Department of Energy
National Nuclear Security Administration
Albuquerque Operations Office
Office of Los Alamos Site Operations
Los Alamos, New Mexico 87544

LIBRARY COPY

Los Alamos Land Transfer Project Office

July 3, 2002

03031—123456789101112131415
02

James Bearzi, Chief
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, New Mexico 87502

Dear Mr. Bearzi:

Enclosed for your review are documents prepared by the Department of Energy (DOE), in support of the conveyance of one tract of land, pursuant to DOE's mandate under Public Law 105-119. The tract will be conveyed to the County of Los Alamos. The enclosed documents relate to the following tract:

- Tract A-17, part of the TA-74 Tract

Enclosed are

- the Environmental Baseline Survey
- the environmental site assessment
- the notice required by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), together with supporting information from the Environmental Restoration Project
- the tract map

Please review the enclosed documents and provide your comments to me within 30 days of receipt of this letter. I would be pleased to meet with you or your staff to discuss these documents. Please let me know if I can be of assistance to you in your reviews.

13666

Please call me at 665-7203 if you have questions or concerns.

Sincerely,

Theodore J. Taylor
Project Manager

Enclosures: as stated

Cc w/o enclosure:
T. Taylor, DIR, OLASO
E.D. Martinez, Acting Director, OLASO
E. Romero, Program Manager, OLASO
R. Mayer, EPA
K. Rea, RRES-ECO, UC-LANL, MS M889
LandTran File

Environmental Baseline Survey

for

A-17

Technical Area 74-1 (West) Tract

Pursuant to the US Department of Energy

Cross-Cut Guidance on Environmental Guidance
for DOE Real Property Transfers

June 25, 2002

Environmental Baseline Survey

for

A-17

Technical Area 74-1 (West) Tract

Executive Summary

This document, "Environmental Information for Real Property Transfer", was prepared in accordance with the "Cross-Cut Guidance on Environmental Requirements for DOE Real Property Transfers" in preparation of transferring ownership of parcel A-17, the Technical Area (TA) 74-1 (West) Tract (hereafter referred to as TA-74 West), at Los Alamos National Laboratory from the US Department of Energy (DOE), National Nuclear Security Administration (NNSA)[1] to Los Alamos County pursuant to Public Law 105-119, Section 632. It discusses NNSA compliance with the environmental requirements associated with real property transfers established by DOE. It also demonstrates that, although potentially contaminated, TA-74 West is in such condition that NNSA may issue deeds on the basis that "all remedial action necessary to protect human health and the environment has been taken".

The methodology used to prepare this report was to:

- use the environmental site assessment conducted for TA-74 North (it was determined to be applicable to TA-74 West). This assessment was conducted consistent with the American Society of Testing and Materials (ASTM) "Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process" (ASTM E 1527-00) (see Appendix B),
- review historical and current information and documents pertinent to TA-74 West,
- perform a physical examination of the TA-74 West, and
- consult with both University of California and DOE staff to confirm existing information or develop additional information.

Based on this assessment, it has been determined that TA-74 West has:

- one potential release site (PRS). The canyon bottom of Pueblo Canyon contains residual contamination from historical operations at the Laboratory, and is under investigation by the ER Project.
- no record that hazardous substances were ever stored at this site, and

1 Congress established the National Nuclear Security Administration (NNSA) within the DOE to manage the nuclear weapons program for the United States. Los Alamos National Laboratory (LANL or Laboratory) is one of the facilities now managed by the NNSA. The NNSA officially began operations on March 1, 2000. Its mission is to carry out the national security responsibilities of the DOE, including maintenance of a safe, secure, and reliable stockpile of nuclear weapons and associated materials capabilities and technologies; promotion of international nuclear safety and nonproliferation; and administration and management of the naval nuclear propulsion program.

- no requirements for future remedial clean-up activities.

Air quality at TA-74 West is high. Neither hazardous nor radioactive air pollutant sources exist at TA-74 West. Vehicles passing near the southern edge of the site on State Road 502 emit small amounts of hydrocarbon-generated ozone and carbon dioxide; but no criteria pollutants are emitted from anywhere on this small tract of land.

The TA-74 West tract is located in the bottom of Pueblo Canyon. Pueblo Canyon has a natural ephemeral stream that crosses this tract. There are no wetlands or springs at this location.

No threatened or endangered species have been observed at the TA-74 West Tract, although it is within an area of environmental interest for the Mexican spotted owl.

TA-74 West was used from the Archaic period through the Nuclear Energy period. The tract was part of the Ramon Vigil Spanish land grant. The region of influence for this tract includes the land tract itself, plus nearby cultural resources located off the tract. For this tract, the nearby resources are located on LANL, Bandelier National Monument, Santa Fe National Forest, and San Ildefonso Pueblo lands.

Based on this information, the University of California and DOE conclude that there are no outstanding environmental issues to prevent conveyance or transfer of TA-74 West to Los Alamos County.

Table of Contents

Executive Summary 2
1.0 Purpose of the Environmental Baseline Survey 5
1.1 Boundaries of Property and Scope of Survey 5
2.0 Survey Methodology 6
2.1 Approach and Rationale 6
2.1.1 List and Description of Documents Reviewed 7
2.1.2 Inspections of Properties Conducted and Personnel Contacted 8
3.0 Summary of Data 8
3.1 History and Current Use 8
3.2 Environmental Setting 9
3.2.1 Stormwater Runoff Patterns 10
3.2.2 Hazardous Materials and Waste Management 10
3.2.3 CERCLA-Related Contamination 10
3.2.4 Storage Tanks and Pipelines 10
3.2.5 Wastewater Treatment and Disposal 10
3.2.6 Lead in Drinking Water 11
3.2.7 Oil Water Separator 11
3.2.8 Asbestos 11
3.2.9 Air 11
3.2.10 Lead-Based Paint Surveys and Other Sources of Lead 11
3.2.11 PCBs 11
3.2.12 Pesticides 11
3.2.13 Medical Wastes 11
3.2.14 Ordnance 12
3.2.15 Radioactive Materials and Wastes 12
3.2.16 Radon 12
3.2.17 Groundwater 12
3.3 Natural and Cultural Resources 12
3.4 Identification of Uncontaminated Properties 13
3.5 All Other Properties 13
4.0 Summary of Data for Adjacent Properties 13
4.1 History and Current Use 13
4.2 Environmental Setting 13
4.3 Adjacent Properties with No Known or Suspected Releases 13
4.4 Adjacent Properties with Known or Suspected Releases 14
5.0 Conclusions and Recommended Courses of Action 14
5.1 Facility Matrix 14
5.2 Property Categorization 14
5.3 Resource Map 14
6.0 Certification of Environmental Baseline Survey 14
Appendix A .....
Appendix B .....
Appendix C .....
Appendix D .....

1.0 Purpose of the Environmental Baseline Survey

On November 26, 1997, Congress passed Public Law 105-119. Section 632 of that law directed the Secretary of Energy to convey to the Incorporated County of Los Alamos, NM, or to the designee of the County and transfer to the Secretary of the Interior, in trust for the Pueblo of San Ildefonso, parcels of land under the jurisdictional administrative control of the Secretary at or in the vicinity of Los Alamos National Laboratory. Such parcels, or tracts, of land must meet the suitability criteria established by the law, that is, they are not required for the national security mission before the end of 11/26/2007; can be restored or remediated by 11/26/2007; and are suitable for historic, cultural or environmental preservation, economic diversification, or community self-sufficiency. The DOE[2] identified 10 tracts of land for potential transfer to the County of Los Alamos or to San Ildefonso Pueblo. These 10 tracts of land have been further divided into sub-parcels for transfer purposes.

DOE's "Cross-Cut Guidance on Environmental Requirements for DOE Real Property Transfers (DOE/EH-413/9712) provides guidance on types of information needed to support real property transfers. Information such as the presence of floodplains and wetlands; critical habitats; historic properties; and hazardous substances must be gathered and provided to potential recipients of the property. This document provides relevant environmental information as outlined in the Cross-Cut Guidance and provides references to more detailed information.

1.1 Boundaries of Property and Scope of Survey

Technical Area (TA) 74 represents a large area of LANL buffer lands, consisting of approximately 2,715 acres (1,100 hectares) (DOE 1998b). The tract is located east of the Los Alamos townsite and below the mesa upon which the townsite is built. The northern half of the site is dominated by lower Bayo Canyon; the southern half includes much of Pueblo Canyon. U.S. Forest Service (USFS) property borders the tract to the north. State Road 502 forms the southern border of the tract and provides the primary vehicle access. State Road 502 also serves to separate TA-74 from the northeast edge of the White Rock Y Tract and the northwest edge of Bandelier National Monument (BNM). Pueblo of San Ildefonso lands lie to the east, and the Airport Tract is to the west. See Figure 13.1.1-1 for the TA-74 Tract Layout in the CT EIS (DOE/EIS-0293).

