 15142 |
| 48-007(c) | 48-2046 | AAA3533 | 0.5–1.5 | Soil | NR | 15136 | 15136 | NR |
| 48-007(c) | 48-2046 | AAA3524 | 1.5–2 | Soil | NR | NR | NR | 15142 |
| 48-007(c) | 48-2165 | 0448-97-0067 | 0–1 | Soil | NR | NR | NR | NR |
| 48-007(c) | 48-2165 | 0448-97-0068 | 1–2 | Soil | NR | NR | NR | NR |
| 48-007(c) | 48-2165 | 0448-97-0069 | 1–2 (dup)[b] | Soil | NR | NR | NR | NR |
| 48-007(c) | 48-2165 | 0448-97-0070 | 2–2.8 | Soil | NR | NR | NR | NR |
| 48-007(c) | 48-2166 | 0448-97-0078 | 0–1 | Soil | NR | NR | NR | NR |
| 48-007(c) | 48-2166 | 0448-97-0079 | 1–2 | Soil | NR | NR | NR | NR |
| 48-007(c) | 48-2169 | 0448-97-0105 | 0–1 | Soil | NR | NR | NR | NR |
| 48-007(c) | 48-2169 | 0448-97-0106 | 0–1 | Soil | NR | NR | NR | NR |
| 48-007(c) | 48-2169 | 0448-97-0107 | 1–2 | Soil | NR | NR | NR | NR |
| 48-007(c) | 48-2170 | 0448-97-0108 | 0–0.5 | Soil | NR | NR | NR | NR |
| 48-007(c) | 48-2170 | 0448-97-0109 | 0.5–1.2 | Soil | NR | NR | NR | NR |

**Part 2**

| PRS | Location ID | Sample ID | Depth | Media | Gamma Spec Fixed Lab | Am-241 | Iso-Pu | Iso-Th | Iso-U |
|---|---|---|---|---|---|---|---|---|---|
| 48-007(c) | 48-2045 | AAA3521 | 0–0.5 | Soil | NR | 15146 | 15146 | 15146 | 15146 |
| 48-007(c) | 48-2046 | AAA3522 | 0–0.5 | Soil | NR | 15146 | 15146 | 15146 | 15146 |
| 48-007(c) | 48-2046 | AAA3523 | 0.5–1.5 | Soil | NR | 15146 | 15146 | 15146 | 15146 |
| 48-007(c) | 48-2046 | AAA3533 | 0.5–1.5 | Soil | NR | NR | NR | NR | NR |
| 48-007(c) | 48-2046 | AAA3524 | 1.5–2 | Soil | NR | 15146 | 15146 | 15146 | 15146 |
| 48-007(c) | 48-2165 | 0448-97-0067 | 0–1 | Soil | 2955 | NR | NR | NR | NR |
| 48-007(c) | 48-2165 | 0448-97-0068 | 1–2 | Soil | 2955 | NR | NR | NR | NR |
| 48-007(c) | 48-2165 | 0448-97-0069 | 1–2 (dup)[b] | Soil | 2955 | NR | NR | NR | NR |
| 48-007(c) | 48-2165 | 0448-97-0070 | 2–2.8 | Soil | 2955 | NR | NR | NR | NR |
| 48-007(c) | 48-2166 | 0448-97-0078 | 0–1 | Soil | 2955 | NR | NR | NR | NR |
| 48-007(c) | 48-2166 | 0448-97-0079 | 1–2 | Soil | 2955 | NR | NR | NR | NR |
| 48-007(c) | 48-2169 | 0448-97-0105 | 0–1 | Soil | 3220R | NR | NR | NR | NR |
| 48-007(c) | 48-2169 | 0448-97-0106 | 0–1 | Soil | 3220R | NR | NR | NR | NR |
| 48-007(c) | 48-2169 | 0448-97-0107 | 1–2 | Soil | 3220R | NR | NR | NR | NR |
| 48-007(c) | 48-2170 | 0448-97-0108 | 0–0.5 | Soil | 3220R | NR | NR | NR | NR |
| 48-007(c) | 48-2170 | 0448-97-0109 | 0.5–1.2 | Soil | 3220R | NR | NR | NR | NR |

a. The numbers in the analytical suite columns are analytical request numbers.
b. Field duplicate

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0 50 100 150

FEET

Coordinates are NMSP NAD-83
Contour interval = 10 ft

| | |
|---|---|
| Building or structure | Paved area |
| Sample collected before 1997 | Unpaved road |
| 1997 sample location | Fence |
| Approx. location of PRS | Outfall |
| Sewer or waste line/ storm drain | |

**Figure 5.3.4-1. Locations of PRS No. 48-007(c) samples.**

### 5.3.6 Evaluation of Radionuclides

Background comparisons were performed for radionuclides for which UTL values are available, as discussed in Section 3.2 in Chapter 3 of this addendum. Four soil samples collected from two locations, including one field duplicate, were analyzed by alpha spectrometry at a fixed-site laboratory for an analyte suite that included $^{241}$Am, $^{238}$Pu, $^{239,240}$Pu, $^{228}$Th, $^{230}$Th, $^{232}$Th, $^{234}$U, $^{235}$U, and $^{238}$U. Eleven soil samples from four locations, including three field duplicates, were analyzed by gamma spectroscopy at a fixed-site laboratory for an analyte suite that included gamma-emitting fission and activation products as well as naturally occurring radionuclides.

The highest detected value for each analyte was used for the background comparison. The sediment UTL values were used for background comparison of naturally occurring radionuclides ($^{228}$Th, $^{230}$Th, $^{232}$Th, $^{234}$U, $^{235}$U, and $^{238}$U) in soil (Ryti et al. 1997, 56186). The surface UTL values for fallout radionuclides ($^{241}$Am, $^{137}$Cs, $^{238}$Pu, and $^{239,240}$Pu) were used for soil samples collected in the 0 to 0.5-ft interval. Fallout radionuclide concentrations in deeper sample intervals were not compared with the surface UTL values because fallout activity is limited to surface soils. However, any fallout radionuclide detected at depths below 0.5 ft is considered to be present above background level. In Table 5.3.6-1, the values in the outlined boxes indicate radionuclides that were detected in soil at concentrations greater than or equal to their respective UTL values, or, in the case of fallout radionuclides, those that were detected below 0.5 ft. Table 5.3.6-1 also includes detected radionuclides for which there are no UTL values for comparison. The radionuclides that exceed background levels at each location are shown in Figure 5.3.6-1.

The isotopic plutonium results for one sample from Location ID No. 48-2046 have been qualified as estimated and potentially biased low (J- flag) because of poor tracer recovery (less than 30% recovery but greater than 10%). A low tracer recovery indicates that problems may have occurred during the analytical procedure. These data are usable for the screening assessment because the sample concentrations have been corrected for the chemical yield of the tracer isotope, as required by the alpha spectrometry analytical procedure. Both $^{238}$Pu and $^{239,240}$Pu were detected in this sample at concentrations comparable to the other three samples analyzed at this site, as shown in Table 5.2.6-1.

The gamma spectroscopy results were rejected for one sample collected at Location ID No. 48-2166, Sample ID No. 0448-97-0078. Because of sample loss during handling and preparation, the analytical laboratory analyzed an insufficient aliquot size to obtain a reliable measurement. The sample results for naturally occurring radionuclides were anomalous and biased very high. Supplemental samples were collected to replace the rejected sample data (see Section 5.3.4.2 and Section 5.3.4.3).

Detected radionuclides with one or more measured soil concentrations equal to or exceeding UTL values, or present above background levels, are summarized in the following list.

- The fallout radionuclide $^{241}$Am was detected above its UTL value of 0.013 pCi/g in one sample, collected from the 0 to 0.5-ft interval, at a concentration of 0.0456 pCi/g.

- The fallout radionuclide $^{137}$Cs was detected in four samples collected from three locations at a maximum concentration of 0.315 pCi/g. The samples were collected at the following depth intervals: 0 to 1 ft, 0.5 to 1.2 ft, and 1 to 2 ft.

- The fallout radionuclide $^{238}$Pu was detected above its UTL value of 0.023 pCi/g in two samples, collected from the 0 to 0.5-ft intervals, at a maximum concentration of 0.054 pCi/g. Plutonium-238 was also detected in two samples collected from intervals of 0.5 to 1.5 ft and 1.5 to 2 ft at a maximum concentration of 0.172 pCi/g.