TA-74 West is a small (about 5.5 acre parcel) wanted by Los Alamos County for construction of a sewer treatment plant prior to transfer of the remaining portions of TA-74 slated for transfer to the County. It is located in the bottom of Pueblo Canyon

---

2 Congress established the National Nuclear Security Administration (NNSA) within the DOE to manage the nuclear weapons program for the United States. Los Alamos National Laboratory (LANL or Laboratory) is one of the facilities now managed by the NNSA. The NNSA officially began operations on March 1, 2000. Its mission is to carry out the national security responsibilities of the DOE, including maintenance of a safe, secure, and reliable stockpile of nuclear weapons and associated materials capabilities and technologies; promotion of international nuclear safety and nonproliferation; and administration and management of the naval nuclear propulsion program.

approximately 600 yards upstream from the existing sewer treatment plant. The northeast corner of TA-74 West is located at the junction of the Los Alamos County line and the boundary line between NNSA and County property. It measures approximately 600 feet east to west by 300 feet north to south.

Access to TA-74 is currently gated and limited to Federal, State, and local government personnel on official business. However, access by others may be coordinated on a case-by-case basis. Access to TA-74 West is via the dirt road going to the existing sewer treatment plant, and then up a dirt road entering Pueblo Canyon. Although not subject to Los Alamos County land use controls, the whole TA-74 tract is zoned by the County as Federal lands for planning purposes (LAC 1998).

The whole TA-74 Tract is isolated from LANL operations and contains numerous archaeological sites and sensitive wildlife habitat (LANL 1990). The site is heavily forested with ponderosa pine and pinyon-juniper woodlands (DOE 1999c).[3] The TA-74 West parcel is within the ponderosa pine woodland with a mixture of pinyon and juniper.

The legal property boundary description of the whole TA-74 tract is provided by the Army Corps of Engineers Title Report, "Technical Area 74 at Los Alamos, New Mexico", September 15, 1998. The description of the 5.5 acre TA-74 West parcel is contained in the Army Corps of Engineers survey and property description.

The scope of this Environmental Baseline Survey was to identify potential environmental issues associated with TA-74 West that might impact transfer of ownership.

2.0 Survey Methodology

The methodology used to prepare this report was to:

- use the environmental site assessment conducted for TA-74 North (it was determined to be applicable to TA-74 West). This assessment was consistent with the American Society of Testing and Materials (ASTM) "Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process" (ASTM E 1527-00) (see Appendix B),
- review historical and current information and documents pertinent to TA-74 West,
- perform a physical examination of TA-74 West, and
- consult with both University of California and DOE staff to confirm existing information or develop additional information.

2.1 Approach and Rationale

3 Extracted from the DOE/EIS – 0293, Final Environmental Impact Statement for the Conveyance and Transfer of Certain Land Tracts Administered by the U.S. Department of Energy and Located at Los Alamos National Laboratory, Los Alamos and Santa Fe Counties, New Mexico, October 1999, Chapter 19, Section 19.1.1, Land Use.

Historical and current information (see 2.1.1 below) for TA-74 West was reviewed, and the site was physically visited and surveyed. After determining the nature and quality of available information, UC and DOE staff were consulted to confirm existing information or develop new information as needed. Collectively, this survey addressed air quality, water quality (surface and groundwater), soil and sediment contamination, and any structures, waste sites, natural resources or other environmental concerns present at the site.

To conduct this assessment it was assumed that the TA-74 West parcel boundaries were established and not subject to significant change. Environmental conditions and associated information were evaluated based upon those boundaries. Second, it was assumed that the nature and quality of the document reviews and site surveys were independent of, and unaffected by, the recipients' intended use as identified in the "Conveyance and Transfer Plan for Certain Land Tracts Administered by the U.S. Department of Energy Located at the Los Alamos National Laboratory, Los Alamos and Santa Fe Counties, New Mexico" (DOE September 2000). Lastly, it was assumed that a final inspection or "walk-through" of each parcel would occur prior to conveyance or transfer.

2.1.1 List and Description of Documents Reviewed

In addition to the documents listed below, the Environmental Site Assessment (Appendix B) identifies additional resources used in this evaluation.

1. "Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory", US Department of Energy, DOE/EIS-0238, January 1999.

2. "Final Environmental Impact Statement for the Conveyance and Transfer of Certain Tracts Administered by the US DOE and Located at Los Alamos National Laboratory", US Department of Energy, DOE/EIS-0293, October 1999

3. "Final Environmental Restoration Report to Support Land Conveyance and Transfer under Public Law 105-119", Los Alamos National Laboratory, LA-UR-99-4187, August 1999

4. "Combined Data Report to Congress to Support Land Conveyance and Transfer under Public Law 105-119", US Department of Energy, Unnumbered Report, January 2000.

5. "Conveyance and Transfer Plan for Certain Land Tracts Administered by the U.S. Department of Energy Located at the Los Alamos National Laboratory, Los Alamos and Santa Fe Counties, New Mexico", U.S. Department of Energy, Report to Congress Under Public Law 105-119, Unnumbered Report, September 2000.

6. "Technical Area 74 at Los Alamos, New Mexico", U.S. Army Corps of Engineers Title Report, September 15, 1998.

7. LANL Hazardous Waste Facility Permit, NM 0890010515-1, 11/8/89

8. "Environmental Surveillance at Los Alamos During 1999", Los Alamos National Laboratory, LA-13775-ENV, December 2000.

9. "Cross-Cut Guidance on Environmental Requirements for DOE Real Property Transfers", U.S. Department of Energy, DOE/EH-413/9712, October 1997

10. "Threatened and Endangered Species Habitat Management Plan," Los Alamos National Laboratory, August 1998.

11. "A Status Report on Threatened and Endangered Species, Wetlands, and Floodplains for the Proposed Conveyance and Transfer Tracts at Los Alamos National Laboratory, Los Alamos, New Mexico", Los Alamos National Laboratory, July 1998.

12. LANL Draft Watershed Management Plan

13. LANL Environmental Restoration Project Baseline, WBS 1.4.2.6.01.02.24.JG.

14. "Endangered Species Act", United States Code, Washington, D.C., Title 16, Conservation; Chapter 35, Endanger Species Act, December 1973.

2.1.2 Inspections of Properties Conducted and Personnel Contacted

The Environmental Site Assessment (Appendix B) identifies personnel contacted during this evaluation.

3.0 Summary of Data

3.1 History and Current Use

Prior to LANL occupancy, there was little development in this remote area. Historical maps from the pre-LANL era (1924), aerial photographs of the area (1935), and historical accounts of life in the area show little development in the area until 1917 when the Los Alamos Ranch School for boys was established.

In the early 1920's, a man named Coomer leased land in Pueblo Canyon and built a cabin to use as a base for guided tours of the area. The lease was purchased in 1923 by a benefactor and was provided to the Los Alamos Ranch School for boys as a base for outdoor activities for the boys. As a result, the cabin came to bear the benefactor's name, Camp Hamilton, and was used by the Boy's School for nearly two decades. This cabin, left to ruin, is located near the TA-74 West parcel.

Even after LANL occupancy, TA-74 had very little development and served instead to buffer Laboratory activities from the surrounding region. Very early in the Laboratory's history (1949), four structures were built on the western-most mesa-top area of TA-74. This development was called the East Gate Laboratory and was designated TA-19. In approximately1960, East Gate was decommissioned, the buildings were removed and all Laboratory activity in this parcel ceased. The ultimate disposition of these buildings is not documented; however, during the ER Project investigations of this area, there has been no indication of building debris or other indications that the buildings were disposed of onsite. This development was approximately 1800 feet south of the TA-74 West parcel.

Existing uses of TA-74, as a whole, include activities associated with the State highway maintenance facility, which includes two buildings, and the water wells and tanks present at the site. Adjacent land uses to TA-74 include the Bayo Wastewater Treatment Plant located in the west-central portion of the tract (about 600 yards east of TA-74 West), land practices of the Pueblo of San Ildefonso to the east, and ongoing airport activities to the west. Land use directly to the south and southwest includes the use and maintenance of State Road 502 and the White Rock Y intersection of State Road 502 and State Road 4. Directly to the southeast, land use is dominated by tourism and National Park Service activities at Bandelier National Monument. Land uses to the north on USFS lands include hiking, horseback riding, climbing, bird watching, and forest management activities. The road into the tract and several unpaved roads within the tract serve as fire-break roads for the USFS and provide access to adjacent land, including the Bayo Wastewater Treatment Plant.