**TABLE 5.3.6-1**

**RADIONUCLIDES WITH CONCENTRATIONS AT OR ABOVE BACKGROUND SCREENING VALUES FOR PRS No. 48-007(c)[a]**

**Part 1**

| Location ID | Sample ID | Depth (ft) | Media | Am-241 (pCi/g) | Co-60 (pCi/g) | Cs-134 (pCi/g) | Cs-137 (pCi/g) | Eu-152 (pCi/g) |
|---|---|---|---|---|---|---|---|---|
| Soil SAL | N/A | N/A | N/A | 22 | 1.1 | 1.9 | 5.1 | 2.6 |
| Surface UTL | N/A | N/A | N/A | 0.013 | N/A | N/A | 1.65 | N/A |
| Sediment UTL | N/A | N/A | N/A | N/A | N.A. | N.A. | N/A | N.A. |
| Qbt3 UTL | N/A | N/A | N/A | N/A | N.A. | N.A. | N/A | N.A. |
| 48-2045 | AAA3521 | 0–0.5 | Soil | 0.047 U | NA | NA | NA | NA |
| 48-2046 | AAA3522 | 0–0.5 | Soil | 0.0456 | NA | NA | NA | NA |
| 48-2046 | AAA3523 | 0.5–1.5 | Soil | 0.052 U | NA | NA | NA | NA |
| 48-2046 | AAA3524 | 1.5–2 | Soil | 0.024 U | NA | NA | NA | NA |
| 48-2165 | 0448-97-0067 | 0–1 | Soil | -0.032 U | 0.077 | 0.095 | 0.315 | -0.018 U |
| 48-2165 | 0448-97-0068 | 1–2 | Soil | -0.171 U | -0.018 U | -0.005 U | 0.052 | -0.083 U |
| 48-2165 | 0448-97-0069 | 1–2 (dup)[b] | Soil | -0.066 U | 0.017 U | -0.025 U | 0.051 U | -0.032 U |
| 48-2165 | 0448-97-0070 | 2–2.8 | Soil | -0.077 U | -0.036 U | -0.050 U | 0.018 U | 0.082 |
| 48-2166 | 0448-97-0079 | 1–2 | Qbt3 | 0.192 U | 0.0025 U | -0.029 U | 0.018 U | 0.063 U |
| 48-2169 | 0448-97-0105 | 0–1 | Soil | 0.048 U | -0.008 U | 0.0 U | 0.017 U | -0.023 U |

**Part 2**

| Location ID | Sample ID | Depth (ft) | Media | Pu-238 (pCi/g) | Pu-239,240 (pCi/g) | Ru-106 (pCi/g) | U-235 (pCi/g) |
|---|---|---|---|---|---|---|---|
| Soil SAL | N/A | N/A | N/A | 27 | 24 | 13 | 10 |
| Surface UTL | N/A | N/A | N/A | 0.023 | 0.054 | N/A | N/A |
| Sediment UTL | N/A | N/A | N/A | N/A | N/A | N.A. | 0.16 |
| Qbt3 UTL | N/A | N/A | N/A | N/A | N/A | N.A. | 0.067 |
| 48-2045 | AAA3521 | 0–0.5 | Soil | 0.044 | 0.041 | NA | 0.148 |
| 48-2046 | AAA3522 | 0–0.5 | Soil | 0.054 | 0.046 | NA | 0.040 U |
| 48-2046 | AAA3523 | 0.5–1.5 | Soil | 0.172 | 0.164 | NA | 0.035 U |
| 48-2046 | AAA3524 | 1.5–2 | Soil | 0.064 J- | 0.035 J- | NA | 0.049 U |
| 48-2165 | 0448-97-0067 | 0–1 | Soil | NA | NA | 0.0 U | 0.126 |
| 48-2165 | 0448-97-0068 | 1–2 | Soil | NA | NA | 0.174 U | 0.097 |
| 48-2165 | 0448-97-0069 | 1–2 (dup)[b] | Soil | NA | NA | -0.018 U | 0.050 |
| 48-2165 | 0448-97-0070 | 2–2.8 | Soil | NA | NA | 0.358 | 0.077 |
| 48-2166 | 0448-97-0079 | 1–2 | Qbt3 | NA | NA | -0.270 U | 0.119 |
| 48-2169 | 0448-97-0105 | 0–1 | Soil | NA | NA | 0.210 U | 0.014 U |

a. Qualifiers used in table are defined in Section 3.1.2.
b. Field duplicate

**TABLE 5.3.6-1 (continued)**

**RADIONUCLIDES WITH CONCENTRATIONS AT OR ABOVE BACKGROUND SCREENING VALUES FOR PRS No. 48-007(c)[a]**

**Part 1**

| Location ID | Sample ID | Depth (ft) | Media | Am-241 (pCi/g) | Co-60 (pCi/g) | Cs-134 (pCi/g) | Cs-137 (pCi/g) | Eu-152 (pCi/g) |
|---|---|---|---|---|---|---|---|---|
| Soil SAL | N/A | N/A | N/A | 22 | 1.1 | 1.9 | 5.1 | 2.6 |
| Surface UTL | N/A | N/A | N/A | 0.013 | N/A | N/A | 1.65 | N/A |
| Sediment UTL | N/A | N/A | N/A | N/A | N.A. | N.A. | N/A | N.A. |
| Qbt3 UTL | N/A | N/A | N/A | N/A | N.A. | N.A. | N/A | N.A. |
| 48-2169 | 0448-97-0106 | 0–1 (dup)[b] | Soil | -0.070 U | 0.019 U | 0.012 U | 0.117 | 0.183 |
| 48-2169 | 0448-97-0107 | 1–2 | Soil | -0.201 U | -0.012 U | -0.007 U | 0.012 U | -0.126 U |
| 48-2170 | 0448-97-0108 | 0–0.5 | Soil | -0.169 U | 0.016 U | -0.010 U | 0.477 | -0.044 U |
| 48-2170 | 0448-97-0109 | 0.5–1.2 | Soil | 0.049 U | -0.035 U | -0.030 U | 0.144 | -0.120 U |

**Part 2**

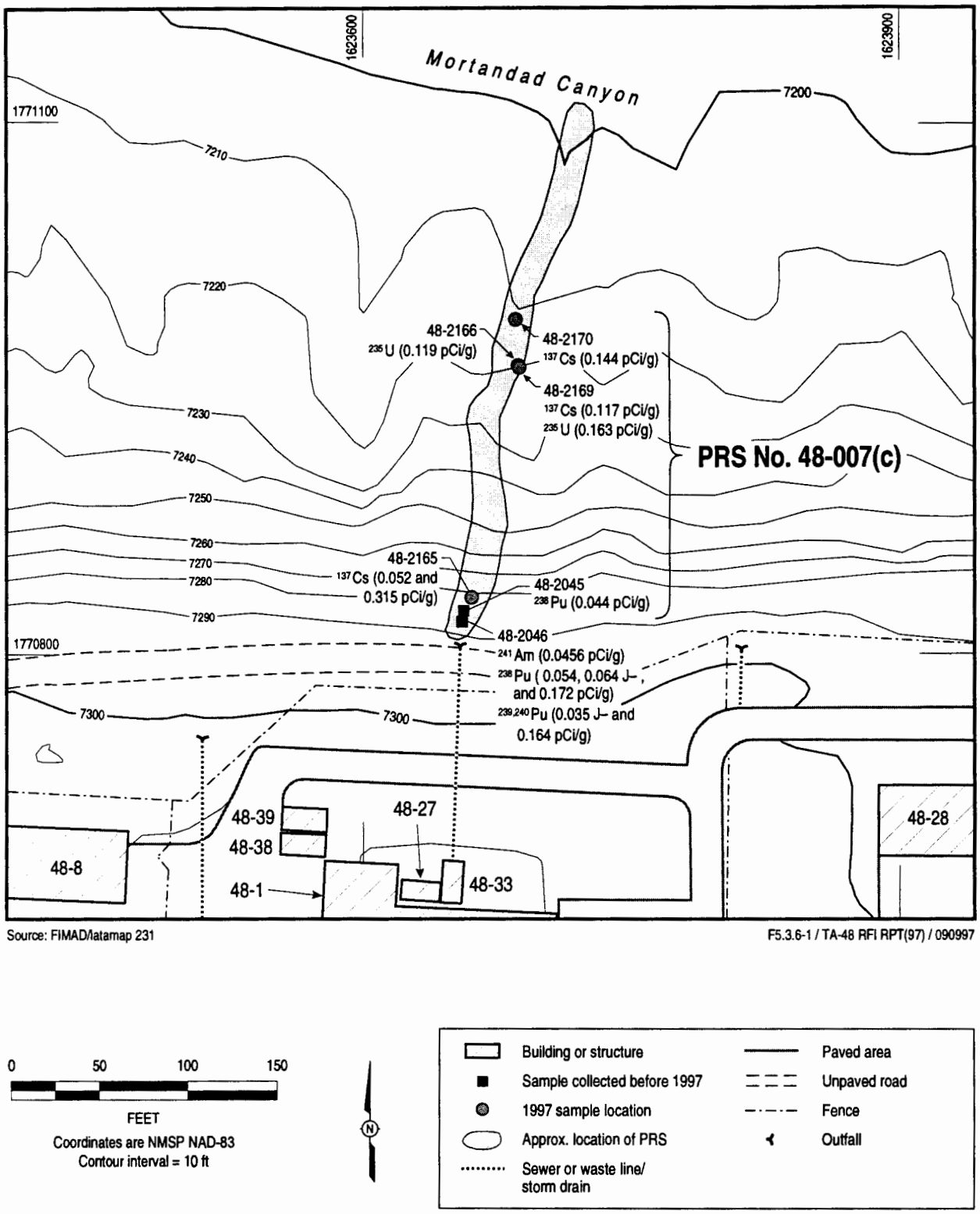
| Location ID | Sample ID | Depth (ft) | Media | Pu-238 (pCi/g) | Pu-239,240 (pCi/g) | Ru-106 (pCi/g) | U-235 (pCi/g) |
|---|---|---|---|---|---|---|---|
| Soil SAL | N/A | N/A | N/A | 27 | 24 | 13 | 10 |
| Surface UTL | N/A | N/A | N/A | 0.023 | 0.054 | N/A | N/A |
| Sediment UTL | N/A | N/A | N/A | N/A | N/A | N.A. | 0.16 |
| Qbt3 UTL | N/A | N/A | N/A | N/A | N/A | N.A. | 0.067 |
| 48-2169 | 0448-97-0106 | 0–1 (dup)[b] | Soil | NA | NA | 0.481 | 0.163 |
| 48-2169 | 0448-97-0107 | 1–2 | Soil | NA | NA | 0.094 U | 0.087 |
| 48-2170 | 0448-97-0108 | 0–0.5 | Soil | NA | NA | -0.067 U | 0.051 |
| 48-2170 | 0448-97-0109 | 0.5–1.2 | Soil | NA | NA | -0.367 U | 0.133 |

a. Qualifiers used in table are defined in Section 3.1.2.
b. Field duplicate

- The fallout radionuclide $^{239,240}Pu$ was detected in two samples collected from intervals of 0.5 to 1.5 ft and 1.5 to 2 ft at a maximum concentration of 0.164 pCi/g.
- The radionuclide $^{235}U$ was detected above its Qbt3 UTL value of 0.067 pCi/g in one sample at a concentration of 0.119 pCi/g. Uranium-235 was also detected above its sediment UTL value of 0.16 pCi/g in one sample at a concentration of 0.163 pCi/g.