There are three well-established trails that cross TA-74. The Otowi Mesa Trail crosses between the northwest corner of the tract and the northwest side of the tract. The Bayo Canyon Trail enters the tract from the northwest and continues in a southeasterly direction to its terminus within the TA-74 Tract. The Camp Hamilton Trail trends roughly south and north along the western edge of the tract (LANL 1998c). Although access via the gated main road is limited, access is available to the general public for recreational purposes (hiking, horseback riding, climbing) via these trails. There are also environmental media monitoring stations located on and near TA-74. The Camp Hamilton Trail comes near TA-74 West (approximately 1600 feet east) as it crosses Pueblo Canyon.

3.2 Environmental Setting

Vegetation communities present within the TA-74 tract are basically ponderosa pine forest; pinyon-juniper woodland; and open shrub, grassland, and wildflower areas. Maintained dirt roads are the primary development within the tract. Pueblo, Bayo, and Los Alamos Canyons cross this tract. An ephemeral stream is associated with each canyon. Floodplains with the TA74 Tract are not well defined. Wetland areas are present downstream of the Bayo Wastewater Treatment plant. Flora and fauna are characteristic of the region. Suitable habitat is present for the Mexican Spotted Owl and bald eagle. Los

Alamos Canyon and Pueblo Canyon areas of environmental interest (AEIs) are defined within this land tract for the Mexican Spotted Owl. Noise levels within the TA-74 Tract are associated with vehicular traffic on State Road 4 and State Road 502, and with casual recreational use. Current lighting in the tract is associated with vehicles and distant residential and commercial facilities.

Given its location in the bottom of Pueblo Canyon in the western portion of TA-74, TA-74 West is dominated by ponderosa pine. It is crossed by an ephemeral stream, but contains no wetlands or springs. It is within the AEI for the Mexican Spotted Owl; however, the USFWS issued a final biological opinion on January 15, 2002, that addresses all land transfer tracts. This opinion states that transfer "may affect, likely to adversely affect" the owl on the TA-74 Tracts, and provides four conservation recommendations to mitigate the adverse affects.

3.2.1 Stormwater Runoff Patterns

The TA-74 West tract is transected by the Pueblo Canyon stream channel. This stream receives run-off from the mesa tops, and is subject to flash flooding during heavy rainfall events.

3.2.2 Hazardous Materials and Waste Management

Not applicable. No hazardous wastes have historically been or are currently managed by LANL at TA-74 West.

3.2.3 CERCLA-Related Contamination

The TA-74 West Tract has one potential release site (PRS): the Pueblo Canyon stream channel which contains residual contamination from past LANL operations. Characterization performed to date indicates the presence of several radioactive isotopes in stream channel sediments. Although additional sampling may be performed, sampling conducted to date indicates that existing levels of contamination are orders of magnitude lower than levels that would elicit health concerns..

3.2.4 Storage Tanks and Pipelines

There is no historical record, employee recollection, or visible indication that there are or were USTs in service at TA-74 West.

3.2.5 Wastewater Treatment and Disposal

Los Alamos County plans to construct and operate a sanitary wastewater treatment plant at TA-74 West. However, to date, no wastewater treatment or disposal has occurred at TA-74 West.

3.2.6 Lead in Drinking Water

There are no wells on TA-74 West, or no known sources of lead contamination present.

There are several LANL environmental monitoring wells located near TA-74 West. None of these monitoring wells have indicated lead contamination.

3.2.7 Oil Water Separator

Not applicable. No current or historic use of oil water separators are associated with this site.

3.2.8 Asbestos

Not applicable. No current or historic use of asbestos is associated with this site.

3.2.9 Air

Air quality at the tract is high. Neither hazardous nor radioactive air pollutant sources exist at TA-74 West. Small amounts of hydrocarbon-generated ozone and carbon dioxide are emitted by vehicles passing near the southern edge of TA-74 West on State Road 502; but no criteria pollutants are emitted from anywhere on this small tract of land.

The tract is part of New Mexico Region 3, an attainment area that meets National Ambient Air Quality Standards (NAAQS) for criteria pollutants. Analyses performed for the LANL SWEIS estimate that concentrations of chemical air pollutants will not exceed health-based standards for any point beyond the LANL boundary (DOE 1999c, Chapter 5), and no adverse human health effects are expected. From this information, it can be extrapolated that the same conclusion can be applied to TA-74 West.

3.2.10 Lead-Based Paint Surveys and Other Sources of Lead

Not applicable. There are no known sources of lead at this site.

3.2.11 PCBs

Not applicable. LANL's PCB database shows that no PBC-containing equipment was used, stored or disposed at this site.

3.2.12 Pesticides

Not applicable. There are no records of pesticides being used or stored at this site.

3.2.13 Medical Wastes

Not applicable. There are no records of medical wastes being generated or disposed at this site.

3.2.14 Ordnance

Not applicable. There are no records of ordnance being used, stored, or disposed at this site.

3.2.15 Radioactive Materials and Wastes

Not applicable. Although the TA-74 West sub-parcel does not contain any solid waste management units within its boundaries, the sub-parcel spans a portion of the stream channel and flood plain of Pueblo Canyon. This stream channel is an area of concern by definition (see appendix C). A human health screening evaluation was performed using the data from the nearest sampled reaches of the stream channel. The results of this screening support the conclusion that the stream channel and flood plain do not pose an unacceptable risk to human health within the TA-74 West sub-parcel.

3.2.16 Radon

Not applicable.

3.2.17 Groundwater

Not applicable. There are no supply or monitoring wells located on this site, and there is no known contamination at this site that would impact these resources.

3.3 Natural and Cultural Resources

TA-74 West is within an Area of Ecological Interest for the Mexican Spotted Owl. NNSA and the UC consulted with the US Fish and Wildlife Service to assess those affects. The USFWS issued a final biological opinion on January 15, 2002, that addresses all land transfer tracts. This opinion states that transfer "may affect, likely to adversely affect" the owl on the TA-74 tracts, and provides four conservation recommendations to mitigate adverse affects.

There are no known traditional cultural properties (TCPs) located in TA-74 West. Consultations to identify TCP resources have not been conducted. However, because of the tract's location and size, it has a low potential for unidentified resources.

There are no historic structures located on TA-74 West. Prior to DOE use, this tract was part of the Ramon Vigil Spanish Land Grant. The region of influence for this tract includes the land tract itself, plus nearby cultural resources located off the tract. For this tract, these nearby resources are located on privately held land.

3.4 Identification of Uncontaminated Properties

TA-74 West, though potentially contaminated from activities conducted by LANL during the late 1940s and early 1950s, does not have environmental contamination as defined by CERCLA 120(h)(4).

3.5 All Other Properties

Not applicable. There are no other properties associated with this site.

4.0 Summary of Data for Adjacent Properties

The immediate adjacent properties consist of large expanses of TA-74 slated to go to Los Alamos County. Bounding TA-74 the adjacent properties currently consist of a commercial storage business and a fast-food restaurant to the north and the Los Alamos Canyon to the south. Canyon rim exists to both the east and west. The Environmental Site Assessment (Appendix B) reviewed the appropriate ASTM records out to a distance of 2 or 3 miles as appropriate to identify if hazardous sites or serious local environmental problems may exist on or immediately adjacent to the facility. None were found.

4.1 History and Current Use

The property adjacent to TA-74 was part of the historic Technical Area 1 or main technical area of Los Alamos National Laboratory during the late 1940s and early 1950s. This land was conveyed to Los Alamos County during the late 1950s and early 1960s and has subsequently been developed into commercial property.

4.2 Environmental Setting

The lands adjacent to TA-74 are industrialized and mostly paved.

4.3 Adjacent Properties with No Known or Suspected Releases

Not applicable. Though not identified as having environmental contamination as defined by CERCLA 120 (h)(4), these lands were part of the historic Technical Area 1 or main technical area of Los Alamos National Laboratory during the late 1940s and early 1950s. Though significant clean-up activities have taken place at TA-1, the potential for residual contamination still remains wherever past LANL operations took place.

Pueblo Canyon is known to have received contaminants from multiple potential release sites within the watershed located upstream from the TA-74 West sub-parcel. However, the results of a human health screening assessment support the conclusion that the stream channel and flood plain do not pose an unacceptable risk to human health (see Appendix C).

4.4 Adjacent Properties with Known or Suspected Releases

See 4.3 above.

5.0 Conclusions and Recommended Courses of Action

DOE and UC health and safety professionals have reviewed environmental conditions at TA-74 West and have determined that no special precautions are required.

Based on best available environmental information, the University of California and the Department of Energy conclude that there are no outstanding environmental issues to prevent conveyance or transfer of TA-74 West. DOE may issue deeds on the basis that "all remedial action necessary to protect human health and the environmental have been taken".

5.1 Facility Matrix

Not applicable. TA-74 West has never been developed.

5.2 Property Categorization

Not applicable. All lands at TA-74 West are categorized the same.

5.3 Resource Map

Not applicable. No hazardous materials were identified, and no wells are located on this property.

6.0 Certification of Environmental Baseline Survey

Los Alamos National Laboratory staff and Environmental Contractors conducted this Environmental Baseline Survey under direction and guidance of the Ecology Group Office. The information contained in this document is accurate to the best of our knowledge.

Kenneth Rea, RRES-ECO
LANL Land Transfer

Appendix A
CERCLA 120(h)

NOTICE of CERCLA 120(h) INFORMATION FOR PROPERTY SUBJECT TO CONVEYANCE AND TRANSFER:

Technical Area 74-1 (West) Tract CERCLA 120(h)

Purpose:
The purpose of this document is to meet the reporting requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Section 120(h) for the conveyance and transfer of a parcel of land identified as the "Technical Area (TA) 74-1 (West) Tract" (hereafter referred to as TA-74 West). ***The information contained in this notice is required under the authority of regulations promulgated under section 120(h) of the Comprehensive Environmental Response, Liability [sic], Compensation Act (CERCLA or "Superfund") 42 U.S.C. section 9620(h)***[1]. CERCLA 120(h) and the implementing regulations at 40 CFR 373 require the DOE, when entering into the sale or transfer of real property, to disclose whether any hazardous substances, as defined by CERCLA, have been stored for more than one year in quantities greater than or equal to 1000 kg or the reportable quantity (RQ); any hazardous substances known to be released or disposed of; and any acutely hazardous wastes stored for one year or more and in quantities greater than or equal to 1 kg.

Description:
The TA-74 West Tract is approximately 5.5 acres (about 2.2 hectares) located in Pueblo Canyon approximately 0.3 miles upstream (west) of the current Los Alamos County Sewage Treatment Plant. The northeast corner of the TA-74 West Tract is located at the junction of the Los Alamos County line and the boundary line between NNSA and County property.

Methodology:
The information in this report is based on a review of available records and interviews. The Laboratory's environmental and health and safety groups, the Water Quality Group, the Hazardous and Solid Waste Group, the Air Quality Group, and the Industrial Hygiene Group, were asked to review their records, including Laboratory and group files and databases on chemical inventories and usage; solid and hazardous waste management and storage; releases and spills; emergency response, and PCB equipment. The ER Project has provided relevant information concerning potential release sites (PRSs) in Appendix C.

Is there any record of a hazardous substance having been stored on site?
No records of hazardous substances having been used, stored, or disposed of on the TA-74 West Tract have been observed. However, the canyon bottom of Pueblo Canyon may contain residual contamination from historical operations at the Laboratory, and is under investigation by the Laboratory's Environmental Restoration (ER) Project. See Appendix C for information on PRSs and ER Project activities.

Was the amount stored greater than or equal to 1,000 kg or the Reportable Quantity (RQ), whichever is greater; and, was the hazardous substance stored for one year or longer?

---

[1] This statement is explicitly required under 40 CFR 373.3(b).

N/A - No records of hazardous substances having been used, stored, or disposed on the TA-74 West Tract have been observed.

Was the amount disposed of or released greater than or equal to the RQ?
N/A - No records of hazardous substances having been used, stored, or disposed on the TA-74 West Tract have been observed.

Current Regulatory Status: The TA-74-1 West Tract does not have any operations that are included in the Laboratory's Hazardous Waste Facility Permit. However, the canyon bottom PRSs may be listed in Module VIII of the Laboratory's Hazardous Waste Facility Permit.

Appendix B
Environmental Assessment

ENVIRONMENTAL ASSESSMENT

Land Transfer Parcel, TA-74 North

Prepared For: THE DEPARTMENT OF ENERGY

November 5, 2001

Revision 0

EXECUTIVE SUMMARY

This report presents a findings summary for an assessment of the actual and potential environmental concerns associated with the northern portion of the TA-74 parcel and the northeastern portion of the White Rock Y parcel, which is slated for transfer to the Secretary of the Interior in trust for San Ildefonso Pueblo. The TA-74 parcel is located predominantly in Santa Fe County, NM, and the northern portion of the parcel is located entirely in Santa Fe County, NM, as is the northeastern portion of the White Rock Y parcel. The northern portion of the TA-74 parcel encompasses the area whose southern boundary is approximately 200 feet north of the effluent channel associated with the Los Alamos County Bayo Canyon Wastewater Treatment Plant, and extends to the northern boundary of the TA-74 parcel, as defined in the *Environmental Impact Statement for the Conveyance and Transfer of Certain Land Tracts Administered by the U.S. Department of Energy and Located at Los Alamos National Laboratory, Los Alamos and Santa Fe Counties, New Mexico* (DOE/EIS – 0293, October 1999). It also includes a small, mesa-top area to the south of the effluent channel, known as the Little Otowi site. The northeastern portion of the White Rock Y parcel is located north of State Road 502 and east of the White Rock Y interchange, and it abuts the southern boundary of the northern portion of the TA-74 parcel. For linguistic ease, these sub-parcels are collectively called the "TA-74 North" parcel. Collectively, the TA-74 North parcel is 2,089 acres in size. Exhibit 1 (at the end of this executive summary) provides a descriptive summary for the TA-74 North parcel and Exhibit 2 (also at the end of this executive summary) summarizes the known history of this site. Los Alamos National Laboratory conducted its assessment on August 28, 2000, and subsequently on October 2-3, 2001 at the request of the U.S. Department of Energy. The LANL site assessors for this assignment were Ms. Jennifer Pope and Ms. Virginia Smith.

This assessment (hereafter referred to as an environmental site assessment (ESA)) was conducted pursuant to a scope of work consistent with the American Society of Testing and Materials (ASTM) *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process* (ASTM E 1527-00); along with an additional off-site disposal practices review (including evaluating whether the subject site is listed as a potentially responsible party (PRP) at an off-site waste disposal site); and an examination of possible asbestos-containing materials (ACMs). A specific discussion of the tasks undertaken is set forth in Attachment A. LANL performed no soil, groundwater, surface water, air, building material, or other environmental sampling and analysis as part of this assessment.

It is LANL's understanding and agreement that the DOE may provide this report to the recipient of the subject parcel, as well as to the public. The parcel recipient may provide this report to third parties and other financing institutions and institutional lenders connected with the contemplated transaction (including, without limitation, any such party providing financing on or after consummation of the contemplated transaction and all assignees and participants of any of the foregoing), and that these parties may rely on the information in the report to the same extent as and subject to the same restrictions agreed to by DOE.

1.2 LIMITATIONS

All the information contained in this report, including any engineering conclusions, is based on the information made available to LANL's site assessor during the investigation, which we assume to have been provided in good faith. This report represents an assessment of the TA-74 North parcel performed in accordance with generally accepted industry standards regarding environmental assessments. LANL makes no other representations whatsoever, including those concerning the legal significance of its findings or as to other legal matters touched on in this report, including, but not limited to ownership of any property or the application of any law to the facts set forth herein. Except as otherwise may be requested by DOE, LANL disclaims any obligation to update the report for events taking place after the time during which we conducted our assessment.

Exhibit 1. TA-74 North Parcel Description Summary

# of Acres	# of Buildings (approx. total sq. ft)	# of Potential Release Sites (and remediation status)	Current Activities
Approximately 2,089 acres.	None.	Three: Pueblo, Bayo and Barrancas Canyons. Pueblo Canyon is known to contain residual contamination from historical operations at the Laboratory. Results of investigations conducted by LANL's Environmental Restoration (ER) Project to date indicate that the levels of contamination in Pueblo Canyon sediments do not present a significant human health risk under the conditions of present-day land use, including trail users and resource users. The stream channels and flood plains of Bayo and Barrancas Canyons may have been adversely affected by contaminants carried downstream within surface water or sediments from historical operations at TAs 10 and 0. The portions of these canyon bottoms within the TA-74 North parcel are slated for investigation by LANL's ER Project in FY 2004.	There is no activity related to LANL operations on this parcel. The only LANL-related activity slated for this parcel is the investigation and remediation, if necessary, of Pueblo, Bayo and Barrancas Canyons.