The following radionuclides were detected in one or more samples, but UTL values are not available.

- The radionuclide $^{60}Co$ was detected in one sample at a concentration of 0.077 pCi/g.
- The radionuclide $^{134}Cs$ was detected in one sample at a concentration of 0.095 pCi/g.
- The radionuclide $^{152}Eu$ was detected in two samples collected from two locations at a maximum concentration of 0.183 pCi/g.
- The radionuclide $^{106}Ru$ was detected in two samples collected from two locations at a maximum concentration of 0.481 pCi/g.




Source: FIMAD/latamap 231

F5.3.6-1 / TA-48 RFI RPT(97) / 090997

**Figure 5.3.6-1. Locations of analytes that exceed background UTLs at PRS No. 48-007(c).**

### 5.3.7 Evaluation of Organic Chemicals

Organic chemicals were not analyzed for during this RFI sampling event. The results of organic chemical analyses for PRS No. 48-007(c) are presented in the RFI report (LANL 1995, 50295).

### 5.3.8 Risk-Based Screening Assessment

A total of nine radionuclides (five with one or more measured concentrations above background values) were carried forward from the background comparison. All COPCs carried forward from the background comparison in Section 5.3.6 have soil SAL values for comparison. All detected radionuclides were measured at concentrations below their respective SAL values. The MCE calculation for $^{241}$Am, $^{134}$Cs, $^{137}$Cs, $^{60}$Co, $^{152}$Eu, $^{238}$Pu, $^{239,240}$Pu, $^{106}$Ru, and $^{235}$U yielded a result of 0.3, well below the threshold of 1.0 at which additive effects may be a concern. The normalized values for the MCE are shown in Table 5.3.8-1.

**TABLE 5.3.8-1**

**MULTIPLE CHEMICAL EVALUATION FOR SOIL SAMPLES AT PRS No. 48-007(c)**

| Carcinogenic Effects of Radionuclides (pCi/g) | | | | | | |
|---|---|---|---|---|---|---|
| Chemical | Location ID | Sample ID | Depth (ft) | Maximum Sample Value | Soil SAL | Normalized Value |
| Americium-241 | 48-2045 | AAA3522 | 0–0.5 | 0.0456 | 22 | 0.002 |
| Cesium-134 | 48-2165 | 0448-97-0067 | 0–1 | 0.095 | 1.9 | 0.050 |
| Cesium-137 | 48-2165 | 0448-97-0067 | 0–1 | 0.315 | 5.1 | 0.062 |
| Cobalt-60 | 48-2165 | 0448-97-0067 | 0–1 | 0.077 | 1.1 | 0.070 |
| Europium-152 | 48-2169 | 0448-97-0106 | 0–1 | 0.183 | 2.6 | 0.070 |
| Plutonium-238 | 48-2046 | AAA3523 | 0.5–1.5 | 0.172 | 27 | 0.006 |
| Plutonium-239,240 | 48-2046 | AAA3523 | 0.5–1.5 | 0.164 | 24 | 0.007 |
| Ruthenium-106 | 48-2169 | 0448-97-0106 | 0–1 | 0.481 | 13 | 0.037 |
| Uranium-235 | 48-2169 | 0448-97-0106 | 0–1 | 0.163 | 10 | 0.016 |
| | | | | | Total* | 0.3 |

*Total may not equal sum of normalized values due to rounding.

No radionuclide COPCs were identified as a result of the human health risk-based screening assessment.

### 5.3.9 Human Health Risk Assessment

No human health risk assessment was performed for PRS No. 48-007(c). No radionuclide COPCs were identified during the human health risk-based screening assessment.

### 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 site will be deferred until the site can be assessed as part of the ecological exposure unit methodology currently being developed.

### 5.3.11 Conclusions and Recommendations

The objective of the Phase I RFI at PRS No. 48-007(c) was to determine the presence or absence of contamination associated with the outfall. As described in the NOD response (LANL 1996, 54448), additional gamma spectroscopy data were required to evaluate the presence or absence of radionuclides at several PRSs at TA-48, including PRS No. 48-007(c).

Although the work plan states that the source of this outfall is noncontact cooling water from vacuum pumps, further archival research indicated that other sources contribute to this outfall (see Section 5.3.1). Nevertheless, the characterization activities conducted for this PRS are sufficient to identify any potential problems associated with discharges to the outfall because samples were analyzed for a complete suite of chemicals and radionuclides.

The sampling design for characterizing potential radionuclide contamination at this PRS was based on professional judgment. To maximize the likelihood of observing residual contamination associated with historical releases from the outfall by collecting only a few samples, sample locations were biased to areas of significant sediment accumulation. Because contaminants associated with historical releases may have been carried in water or sediments from the outfall location and deposited lower in the drainage channel, samples were collected at depth as well as on the surface to determine whether historical contamination may have been covered by later sedimentary deposits.

A total of 14 soil samples (including three field duplicates) and 1 tuff sample were collected from six locations at depths ranging from surface to 2 ft and submitted for radiological analyses. As described in Section 5.3.4, five samples were collected at two locations in addition to the samples proposed in the SAP (LANL 1997, 55326). Higher concentrations were generally observed in surface or near-surface samples; at Location ID No. 48-2170 (the farthest down the drainage) lower concentrations than those higher up in the drainage were generally observed. These patterns support a conclusion that the extent of contamination has been adequately defined at PRS No. 48-007(c).

No radionuclide COPCs were identified during the human health risk-based screening assessment. Radionuclide contamination at this site is not likely to result in unacceptable dose rates now or in the future. Additional sampling or further assessment activities for evaluating contamination at this PRS is not proposed. PRS No. 48-007(c) is proposed for NFA based on NFA Criterion 5 (LANL 1996, 54943). A Class III permit modification will be requested to remove this site from the HSWA Module of the Laboratory's RCRA operating permit.

## 5.4 PRS No. 48-007(f)

PRS No. 48-007(f) is an outfall that was submitted to the EPA in November 1987 for inclusion under the NPDES permit. The work plan states that when the outfall was submitted for the permit it discharged up to 100 gal. per day of noncontact cooling water from x-ray equipment housed in building TA-48-46 (LANL 1990, 7511); it has NPDES Permit No. EPA 137 04A.

No radionuclide COPCs were identified during the human health risk-based screening assessment. PRS No. 48-007(f) is recommended for NFA based on NFA Criterion 5 (LANL 1996, 54943).

### 5.4.1 History

PRS No. 48-007(f) is discussed in detail in Section 3.5 of the work plan (LANL 1992, 7666) and in Section 7.29 of the June 1994 addendum to the work plan (Pratt 1994, 43475). Results of the Phase I investigation are presented in the RFI report (LANL 1995, 50295).

Information that became available after the work plan was written includes the wastewater stream characterization for TA-48, which was conducted in 1993 by Santa Fe Engineering (Santa Fe Engineering 1994, 56204). This study was conducted to identify building drain pipes and characterize the wastewater flows and sources that existed in 1993. Drain pipes were verified by dye tracing. Site visits were performed to verify drain schematics and identify potential outfall pipes that exit the buildings. PRS No. 48-007(f) is identified as outfall 48-46-OPN-2. The report (Santa Fe Engineering 1994, 56204) states that at the time of the wastewater stream characterization this outfall discharged to daylight and that two sink drains flow to this outfall. The report also states that the outfall is no longer being used and there is no active flow to this outfall. During the dye test, the dye reached the expected destination.

The potential contaminants evaluated during the activities described in this addendum included alpha- and gamma-emitting radionuclides.

### 5.4.2 Description

The point of discharge for the outfall that comprises this PRS is on the mesa edge. The drainage channel originating from the discharge point is on a steep section of the slope into Mortandad Canyon. The canyon slope is north facing and heavily vegetated; the vegetation appears normal and healthy.

### 5.4.3 Previous Investigations

Phase I of the RFI site characterization at PRS No. 48-007(f) was performed in July 1993. The results were presented in the RFI report (LANL 1995, 50295), which was submitted to EPA in September 1995. PRS No. 48-007(f) was recommended for NFA (for the RCRA component) in the RFI report. In January 1997 a SAP (LANL 1997, 55326) was prepared and submitted to DOE; a copy was sent to NMED for informational purposes. The SAP describes sampling activities proposed to satisfy the requirements of a regulator NOD for the RFI report (LANL 1996, 54448) and an NMED request for additional information about the RFI report (LANL 1996, 55064). In March 1997 sampling activities were performed in accordance with the SAP.