Exhibit 2. TA-74 North Parcel Site History Summary

Site History Prior to LANL Occupancy	Prior to LANL occupancy, there was little development in this remote area. Historical maps from the pre-LANL era (1924), aerial photographs of the area (1935), and historical accounts of life in the area show little development in the area until 1917 when the Los Alamos Ranch School for boys was established.
Site History After LANL's Occupancy	Even after LANL occupancy, this land parcel had very little development and served instead to buffer Laboratory activities from the surrounding region.

ATTACHMENT A

ASSESSMENT METHODOLOGY

This environmental assessment, consistent with the ASTM Practice E 1527-00 (with added evaluations of ACMs, and possible wetland areas), consisted, in general, of the following steps:

- We met with the following individuals at LANL to discuss parcel-specific environmental and occupational health and safety (EH&S) issues:

  - Mr. Albert Dye, ESH-19, PCB Database Manager;
  - Ms. Debra Archuleta, ESH-17, Asbestos Program Manager;
  - Mr. David Ortiz and Ms. Josie Encinias, ESH-5, Asbestos Management Program;
  - Ms. Louann Romero, ESH-19, HSTD Database Manager;
  - Mr. Harvey Decker, ESH-18, SPCC and SWPPP Plans;
  - Mr. William Flor, HAZMAT Spills Database Manager;
  - Mr. Terry Rust and Dr. Steve Reneau, Environmental Restoration, Potential Release Sites; and
  - Ms. Jean Dewart, ESH-17, Air Quality Program.

- We visited the parcel on September 6, 2000, and subsequently on October 2-3, 2001 to gather more detailed information concerning possible on-site contamination, and to determine the compliance status of the parcel. Before, during and after the September 6, 2000 visit, we interviewed LANL personnel about past and present site operations, raw materials and waste management practices, and significant environmental liability problems, if any. We did not repeat these interviews in October 2001 because there are no ongoing LANL operations on or near the parcel. We also observed actual site conditions in an attempt to identify and assess the status of potential liabilities such as past disposal areas, waste management units and systems, and sites of environmental releases.

- We reviewed ES&H-related files, correspondence, and other documents supplied by LANL.

- We visited the Los Alamos County Archives office in Los Alamos, NM to review aerial photographs of the area and to collect information on site use prior to the Manhattan Project.

- We performed a walk-by and drive-by survey of the immediate neighboring properties from publicly accessible areas for obvious signs of environmental concerns and how those concerns may have environmentally degraded the property under study, and to assess the proximity of the subject property to sensitive ecological areas (e.g., wetlands).

- We reviewed a search of the following computerized environmental databases to determine if hazardous sites or serious local environmental problems may exist on or immediately adjacent to the facility (see radius specifications):[1]

  Federal ASTM Records

[1] *The environmental database searches were completed for LANL by e Data Resources. The database-specific radii specified for These searches either match the ASTM E 1527-00 requirements or are larger than specified in E 1527-00.*

- Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) (subject site and 0.5-mile radius);
- Emergency Response Notification System (subject site only);
- National Priority List (NPL) (subject site and 1-mile radius);
- RCRA Corrective Action Sites (CORRACTS) list (subject site and 1-mile radius);
- Resource Conservation and Recovery Information System (RCRIS) (subject site and 0.25-mile radius for generators and 0.5-mile radius for treatment, storage, and disposal facilities); and
- CERCLIS-No Further Remedial Action Planned (CERCLIS-NFRAP) (subject site and 0.25-mile radius).

Additional Federal Records

- Biennial Reporting System (subject site only);
- PCB Activity Database System (subject site only);
- RCRA Administrative Action Tracking System (RAATS) list (subject site only);
- Toxic Release Inventory System (subject site only);
- Facility Index Data Base System (FINDs) (subject site only);
- Consolidated Docket Enforcement System (subject site and company name only);
- Hazardous Materials Incident Reporting System (subject site only);
- Delisted NPL Sites (subject site and 1-mile radius);
- Federal Superfund Liens (subject site only);
- Superfund Consent Decrees (subject site and 1-mile radius);
- Toxic Substances Control Act data base (subject site only);
- Materials License Tracking System (subject site only);
- Mines Master Index File (subject site and 0.25-mile radius);
- Records of Decision data base (subject site and 1-mile radius); and
- FIFRA/TSCA Tracking System (FFTS) (subject site only).

State ASTM Records

- New Mexico State leaking underground storage tank (UST) database list (subject site and 0.5-mile radius);
- New Mexico State permitted solid waste facilities/landfill sites (subject site and 0.5-mile radius); and
- New Mexico State registered USTs (subject site and 0.25-mile radius).

Additional State Records

- New Mexico State Aboveground Storage Tanks (subject site only).

- We attempted to obtain and review historical Sanborn Fire Insurance land use maps to establish past land uses of the subject property and the surrounding area consistent with the requirements of ASTM Practice E 1527-00. Sanborn Fire Insurance land use maps were not available for this facility or the surrounding area.

- We reviewed historical aerial photographs available from public agency sources to establish past land uses of several of the subject properties and the surrounding

areas consistent with the requirements of ASTM Practice E 1527-00. Aerial photographs dated 1935,1958, 1974, and 1991 were available from the Environmental Restoration, University of New Mexico Archives, and Los Alamos County photographic archives. In general, photographic information of the Laboratory and surrounds has been difficult to obtain and is sparse in nature. We have searched the archives listed above as well as a number of other public and private entities. Amongst the entities not listed above, the New Mexico State Archives, National Resource and Conservation Services Bureau, the State of New Mexico Forestry Division, New Mexico Aerial Surveys, Inc., and Pacific Western Technologies were all contacted regarding aerial photographs of the Los Alamos area.

- We located and reviewed abstracts of available historical city directories to establish past uses of several of the subject properties and the surrounding areas consistent with the requirements of ASTM Practice E 1527-00. A search of the county archives in Los Alamos yielded no historical or current city directories for TA-74 that gave addresses for the subject site. In most cases, older city directories listed names and phone numbers without the benefit of the listing address.

- We assessed possible issues of current or future environmental liability. This assessment evaluated operations, both past and present, with respect to: air pollution control (including, but not limited to, applicable requirements of the 1990 Clean Air Act Amendments); asbestos management; water supply and pollution control, including stormwater management; nonhazardous solid waste management; hazardous solid waste management; USTs; materials, products, and pesticide storage and handling practices (including Superfund Amendments and Reauthorization Act (SARA) Title III programs); polychlorinated biphenyls (PCBs) inventory management; past on-site or off-site waste disposal practices; and occupational safety and health (including hazards communication).

- We completed an assessment of the facility's potentially significant liabilities under the Superfund statute and related state statutes pertaining to potential on-site contamination and related to the off-site disposal of wastes.

- LANL performed no soil, groundwater, surface water, air, building material, or other environmental sampling and analysis as part of this environmental assessment. LANL did, however, review environmental surveillance, monitoring, and sampling results that have been collected over time and that were relevant to the parcel.

ATTACHMENT B

ISSUES SUMMARY

TABLE Exhibit 3

Summary of Environmental Assessment Results for TA-74 North

AREA	ISSUE	COMMENT/RECOMMENDATION/LIABILITY/COST
Air Pollution Control	There appear to be no environmental liability issues associated with air pollution control on this parcel.	None.
Asbestos Management	There appear to be no environmental liability issues associated with asbestos on this parcel.	There are no structures (other than historical cultural resources) on the TA-74 North parcel.
Water Supply and Pollution Control, Including Stormwater Management	There appear to be no environmental liability issues concerning the water supply to or the wastewater discharges from this parcel.	The only source of wastewater discharge in proximity to this parcel is the Los Alamos County Bayo Canyon Wastewater Treatment Plant. The southern boundary of the TA-74 North parcel lies approximately 200 feet north of the effluent channel.
Nonhazardous Solid Waste Management	There appear to be no environmental liability issues associated with nonhazardous waste within the parcel.	There are no nonhazardous wastes generated by LANL at this parcel.
Hazardous Solid Waste Management	There appear to be no environmental liability issues associated with hazardous waste within this parcel.	No hazardous wastes have historically been or are currently managed by LANL on this parcel.
Underground Storage Tanks	There appear to be no environmental liability issues associated with USTs at this facility.	There is no historical record, employee recollection, or visible indication that there are or were USTs in service on this property. There is no plan to install any USTs.
Materials, Products, and Pesticide Handling and Storage Practices	There appear to be no environmental liability issues associated with current materials, products, and pesticide handling and storage practice at this parcel.	LANL handles no materials, products or pesticides within this parcel.
PCB Inventory Management	There appear to be no environmental liability issues associated with PCB inventory management at this land parcel.	LANL's PCB database shows that no PBC-containing equipment was used, stored or disposed on this parcel.
Potential On-Site Contamination and	There is no record, employee recollection, or visible indication that waste materials have been disposed on the	A site walk-through was conducted on October 2-3, 2001; no unusual or suspect site conditions were noted at that

Waste Disposal	subject property. LANL is currently not listed on the proposed or final NPL, in the CERCLIS or CERCLIS-NFRAP databases, or on the State's list of designated potential hazardous waste disposal sites. No USTs are known to have been located on this property. In addition, the site address is currently not listed in the state or federal reportable spills databases.	time. An aerial photo review indicated there was no unusually altered topography, unusually stressed vegetation, unusual ground depressions, or other visible indications of past spills, releases, or waste disposal. Site contacts reported responding to one site spill resulting from an overturned truck at State Road 4. Restaurant grease and hydraulic fluid was released from this spill; however, the spill was contained in the localized area adjacent to the road.
Past Off-Site Waste Disposal	To the best of LANL ESH-19 staff's knowledge, no issues or concerns have been raised regarding this facility's past off-site waste disposal practices. LANL has not received or filed notifications under the Comprehensive Environmental Response, Compensation, and Liability Act related to the disposal of any hazardous substances.	None of the off-site disposal facilities known to have received hazardous or nonhazardous wastes from LANL is currently listed on the proposed or final NPL, in the federal CERCLIS or CERCLIS-NFRAP databases, or in the respective state databases that are the equivalent of the federal CERCLIS and NPL databases.
Environmental Data Base Search Results	No apparent environmental liabilities were identified in any of the federal or state environmental databases searched for this assessment (see Attachment A). The database search to assess whether environmental conditions on the subject property have been affected by any off-site source or sources identified no mappable sites as being within the designated search radii. (NOTE: The term "mappable" means that the address information provided is sufficient for the database search vendor to pinpoint the site's location on a street map with a high degree of confidence.).	Given the database search results and based on an inspection of the surrounding properties from publicly accessible areas, none of the neighboring operations is believed to pose a significant potential concern for environmental conditions on the subject property. The environmental database search also identified 43 "orphan" sites (i.e., sites not mapped by the database search vendor because of poor or inadequate address information). Based on the area tour, none of these listed "orphan" sites is believed to be located within 1 mile of the subject property.

Appendix C
Environmental Restoration CERCLA Report

ENVIRONMENTAL RESTORATION PROJECT

Memorandum

Risk Reduction & Environmental Stewardship (RRES)
Environmental Restoration (ER) Project, MS M992

To/MS: K. Rea, RRES-ECO, MS M887
From/MS: P. Schumann, RRES-ER, MS M992
Phone/FAX: 7-5840/5-4747
Symbol: ER2002-0410
Date: June 13, 2002

SUBJECT: ENVIRONMENTAL RESTORATION (ER) PROJECT COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT (CERCLA) 120(h). THE INFORMATION IN SUPPORT OF THE TRANSFER OF TECHNICAL AREA (TA)-74-1 WEST SUB-PARCEL (MAP DESIGNATION A-17) TO THE COUNTY OF LOS ALAMOS

The purpose of this document is to transmit the ER Project's portion of the CERCLA 120(h) report. This information is submitted in support of the transfer of Sub-parcel TA-74-1 West (Map Designation A-17) to the County of Los Alamos.

The ER Project has not submitted any previous documents regarding CERCLA 120(h) requirements for the Potential Release Site (PRS) associated with the above-mentioned sub-parcel.

Please note that the CERCLA 120(h) report provided herein is based on the review of the four maps (Thiel, Vigil, Merrick and Thatcher/Vigil) provided to the ER Project in 1998, and the most current topographic and PRS information maintained by the Laboratory's Facility for Information Management, Analysis, and Display.

In addition, please note that the CERCLA 120(h) information provided relates only to the status of PRSs; other information relevant to current operations and activities, or other regulations at the parcel included in the transfer, are the responsibility of other Los Alamos National Laboratory organizations and is not included herein. The Department of Energy is advised to contact the Laboratory's Site–Wide Issues Program Office to obtain updates of this other information necessary to complete the CERCLA 120(h) report.

If you have any questions, please call me at (505) 667-5840 or Kim Birdsall at (505) 665-3486.

PS/KB/vn

Attachments: 1. Supporting Documentation for the TA-71 West Sub-parcel [Map Designation A-17] CERCLA 120(h) Report
2. Pueblo Canyon Watershed
3. Summary of Pueblo Canyon COPCs

Cy (w./attach.):

K. Birdsall, RRES-ER, MS M992
M. Kirsch, RRES-ER, MS M992
E. Louderbough, LC-GL, A187
D. McInroy, RRES-ER, MS M992
V. Smith, RRES-ER, MS M992
W. Neff, RRES-ER, MS M992
D. Gregory, OLASO, MS A316
E. Trollinger, OLASO, MS A316
L. Cummings, LC-GL, A187
E. Louderbough, LC-GL, A187
P. Wardwell, LC-GL, A187
RRES-ER File, MS M992
IM-5, MS A150
RPF, MS M707

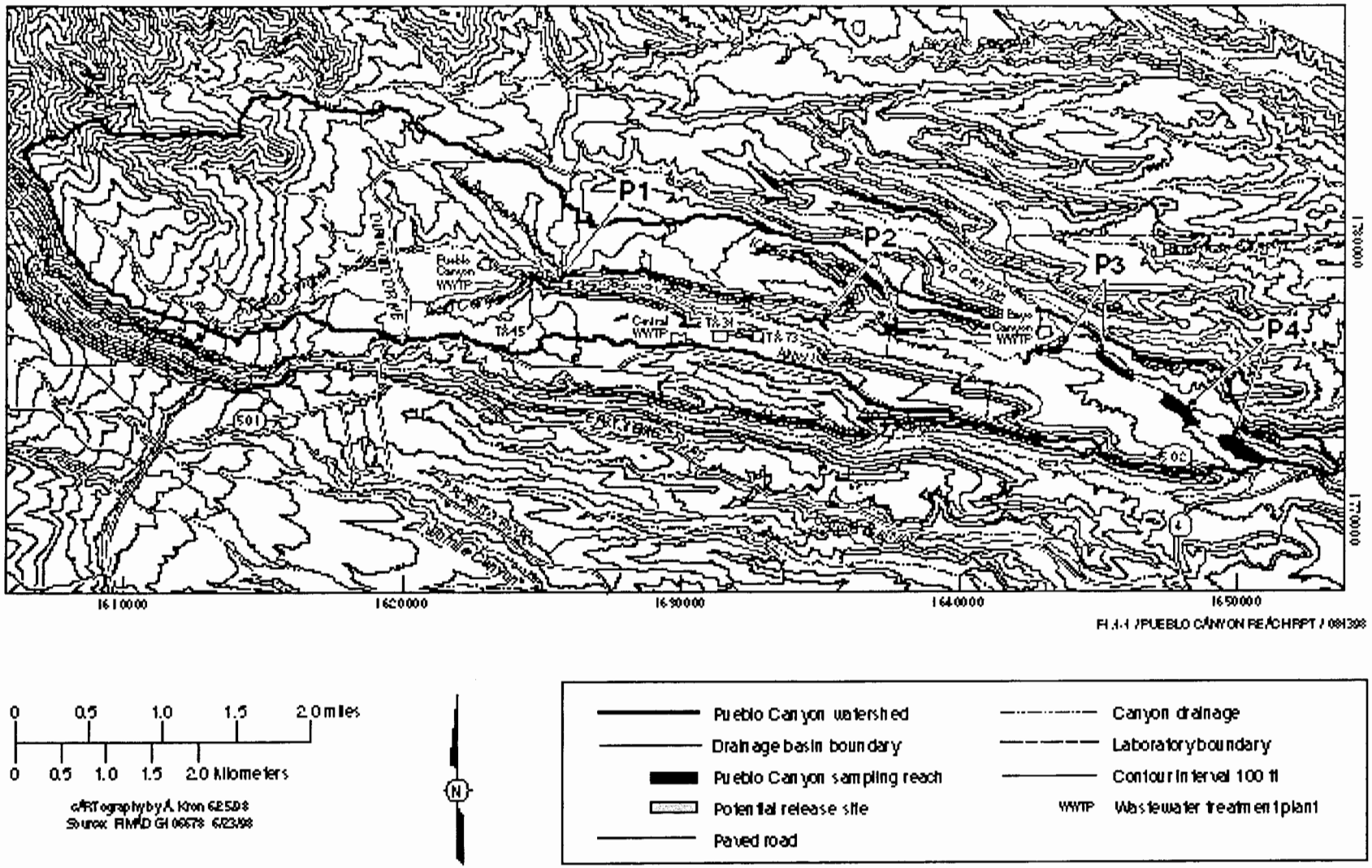


Figure 1.1-1. Pueblo Canyon watershed.