### 5.4.4 Field Investigation

The objective of the investigation was to determine the presence or absence of radionuclides above background levels in soils and sediments within the drainage channel below the outfall and to fulfill the Phase I RFI data objectives as described in the SAP (LANL 1997, 55326).

The general conceptual model of contaminant transport at TA-48 is described in Section 4.3 of the work plan (LANL 1992, 7666). Outfall discharge provides a mechanism for infiltration of contaminants into the vadose zone and transport of contaminants with surface water in either a dissolved state or adhering to eroded soil.

Field screening during sample collection activities was performed using a Ludlum Model 139 alpha meter and an Eberline ESP-1 beta/gamma meter. Background radiation measurements taken at TA-48 using this instrumentation range from 200 to 500 cpm beta/gamma radiation depending on the location and substrate rock type. Field screening measurements greater than 500 cpm beta/gamma radiation are generally considered to be above background levels. No beta/gamma radiation measurements above background levels were obtained during field screening at this site, and no alpha radiation was detected.

#### 5.4.4.1 Environmental and Engineering Surveys

An H&S radiation survey was performed before field activities began in 1993, as described in the RFI report (LANL 1995, 50295). No radioactivity was detected above background levels; therefore, no additional radiation surveys were performed.

On February 4, 1997, an engineering survey was performed to stake sample locations. Based on the SAP (LANL 1997, 55326), two hand-auger holes were located in sediment accumulation areas within the drainage channel below the outfall.

#### 5.4.4.2 Deviations from the Sampling and Analysis Plan

There were no deviations; samples were collected in accordance with the SAP (LANL 1997, 55326).

#### 5.4.4.3 Sampling Activities

Sampling was performed on March 11 and March 24, 1997. Five soil samples were collected from two locations (Location ID Nos. 48-2163 and 48-2164). Hand-auger holes were drilled to the soil/tuff interface. One hand-auger hole was drilled to a depth of 2 ft, and two samples were collected; another hand-auger hole was drilled to a depth of 2.8 ft, and three samples were collected. The sample collection intervals are shown in Table 5.4.4-1. Beta/gamma radiation measurements obtained during field screening of the samples ranged from 150 to 280 cpm, which are within background levels.

Table 5.4.4-1 summarizes all sampling for PRS No. 48-007(f); Figure 5.4.4-1 shows the sample locations.

### 5.4.5 Evaluation of Inorganic Chemicals

Inorganic chemicals were not analyzed for during this RFI sampling event. The results of inorganic chemical analyses for PRS No. 48-007(f) are presented in the RFI report (LANL 1995, 50295).

### 5.4.6 Evaluation of Radionuclides

Background comparisons were performed for radionuclides for which UTL values are available, as discussed in Section 3.2 in Chapter 3 of this addendum. Four soil samples collected from two locations, including one field duplicate, were analyzed by alpha spectrometry at a fixed-site laboratory for an analyte suite that included $^{241}$Am, $^{238}$Pu, $^{239,240}$Pu, $^{228}$Th, $^{230}$Th, $^{232}$Th, $^{234}$U, $^{235}$U, and $^{238}$U. Five soil samples from two locations were analyzed by gamma spectroscopy at a fixed-site laboratory for an analyte suite that included gamma-emitting fission and activation products, as well as naturally occurring radionuclides.

The highest detected value for each analyte was used for the background comparison. The sediment UTL values were used for background comparison of naturally occurring radionuclides ($^{228}$Th, $^{230}$Th, $^{232}$Th, $^{234}$U, $^{235}$U, and $^{238}$U) in soil (Ryti et al.1997, 56186). The surface UTL values for fallout radionuclides ($^{241}$Am, $^{137}$Cs, $^{238}$Pu, and $^{239,240}$Pu) were used for soil samples collected in the 0 to 0.5-ft intervals. Fallout radionuclide concentrations in deeper sample intervals were not compared with the surface UTL values because fallout activity is limited to surface soils. However, any fallout radionuclide detected at depths below 0.5 ft is considered to be present above background level. In Table 5.4.6-1, the values in the outlined boxes indicate radionuclides that were detected in soil at concentrations greater than or equal to their respective UTL values, or, in the case of fallout radionuclides, those that were detected below 0.5 ft. Table 5.4.6-1

also includes radionuclides for which there are no UTL values for comparison. The radionuclides that exceed background levels at each location are shown in Figure 5.4.6-1.

**TABLE 5.4.4-1**

**SUMMARY OF SAMPLES TAKEN AT PRS No. 48-007(f)[a]**

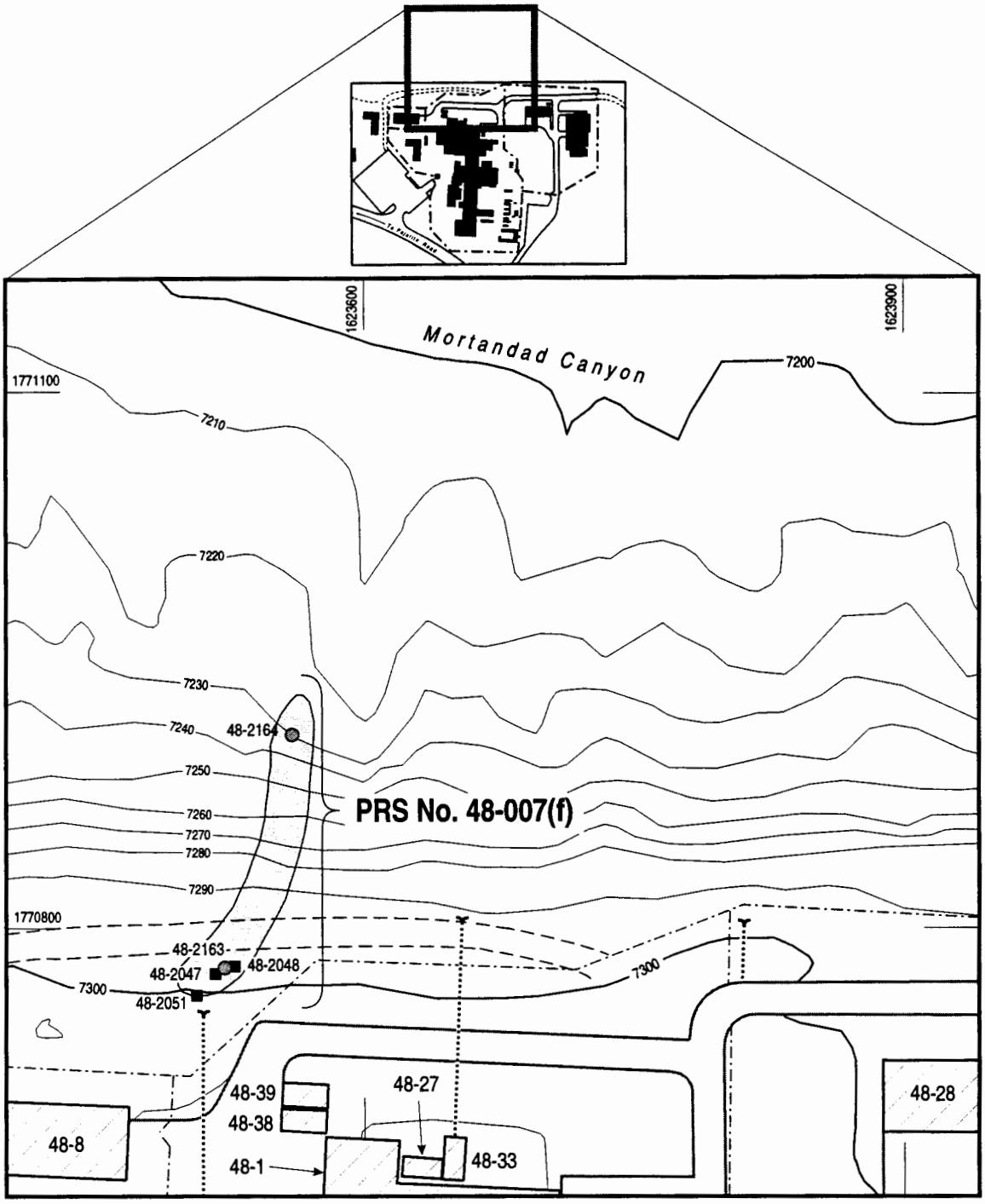
**Part 1**

| PRS | Location ID | Sample ID | Depth | Media | VOCs Fixed Lab | SVOCs Fixed Lab | PCBs Fixed Lab | XRF Mobile Lab | Inorganic Fixed Lab |
|---|---|---|---|---|---|---|---|---|---|
| 48-007(f) | 48-2047 | AAA3525 | 0–0.5 | Soil | NR | NR | NR | 15142 | NR |
| 48-007(f) | 48-2047 | AAA3534 | 0–0.5 (dup)[b] | Soil | NR | NR | NR | 15142 | NR |
| 48-007(f) | 48-2048 | AAA3526 | 0–0.5 (dup)[b] | Soil | NR | NR | NR | 15142 | 15140 |
| 48-007(f) | 48-2048 | AAA3535 | 0–0.5 (dup)[b] | Soil | NR | NR | NR | NR | NR |
| 48-007(f) | 48-2048 | AAA3536 | 0–0.5 (dup)[b] | Soil | NR | NR | NR | NR | 15140 |
| 48-007(f) | 48-2048 | AAA3527 | 0.5–1.5 | Soil | 15136 | 15136 | 15136 | 15142 | 15140 |
| 48-007(f) | 48-2048 | AAA3537 | 0.5–1.5 (dup)[b] | Soil | NR | 15136 | 15136 | NR | NR |
| 48-007(f) | 48-2163 | 0448-97-0064 | 0–1 | Soil | NR | NR | NR | NR | NR |
| 48-007(f) | 48-2163 | 0448-97-0065 | 1–2 | Qbt3 | NR | NR | NR | NR | NR |
| 48-007(f) | 48-2164 | 0448-97-0075 | 0–1 | Soil | NR | NR | NR | NR | NR |
| 48-007(f) | 48-2164 | 0448-97-0076 | 1–2 | Soil | NR | NR | NR | NR | NR |
| 48-007(f) | 48-2164 | 0448-97-0074 | 2–2.8 | Qbt3 | NR | NR | NR | NR | NR |