ER Project Supporting Documentation
For The TA-74-1 West Sub-parcel [Map Designation A-17]
CERCLA 120(h) Report

Location: Technical Area (TA) 74

Description: The TA-74-1 West (Map Designation A-17) Sub-parcel is a small 5.5-acre tract of the original TA-74 parcel (see Conveyance and Transfer Plan). The Sub-parcel is located immediately west of the Los Alamos County line along the northern boundary of the original parcel's western-trending panhandle.

History: Although the TA-74-1 West Sub-parcel does not contain any solid waste management units (SWMUs) within its boundaries, the Sub-parcel spans a portion of the stream channel and flood plain of Pueblo Canyon. The Pueblo Canyon stream channel and flood plain have been designated as an area of concern (AOC), C-00-005. An AOC is by definition a Potential Release Site (PRS).

Pueblo Canyon is known to have received contaminants from multiple potential release sites (PRSs) within the watershed located upstream from this Sub-parcel. The most significant contaminant source for Pueblo Canyon was former TA 45, where radioactive effluent was discharged between 1944 and 1964 into Acid Canyon, a small tributary of Pueblo Canyon. Other PRSs that may have contributed contaminants to Pueblo Canyon are located in TAs 0, 31, and 73. Contaminants may also have originated from residential and commercial areas in the Los Alamos townsite.

An investigation of the Pueblo Canyon sediments conducted by the ER Project in 1998 identified plutonium-239, 240 as the most significant chemical of potential concern (COPC) for potential human health risk. Plutonium-239,240 and other COPCs have been distributed by floods along the full length of Pueblo Canyon downstream from Acid Canyon. Other COPCs identified in the sediments of Pueblo Canyon include 5 radionuclides, 8 inorganic chemicals, and 29 organic chemicals (see Table 1 and Figure 1.1-1 attached). Plutonium-239,240 in Reach P-1 (approximately 3 miles upstream of the Sub-parcel) is measured at concentrations up to 7000 times the levels associated with fallout from worldwide nuclear tests. All other COPCs are found at much lower concentrations relative to background concentrations or detection limits.

Although Pueblo Canyon sediments were not sampled within the TA-74-1 West Sub-parcel, it is located between investigation subreaches P2-East and P3-West. Inorganic and radiological data from these two reaches were used to interpolate contaminant concentrations and inventories for the Sub-parcel. No organic data was available from either P2-East or P3-West; therefore, data from reaches P1-East and P-4 were used to evaluate the presence or absence of organic constituents.

A human health screening evaluation was performed for the Sub-parcel using the data from the nearest sampled reaches bracketing the Sub-parcel, as mentioned above. Five analytes, Plutonium-239, 240, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene, had detected maximum concentrations greater than or equal to the residential land use screening values. However, the upper bound estimate of the average Plutonium-239,240 concentrations was below the residential land use screening value. The four semi-volatile compounds combined present a cancer risk of 10^{-5} given a residential exposure scenario. Residential screening values are considered overly protective and highly conservative for a sub-parcel that is intended for industrial land use. In addition, construction and operational activities at the Sub-parcel are anticipated to be outside the stream channel and flood plain in which any contaminants would be located. The results of the human health screening assessment support the conclusion that the stream channel and flood plain do not pose an unacceptable risk to human health within the Sub-parcel.

Is there any record of a hazardous substance having been stored on site?
No. There is no information that suggests that hazardous substances were stored on site.

Was the amount stored greater than or equal to 1,000 kg or the Reportable Quantity (RQ), whichever is greater?
Not applicable.

Was the amount disposed of or released greater than or equal to the RQ?
No. Although no hazardous substances were stored, released or disposed of within the TA-74-1 West Sub-parcel, small quantities of hazardous substances have been dispersed throughout sediments of the stream channel and floodplain of Pueblo Canyon as a result of upstream releases of hazardous substances. Based on interpolated data from investigated reaches both upstream and downstream of the Sub-parcel, the total inventories of plutonium-239,240 and the four semi-volatile organics [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene] have been estimated as 4.9mCi and range between 1.1 to 4.2 lbs, respectively, using lower and upper bound estimates of average concentrations. (The reportable quantities for these analytes are 10 mCi and 1 lb., respectively)

Current Regulatory Status: The TA-74-1 West Sub-parcel does not contain any SWMUs within its boundaries. However, the Sub-parcel spans the Pueblo Canyon stream channel and flood plain, which is an AOC (and a PRS). PRS C-00-005, Pueblo Canyon, is not currently on the Hazardous and Solid Waste Amendments (HSWA) module of Los Alamos National Laboratory's (LANL's) Resource Conservation and Recovery Act permit. Hence, it is regulated under DOE's authority.

Based on the evaluations performed and presented in both the *Evaluation of Sediments in Pueblo Canyon: Reaches P-1, P-2, P-3, and P-4* and the Assessment *of Sediment Contamination in the TA-74-1 West Land Transfer Sub-parcel* (see reference below), the levels of contamination in the sediments within the Sub-parcel are not believed to present a significant human health risk. In addition, because concentrations of contaminants in sediments carried by floods are not increasing over time, and present levels of contamination have not been shown to either cause an unacceptable risk in downstream areas or exceed regulatory standards, no immediate remedial action is required in the context of future remobilization of contaminated sediments.

At this time, the Department of Energy can certify that this Sub-parcel meets the Comprehensive Environmental Response, Compensation and Liability Act Section 120(h) requirement that all necessary remedial action has been taken prior to transfer.

Future Actions Required: The ER Project is scheduled to complete the Los Alamos and Pueblo Canyons Surface Aggregate Report in 2003.

References:

"Assessment of Sediment Contamination in the TA-74-1 West Land Transfer Subparcel," **Environmental Restoration Project, June 2002, LA-UR-02-3324.**

"Evaluation of Sediment Contamination in the Pueblo Canyon: Reaches P-1, P-2, P-3, and P-4," Environmental Restoration Project, December 1998, LA-UR-98-3324.

"Work Plan for Operable Unit 1049, Los Alamos Canyon and Pueblo Canyon," Environmental Restoration Project, November 1995, LA-UR-95-2053.

"Supplement to Response to Request for Information for the Canyons Investigation Core Work Plan," Environmental Restoration Project, January 1998, EM/ER:98-020.

"Core Document for Canyons Investigations," Environmental Restoration Project, April 1997, LA-UR-96-2083.

"Environmental Restoration Report to Support Land Conveyance and Transfer Under Public Law 105-119," Environmental Restoration Project, August 1999, LA-UR-99-4187.

"Summary of ER Activities to Support Land Conveyance and Transfer at Los Alamos National Laboratory Under Public Law 105-119," Environmental Restoration Project, August 1999, LA-UR-99-1018.

"Conveyance and Transfer Plan for Certain Land Tracts Administered by the U.S. Department of Energy Located at the Los Alamos National Laboratory, Los Alamos and Santa Fe Counties, New Mexico, Report to Congress Under Public Law 105-119," United States Department of Energy, September 2000.

"Combined Data Report to Congress to Support Land Conveyance and Transfer Under Public Law 105-119," United States Department of Energy, January 2000.