**Part 2**

| PRS | Location ID | Sample ID | Depth | Media | Gamma Spec Fixed Lab | Am-241 | Iso-Pu | Iso-Th | Iso-U |
|---|---|---|---|---|---|---|---|---|---|
| 48-007(f) | 48-2047 | AAA3525 | 0–0.5 | Soil | NR | 15146 | 15146 | 15146 | 15146 |
| 48-007(f) | 48-2047 | AAA3534 | 0–0.5 (dup)[b] | Soil | NR | NR | NR | NR | NR |
| 48-007(f) | 48-2048 | AAA3526 | 0–0.5 (dup)[b] | Soil | NR | 15146 | 15146 | 15146 | 15146 |
| 48-007(f) | 48-2048 | AAA3535 | 0–0.5 (dup)[b] | Soil | NR | 15146 | 15146 | 15146 | 15146 |
| 48-007(f) | 48-2048 | AAA3536 | 0–0.5 (dup)[b] | Soil | NR | NR | NR | NR | NR |
| 48-007(f) | 48-2048 | AAA3527 | 0.5–1.5 | Soil | NR | 15146 | 15146 | 15146 | 15146 |
| 48-007(f) | 48-2048 | AAA3537 | 0.5–1.5 (dup)[b] | Soil | NR | NR | NR | NR | NR |
| 48-007(f) | 48-2163 | 0448-97-0064 | 0–1 | Soil | 2955 | NR | NR | NR | NR |
| 48-007(f) | 48-2163 | 0448-97-0065 | 1–2 | Qbt3 | 2955 | NR | NR | NR | NR |
| 48-007(f) | 48-2164 | 0448-97-0075 | 0–1 | Soil | 2977 | NR | NR | NR | NR |
| 48-007(f) | 48-2164 | 0448-97-0076 | 1–2 | Soil | 2977 | NR | NR | NR | NR |
| 48-007(f) | 48-2164 | 0448-97-0074 | 2–2.8 | Qbt3 | 2977 | NR | NR | NR | NR |

a. The numbers in the analytical suite columns are analytical request numbers.
b. Field duplicate

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0 50 100 150

FEET

Coordinates are NMSP NAD-83
Contour interval = 10 ft

N

| | |
|---|---|
| Building or structure | Paved area |
| Sample collected before 1997 | Unpaved road |
| 1997 sample location | Fence |
| Approx. location of PRS | Outfall |
| Sewer or waste line/ storm drain | |

**Figure 5.4.4-1. Locations of PRS No. 48-007(f) samples.**

**TABLE 5.4.6-1**

**RADIONUCLIDES WITH CONCENTRATIONS AT OR ABOVE BACKGROUND SCREENING VALUES FOR PRS No. 48-007(f)[a]**

| Location ID | Sample ID | Depth (ft) | Media | Cs-137 (pCi/g) | Eu-152 (pCi/g) | Pu-238 (pCi/g) | Pu-239,240 (pCi/g) | U-235 (pCi/g) |
|---|---|---|---|---|---|---|---|---|
| Soil SAL | N/A | N/A | N/A | 5.1 | 2.6 | 27 | 24 | 10 |
| Fallout UTL | N/A | N/A | N/A | 1.65 | N/A | 0.023 | 0.054 | N/A |
| Sediment UTL | N/A | N/A | N/A | N/A | N.A. | N/A | N/A | 0.16 |
| Qbt3 UTL | N/A | N/A | N/A | N/A | N.A. | N/A | N/A | 0.067 |
| 48-2047 | AAA3525 | 0–0.5 | Soil | NA | NA | 0.001 U | 0.003 U | 0.042 U |
| 48-2048 | AAA3526 | 0–0.5 | Soil | NA | NA | 0.0 U | 0.003 U | 0.027 U |
| 48-2048 | AAA3535 | 0–0.5 (dup)[b] | Soil | NA | NA | 0.014 | 0.01 | 0.024 U |
| 48-2048 | AAA3527 | 0.5–1.5 | Soil | NA | NA | 0.01 | 0.009 | 0.023 U |
| 48-2163 | 0448-97-0064 | 0–1 | Soil | 0.047 | 0.059 U | NA | NA | 0.109 |
| 48-2163 | 0448-97-0065 | 1–2 | Qbt3 | 0.0 U | 0.026 U | NA | NA | 0.081 |
| 48-2164 | 0448-97-0075 | 0–1 | Soil | 0.067 U | 0.012 U | NA | NA | 0.103 |
| 48-2164 | 0448-97-0076 | 1–2 | Soil | 0.051 U | 0.085 | NA | NA | 0.019 U |
| 48-2164 | 0448-97-0074 | 2–2.8 | Qbt3 | 0.070 | 0.031 U | NA | NA | 0.048 |

a. Qualifiers used in table are defined in Section 3.1.2.
b. Field duplicate

No data quality concerns were noted in the validation process for the PRS No. 48-007(f) radionuclide data set.

Detected radionuclides with one or more measured soil concentrations equal to or exceeding UTL values, or present above background levels, are summarized in the following list.

- The fallout radionuclide $^{137}$Cs was detected in two samples collected from two locations at a maximum concentration of 0.070 pCi/g. The samples were collected from soil and tuff at depth intervals of 0 to 1-ft and 2- to 2.8-ft, respectively.

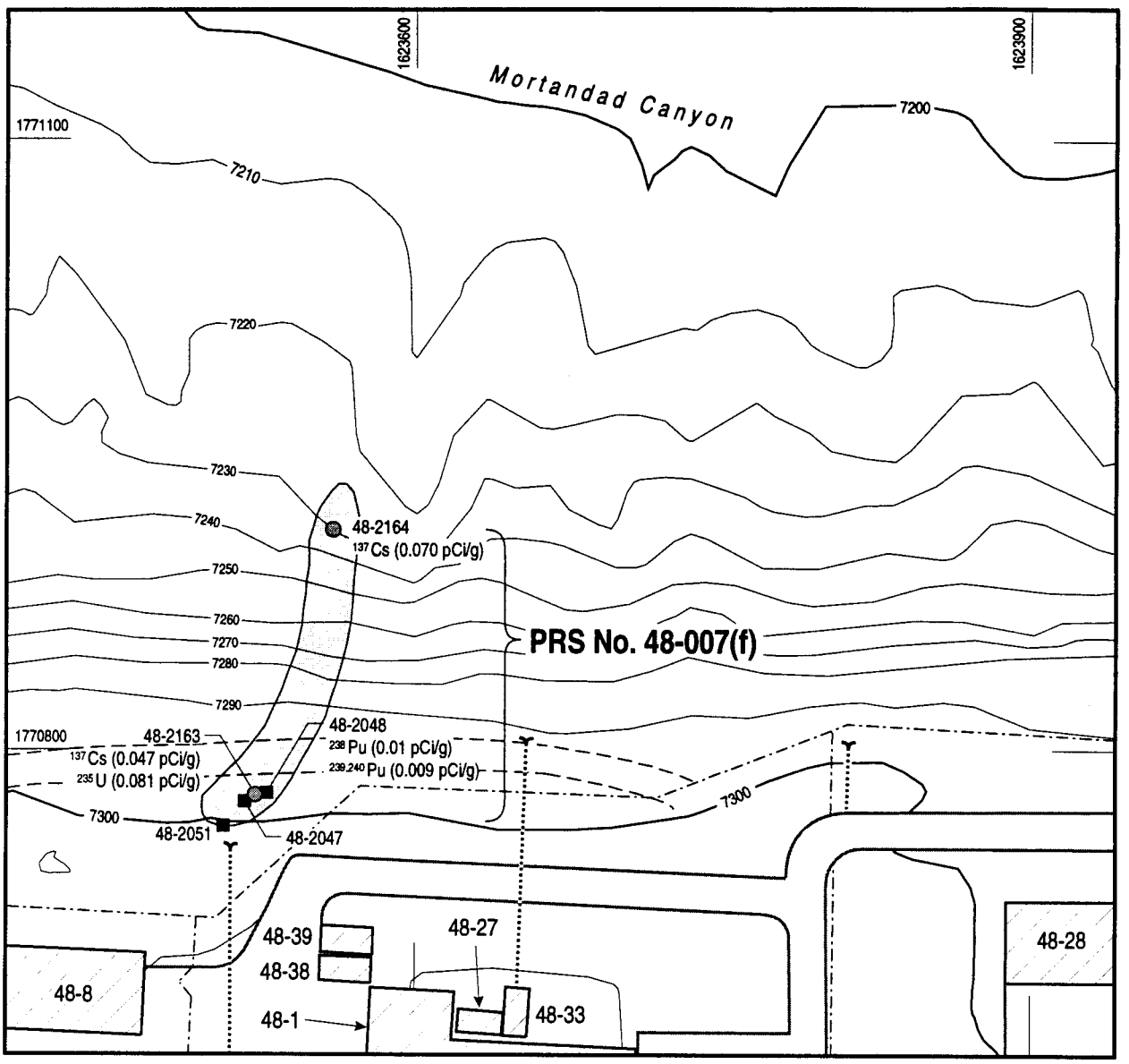
- The fallout radionuclide $^{238}$Pu was detected in one sample at a concentration of 0.01 pCi/g. The sample was collected from the 0.5- to 1.5-ft interval.

- The fallout radionuclide $^{239,240}$Pu was detected in one sample at a concentration of 0.009 pCi/g. The sample was collected from the 0.5- to 1.5-ft interval.

- The radionuclide $^{235}$U was detected above the Qbt3 UTL value of 0.067 pCi/g in one sample at a concentration of 0.081 pCi/g.

The following radionuclide was detected in one or more samples, but a UTL value is not available.

- The radionuclide $^{152}$Eu was detected in one soil sample at a concentration of 0.085 pCi/g.

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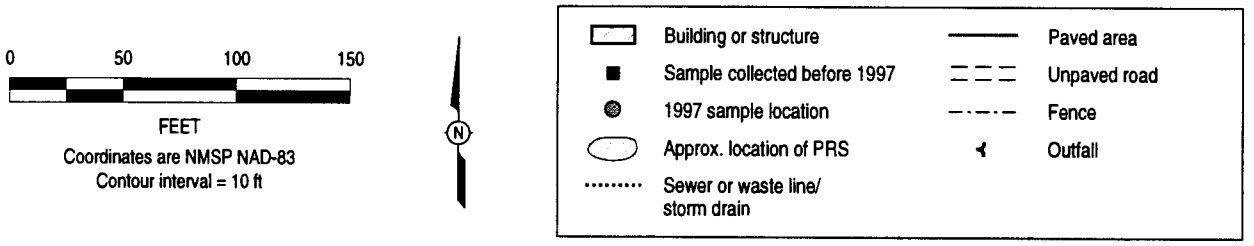


**Figure 5.4.6-1. Locations of analytes that exceed background UTLs at PRS No. 48-007(f).**

### 5.4.7 Evaluation of Organic Chemicals

Organic chemicals were not analyzed for during this RFI sampling event. The results of organic chemical analyses for PRS No. 48-007(f) are discussed in the RFI report (LANL 1995, 50295).

### 5.4.8 Risk-Based Screening Assessment

A total of five radionuclides (four with one or more measured concentrations above background values) were carried forward from the background comparison. All COPCs carried forward from the background comparison in Section 5.4.6 have soil SAL values for comparison. All detected radionuclides were measured at concentrations below their respective SAL values. The MCE calculation for $^{137}Cs$, $^{152}Eu$, $^{238}Pu$, $^{239,240}Pu$, and $^{235}U$ yielded a result of 0.1, well below the threshold of 1.0 at which additive effects may be a concern. The normalized values for the MCE are shown in Table 5.4.8-1.

**TABLE 5.4.8-1**

**MULTIPLE CHEMICAL EVALUATION FOR SOIL SAMPLES AT PRS No. 48-007(f)**

| Carcinogenic Effects of Radionuclides (pCi/g) | | | | | | |
|---|---|---|---|---|---|---|
| Chemical | Location ID | Sample ID | Depth (ft) | Maximum Sample Value | Soil SAL | Normalized Value |
| Cesium-137 | 48-2164 | 0448-97-0074 | 2–2.8 | 0.070 | 5.1 | 0.014 |
| Europium-152 | 48-2164 | 0448-97-0076 | 1–2 | 0.085 | 2.6 | 0.033 |
| Plutonium-238 | 48-2048 | AAA3527 | 0.5–1.5 | 0.01 | 27 | 0.0004 |
| Plutonium-239,240 | 48-2048 | AAA3527 | 0.5–1.5 | 0.009 | 24 | 0.0004 |
| Uranium-235 | 48-2163 | 0448-97-0064 | 0–1 | 0.081 | 10 | 0.008 |
| | | | | | Total* | 0.1 |

*Total may not equal sum of normalized values due to rounding.

No radionuclide COPCs were identified as a result of the human health risk-based screening assessment.

### 5.4.9 Human Health Risk Assessment

No human health risk assessment was performed for PRS No. 48-007(f). No radionuclide COPCs were identified during the human health risk-based screening assessment.

### 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 site 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

The objective of the Phase I RFI at PRS No. 48-007(f) was to determine the presence or absence of contamination associated with the outfall. As described in the NOD response (LANL 1996, 54448),

additional gamma spectroscopy data were required to evaluate the presence or absence of radionuclides at several PRSs at TA-48, including PRS No. 48-007(f).

Although the work plan states that the source of this outfall is noncontact cooling water from vacuum pumps, further archival research indicated that other sources contribute to this outfall (see Section 5.4.1). Nevertheless, the characterization activities conducted for this PRS are sufficient to identify any potential problems associated with discharges to the outfall because samples were analyzed for a complete suite of chemicals and radionuclides.

The sampling design for characterizing potential radionuclide contamination at this PRS was based on professional judgment. To maximize the likelihood of observing residual contamination associated with historical releases from the outfall by collecting only a few samples, sample locations were biased to areas of significant sediment accumulation. Because contaminants associated with historical releases may have been carried in water or sediments from the outfall location and deposited lower in the drainage channel, samples were collected at depth as well as on the surface to determine whether historical contamination may have been covered by later sedimentary deposits. Seven soil samples and two tuff samples were collected for radiological analysis from four locations at depths ranging from surface to 2.8 ft.

No radionuclide COPCs were identified during the human health risk-based screening assessment. Radionuclide contamination at this site is not likely to result in unacceptable dose rates now or in the future. Additional sampling or further assessment activities for evaluating contamination at this PRS is not proposed. PRS No. 48-007(f) is proposed for NFA based on NFA Criterion 5 (LANL 1996, 54943). A Class III permit modification will be requested to remove this site from the HSWA Module of the Laboratory's RCRA operating permit.

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# Appendix A

*Analytical Suites*

## APPENDIX A. ANALYTICAL SUITES

Results of analyses can be found in 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 addendum. Nonetheless, nondetected chemicals are often part of the decision-making process, and it is important to note that analyses for these chemicals were performed. This appendix provides a list of the target analytes in each analytical suite for which samples were taken.

### Radiochemical Suite

**Alpha-emitting radionuclides**

| | | |
|---|---|---|
| Americium-241 | Thorium-228 | Uranium-234 |
| Plutonium-238 | Thorium-230 | Uranium-235 |
| Plutonium-239,240 | Thorium-232 | Uranium-238 |

**Gamma-emitting radionuclides**

| | | | |
|---|---|---|---|
| Actinium-228 | Cobalt-57 | Neptunium-237 | Radon-219 |
| Americium-241 | Cobalt-60 | Potassium-40 | Ruthenium-106 |
| Annihilation radiation | Europium-152 | Protactinium-231 | Selenium-75 |
| Barium-140 | Iodine-129 | Protactinium-233 | Sodium-22 |
| Bismuth-211 | Lanthanum-140 | Protactinium-234m | Thallium-208 |
| Bismuth-212 | Lead-210 | Radium-223 | Thorium-227 |
| Bismuth-214 | Lead-211 | Radium-224 | Thorium-234 |
| Cerium-144 | Lead-212 | Radium-226 | Uranium-235 |
| Cesium-134 | Lead-214 | Radium-228 | Zinc-65 |
| Cesium-137 | Manganese-54 | | |

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# Appendix B

*Data Validation*

## APPENDIX B. DATA VALIDATION

This appendix contains the sample-specific data validation. Data validation tables are presented for potential release sites (PRSs) evaluated for this addendum. Only radiochemical data were evaluated for this addendum; therefore, the data validation tables include only the radiological analytical suites. Data validation tables were not prepared for PRS No. 48-007(f) because no qualification of the radiochemical analytical data was required. Data quality for the entire radionuclide data set is discussed in Chapter 4 of this addendum.

### TABLE B-1

### DATA VALIDATION TABLE FOR PRS No. 48-002(e) SAMPLES

| Request No. | Location ID | Sample ID | Analytical Suite | QC Parameter | Comments |
|---|---|---|---|---|---|
| 15333 | 48-2037 | AAA3545 | Isotopic thorium | Blank | Because of contamination in the method blank sample, sample results for the following analytes should be regarded as estimates and biased high (J+): $^{228}$Th, $^{230}$Th, and $^{232}$Th. |
| 15333 | 48-2037 | AAA3546 | Isotopic thorium | Blank | Because of contamination in the method blank sample, sample results for the following analytes should be regarded as estimates and biased high (J+): $^{228}$Th, $^{230}$Th, and $^{232}$Th. |
| 15333 | 48-2037 | AAA3547 | Isotopic thorium | Blank | Because of contamination in the method blank sample, sample results for the following analytes should be regarded as estimates and biased high (J+): $^{228}$Th, $^{230}$Th, and $^{232}$Th. |
| 15333 | 48-2057 | AAA3782 | Isotopic thorium | Blank | Because of contamination in the method blank sample, sample results for the following analytes should be regarded as estimates and biased high (J+): $^{228}$Th, $^{230}$Th, and $^{232}$Th. |

### TABLE B-2

### DATA VALIDATION TABLE FOR PRS No. 48-007(b) SAMPLES

| Request No. | Location ID | Sample ID | Analytical Suite | QC Parameter | Comments |
|---|---|---|---|---|---|
| 15146 | 48-2043 | AAA3517 | Isotopic thorium | Accuracy | Because of tracer recovery less than 30% (but greater than 10%), results for the following analyte(s) should be regarded as estimates and biased low (J-): $^{228}$Th, $^{230}$Th, and $^{232}$Th. |
| 15146 | 48-2044 | AAA3519 | Isotopic thorium | Accuracy | Because of tracer recovery less than 30% (but greater than 10%), results for the following analyte(s) should be regarded as estimates and biased low (J-): $^{228}$Th, $^{230}$Th, and $^{232}$Th. |

**TABLE B-3**

**DATA VALIDATION TABLE FOR PRS No. 48-007(c) SAMPLES**

| Request No. | Location ID | Sample ID | Analytical Suite | QC Parameter | Comments |
|---|---|---|---|---|---|
| 2977 | 48-2166 | 0448-97-0078 | Gamma spectroscopy | Accuracy | All gamma spectroscopy results are rejected due to insufficient aliquot size to perform reliable measurement. |
| 2977 | 48-2166 | 0448-97-0079 | Gamma spectroscopy | Accuracy | The results for $^{211}$Bi should be regarded as unusable (R) because of interference problems with other radioisotopes. |
| 15146 | 48-2046 | AAA3524 | Isotopic plutonium | Accuracy | Because of tracer recovery less than 30% (but greater than 10%), results for the following analyte(s) should be regarded as estimates and biased low (J-): $^{238}$Pu and $^{239,240}$Pu. |

# Attachment I

*Statistical Tests for Thorium Data*

# ATTACHMENT I. STATISTICAL TESTS FOR THORIUM DATA

## I.1 Introduction

This attachment includes graphical representations and statistical comparisons of Technical Area (TA) -48 and Laboratory sediment background data sets for $^{232}$Th, $^{228}$Th, and $^{230}$Th. Graphical and statistical evaluations of the two data sets were performed to assist in determining whether a release of thorium isotopes may have occurred at TA-48. Potential release site (PRS) data values were aggregated across TA-48 for these comparisons because of the small data sets for individual PRSs. The Laboratory sediment background data set was used. Following the decision logic in Ryti et al. (1997, 56186), naturally occurring radionuclides that are not from tuff samples are compared with the sediment background data set.

Figures A-1 through A-3 show three graphical methods of illustrating a data distribution. These graphs allow a qualitative comparison of the Laboratory sediment background data set and the TA-48 data set for each thorium isotope. Observations reported as nondetected values are shown in the figures as half the reported detection limit. Below is a general description of the graphics that appear in each figure.

- Upper left corner

  The histogram of the Laboratory background data is presented for the analyte being considered. The horizontal axis gives the observed concentrations in pCi/g; the vertical axis gives the number of observations in each concentration class.

- Lower left corner

  The histogram of the site data is presented for the analyte being considered. The axes are the same as for the Laboratory background data histogram.

- Upper right corner

  Box plots of both the Laboratory background data and the site data are presented for the analyte being considered. The outer box area of these plots identifies the region between the 25th percentiles and the 75th percentiles (also known as the interquartile range); the middle line represents the median. The hash marks that extend out from the box represent 1.5 times the interquartile range, which provides an interval outside of which data may be evaluated for their potential to be outliers. The vertical axis units are concentrations of the observed data in pCi/g. Open circles represent detected values; solid triangles represent half the detection limit for values reported as nondetects.

- Lower right corner

  Density functions of both the Laboratory background data and the site data are presented for the analyte being considered. The density functions are smoothed, normalized "histograms" in which the horizontal axis units are again concentrations in pCi/g. The solid line represents the Laboratory background data set; the dotted line represents the TA-48 data set. The vertical axis is essentially equivalent to the probability of observing any particular concentration; however, because these are continuous distributions, the exact probabilities are actually the areas under the curve within some interval of concentrations.

Distribution shift tests were performed to determine whether the distributions of the Laboratory sediment background data set and the TA-48 data set are statistically different. The distribution shift tests that were

performed are sometimes known as the "Gilbert toolbox" and are referenced in Gilbert (1987, 56179). The tests are the Gehan/Wilcoxon Rank Sum (Gehan) test, the quantile test, and the slippage test. Nondetected values are coded as negative detection limit values for these tests. Each of the tests is written to account for nondetected values in their results.

The Gehan test is best suited for assessing complete shifts in distribution, whereas the Quantile test is better suited for assessing partial shifts. The slippage test determines the probability of the observed number of site concentrations being greater than the maximum background concentration, given that the site data originates from the same distribution as the background data. Among the three tests, most types of differences between distributions can be determined.

Observed significance levels (p-values) are reported for the tests. The p-value is the probability of observing data at least as different from the background data as the actual, observed site data if the site concentration distribution is the same as background. If a p-value is less than 0.05, then there is reason to suspect that there is a difference between the background and site distributions; otherwise, no difference is indicated, and the site distribution is not statistically different than the background distribution.

## I.2 Results

Figures A-1 through A-3 graphically show the relationships between the TA-48 (site) data and the Laboratory sediment background (referred to as background) data. Although the range of the site data is greater than the range of the background data for every isotope, the figures show that the site and background distributions are quite consistent. The box plots in Figures A-1 through A-3 show that the medians and interquartile ranges of the site data sets are less than their respective background counterparts. The density estimates in the figures show that the range of concentrations in the site data with the greatest probability overlap the most probable range of concentrations in the background data set. In a qualitative analysis, the figures show that the site distributions are not elevated above background.

The results of the statistical tests confirm the findings of the qualitative analysis. Table A-1 shows the p-values for Gilbert toolbox tests that are used to compare the site and background distributions. A p-value of 0.05 or less indicates that the site distribution "failed" the test. That is, a small p-value shows that there is a statistically significant difference between the site and background characteristic that the test is measuring. The p-values for the TA-48 site data comparison with background are all greater than 0.05.

Table A-1 shows that none of the tests for any of the isotopes result in a significant difference between site and background distributions. These results imply that there is no evidence to suggest that the site distribution is different from the background distribution.

Both the qualitative graphical analysis and the quantitative statistical analysis support the conclusion that isotopic thorium is not elevated above background levels across TA-48. Analyses were not run on a PRS-specific basis because the data sets for several PRSs are too small to allow for anything more than a qualitative comparison.

**TABLE A-1**

**RESULTS FROM THE GILBERT TOOLBOX DISTRIBUTION SHIFT TESTS**

| Isotope | P-values for the Statistical Test | | |
|---|---|---|---|
| | Gehan | Quantile | Slippage |
| Thorium-232 | 1.000 | 0.999 | 0.523 |
| Thorium-228 | 0.998 | 0.9985 | 0.849 |
| Thorium-230 | 1.000 | 1.000 | 0.368 |

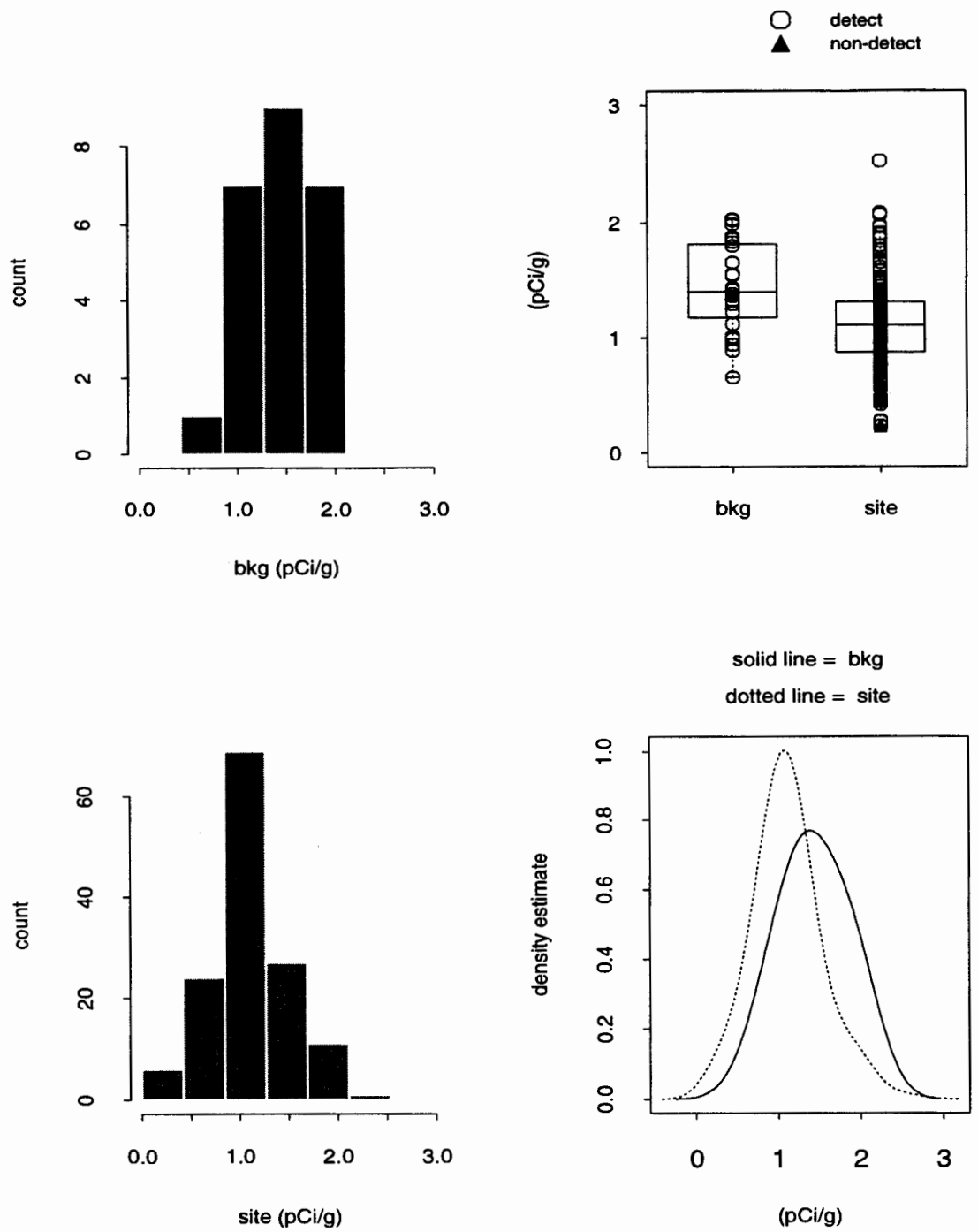


**Figure A-1. Graphical comparisons for $^{232}$Th across TA-48 and Laboratory sediment background data.**

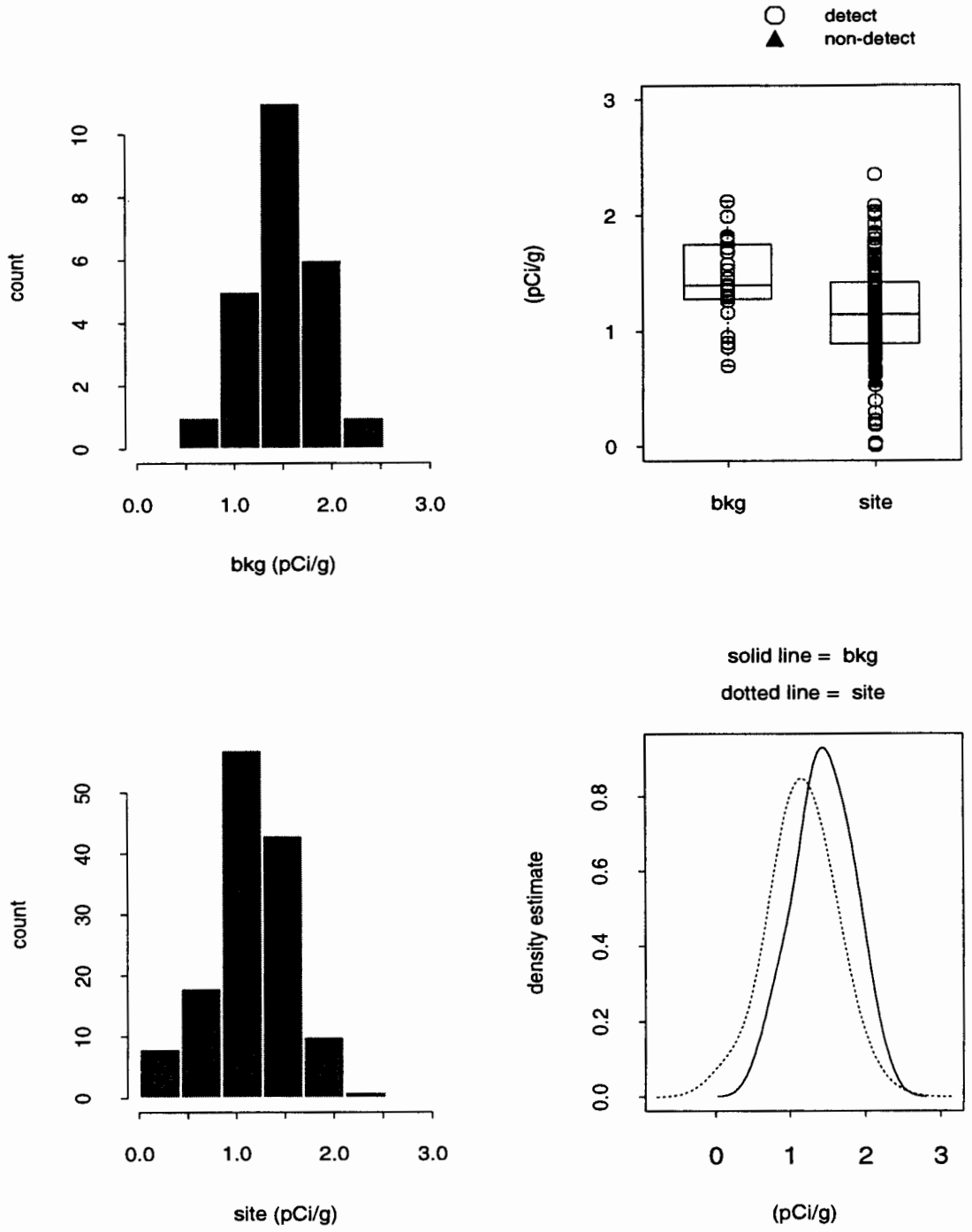


**Figure A-2. Graphical comparisons for $^{228}$Th across TA-48 and Laboratory sediment background data.**

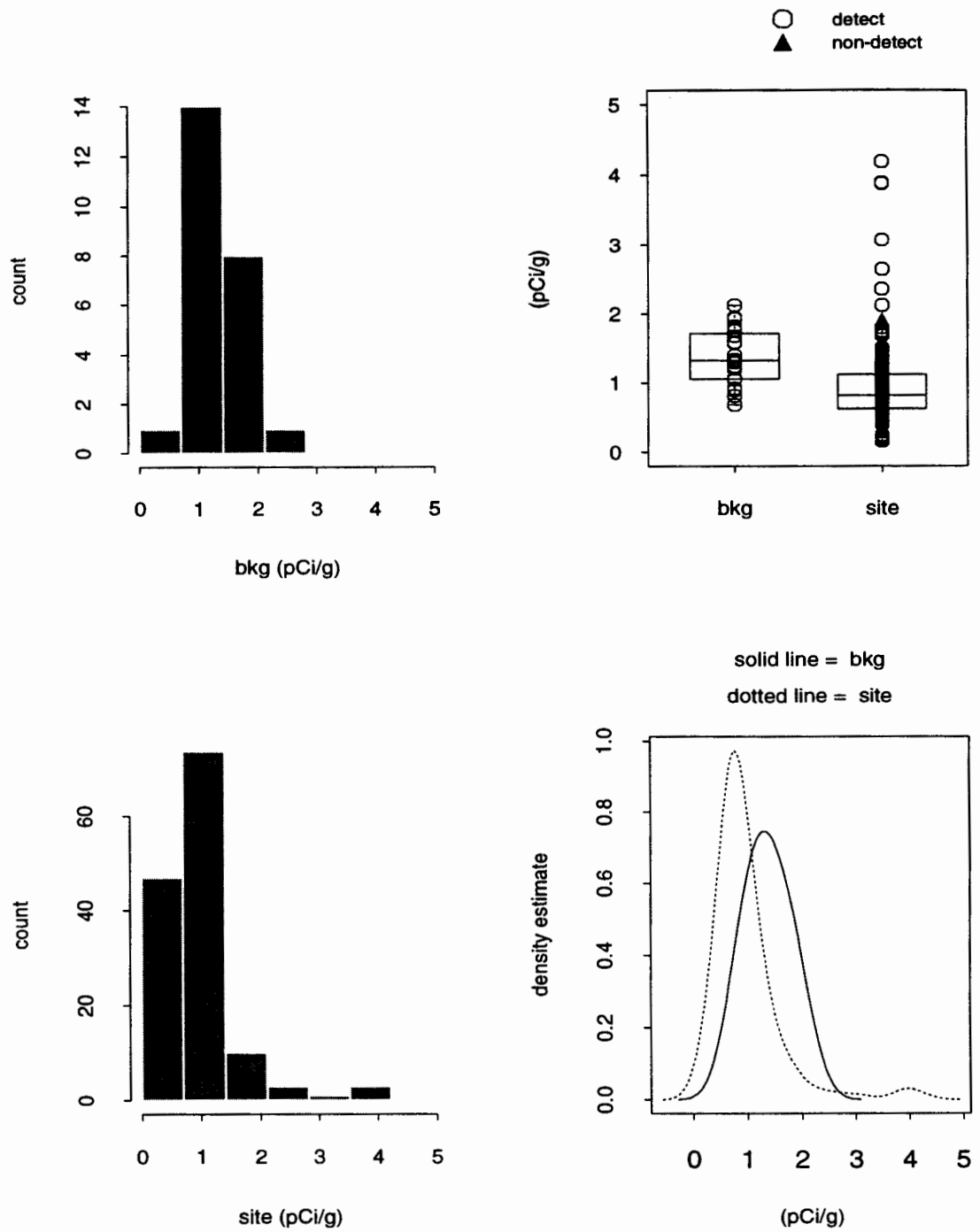


**Figure A-3. Graphical comparisons for $^{230}$Th across TA-48 and Laboratory sediment background data.**

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