TABLE 1

SUMMARY OF PUEBLO CANYON COPCs

COPC and Units	Background Value or Estimated Quantitation Limit	Maximum Result[a]	Reach with Maximum Result
Radionuclides (pCi/g)			
Americium-241	0.04	10.671	P-1
Cesium-137	0.90	1.53	P-1
Plutonium-238	0.006	2.078	P-1
Plutonium-239,240	0.068	502.01	P-1
Strontium-90	1.03	1.4	P-1
Tritium	0.093	1.21	P-1
Inorganic Chemicals (mg/kg)			
Antimony	0.83	[4.9]	[P-1 and P-4]
Cadmium	0.4	0.92	P-1
Copper	11.2	31.5	P-2
Lead	19.7	77.3	P-1
Mercury	0.1	0.65	P-1
Selenium	0.3	0.98 [1.1]	P-2 [P-1]
Silver	1.0	1.7	P-1
Zinc	60.2	113	P-1
Organic Chemicals (mg/kg)			
Aroclor-1254	0.033	0.238	P-1
Aroclor-1260	0.033	0.117	P-1
Aldrin	0.033	0.00211	P-1
δ-BHC	0.033	0.00197 [0.0023]	P-1 [P-3W]
α-Chlordane	0.0165	0.00497	P-1
γ-Chlordane	0.0165	0.00211 [0.0023]	Acid Cyn [P-3]
4,4'-DDT	0.033	0.00599	Acid Cyn
Acenaphthene	0.33	0.219 [0.344]	P-4 [P-4]
Acenaphthylene	0.33	0.44	P-1
Anthracene	0.33	0.369	P-4
Benz(a)anthracene	0.33	1.0	P-1
Benzo(a)pyrene	0.33	1.7	P-1
Benzo(b)fluoranthene	0.33	2.5	P-1
Benzo(g,h,i)perylene	0.33	0.86	P-1
Benzo(k)fluoranthene	0.33	0.95	P-1
Benzoic acid	0.33	0.75 [3.3]	Acid Cyn [P-1]
Bis(2-ethylhexyl)phthalate	0.33	2.8	P-1
Carbazole	0.33	0.18 [0.34]	P-1 [P-1]
Chrysene	0.33	1.2	P-1
Di-n-octylphthalate	0.33	0.094 [0.66]	P-4 [P-1]
Dibenz(a,h)anthracene	0.33	0.28 [0.66]	P-1
Dibenzofuran	0.33	0.18 [0.344]	P-4 [P-4]
Fluoranthene	0.33	1.9	P-1
Fluorene	0.33	0.294 [0.344]	P-4 [P-4]
Indeno(1,2,3-cd)pyrene	0.33	0.88	P-1
2-Methylnaphthalene	0.33	0.167 [0.66]	P-4 [P-1]
Naphthalene	0.33	0.374	P-4
Phenanthrene	0.33	1.505	P-4
Pyrene	0.33	2.2	P-1

a. Values in brackets indicate that the maximum result is reported as a nondetect.
b. PCWWTP = Pueblo Canyon Wastewater Treatment Plant
c. nps = nonpoint sources

DM/SR/th

Enclosure: Assessment of Sediment Contamination in the TA-74-1 West Land Transfer Sub-Parcel (ER2002-0329)

Cy (w/enc.):
S. Reneau, EES-9, MS D462
R. Perona, RRES-R, MS K490
[redacted]
M. Tardiff, RRES-ER, MS M969
K. Birdsall, RRES-ER, MS M992
M. Kirsch, RRES-ER, MS M992
D. Katzman, EES-9, MS M992
A. Pratt, RRES-ER, MS M992
P. Schumann, RRES-ER, MS M992
D. Gregory, OLASO, MS A316
T. Taylor, OLASO, MS A316
RRES-REM File, MS M992
IM-5, MS A150
RPF, MS M707

Cy (w/o enc.):
D. McInroy, RRES-ER, MS M992
W. Neff, RRES-ER, MS M992

ENVIRONMENTAL RESTORATION PROJECT

Los Alamos National Laboratory/University of California
Risk Reduction & Environmental Stewardship (RRES)
Environmental Restoration (ER) Project, MS M992
Los Alamos, New Mexico 87545
(505) 667-0808/FAX (505) 665-4747

Date: June 14, 2002
Refer to: ER2002-0409

Mr. Everett Trollinger
Department of Energy, MS A316
Office of Los Alamos Site Operations
Los Alamos, NM 87545

SUBJECT: SUBMITTAL OF ASSESSMENT OF SEDIMENT CONTAMINATION IN THE TA-74-1 WEST LAND TRANSFER SUB-PARCEL

Dear Everett:

Enclosed is the document "Assessment of Sediment Contamination in the TA-74-1 West Land Transfer Sub-Parcel." This document is being submitted to the Department of Energy Los Alamos Area Office to report an assessment that was conducted in support of potential transfer of this sub-parcel to the County of Los Alamos.

Dave Gregory participated in the review of the draft report, and all of his comments have been incorporated. Please let us know if you find this report acceptable and if we may distribute it to the New Mexico Environment Department and other interested parties.

If you have any questions or comments, please feel free to call Allyn Pratt at (505) 667-4308.

Sincerely,

Warren Hyp for

David McInroy, Acting Program Manager
Environmental Restoration Project

ENVIRONMENTAL RESTORATION PROJECT

A Department of Energy
Environmental Cleanup Program

LA-UR-02-3324
June 2002
ER2002-0329

Assessment of Sediment Contamination in the TA-74-1 West Land Transfer Sub-Parcel

Los Alamos
NATIONAL LABORATORY

Los Alamos NM 87545

Produced by the Canyons Focus Area

Authors: Mark F. Tardiff, Steven L. Reneau, Ralph A. Perona

Los Alamos National Laboratory, an affirmative action/equal opportunity employer, is operated by the University of California for the United States Department of Energy under contract W-7405-ENG-36.

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the Regents of the University of California, the United States Government nor any agency thereof, nor any of their employees make any warranty, express or implied, or assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represent that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the Regents of the University of California, the United States Government, or any agency thereof.

Los Alamos National Laboratory strongly supports academic freedom and a researcher's right to publish; as an institution, however, the Laboratory does not endorse the viewpoint of a publication or guarantee its technical correctness. By acceptance of this article, the publisher recognizes that the U.S. Government retains a nonexclusive, royalty-free license to publish or reproduce the published form of this contribution, or to allow others to do so, for U.S. Government purposes. Los Alamos National Laboratory requests that the publisher identify this article as work performed under the auspices of the U.S. Department of Energy.

EXECUTIVE SUMMARY

This report evaluates a 5.6-acre sub-parcel of land within technical area (TA) 74 of Los Alamos National Laboratory (the Laboratory) that is proposed for transfer from the Department of Energy (DOE) to Los Alamos County. The sub-parcel is herein referred to as "TA-74-1 West," and is located in the bottom of Pueblo Canyon. The planned use of this sub-parcel is for a new municipal wastewater treatment plant. This evaluation is an assessment of potential human health risk from contaminants within sediments in the canyon bottom and was conducted to support a decision on whether the land can be released for unrestricted use.

The data used to support this assessment are from sections of the canyon upstream and downstream of the sub-parcel that were previously characterized. Six radionuclides and eleven inorganic chemicals were inferred to be present at concentrations above or potentially above background levels, based upon data from nearby parts of Pueblo Canyon, and are considered to be chemicals of potential concern (COPCs). Eighteen semivolatile organic compounds (SVOCs) were detected in sediments farther upstream or downstream in Pueblo Canyon and are also considered to be COPCs. The sources for these chemicals include effluent releases from former Laboratory outfalls into Acid Canyon, discharges from former municipal wastewater treatment plants, runoff from the Los Alamos townsite, and the redistribution of ash from areas burned by the Cerro Grande fire. All of these chemicals were compared to criteria for human health risk. Five COPCs had maximum values above screening action levels (SALs): the radionuclide plutonium-239,240, and the SVOCs benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene. The SALs are based on a residential land use and therefore reflect a greater fraction of time spent on-site than would realistically be associated with either a construction worker or an employee of the wastewater treatment plant.

One regulatory requirement for land transfer is the documentation of historic releases on the site that exceed reportable quantities (RQs), as specified in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). There are no known releases of CERCLA hazardous materials on this sub-parcel. However, for certain constituents released historically from upstream locations, the total mass now present on the sub-parcel may exceed the CERCLA RQs. Inventories were estimated for those COPCs with maximum values that exceeded SALs. The RQs from 40 CFR 302.4 are 10 mCi for plutonium-239,240 and 1 lb for each of the four SVOCs. The estimated plutonium inventory, 4.9 mCi, is approximately 50% of the RQ. The estimated inventories for the four SVOCs are 2.2 to 3.3 lb using mid-range estimates of average concentrations. These estimated inventories exceed the RQs by a factor of 2.2 to 3.3.

The available data indicate that the potential risks associated with contaminants at the TA-74-1 West sub-parcel are less than 10^{-5} for carcinogens, and less than a hazard quotient of 1 for noncarcinogens, and the potential dose is less than 15 mrem/yr for radionuclides. These values are New Mexico Environment Department (NMED) and DOE criteria that indicate that there is no unacceptable risk to human health at this site. This assessment supports the transfer of the TA-74-1 West sub-parcel from DOE to Los Alamos County with no additional assessment or remediation.

TABLE OF CONTENTS

1.0 INTRODUCTION 1
- 1.1 Purpose 1
- 1.2 Legislative and Regulatory Context 1
- 1.3 Background 3
  - 1.3.1 Geography and Hydrology 3
  - 1.3.2 Laboratory History and Operations 3
- 1.4 Current Land Use 4
- 1.5 Previous Sediment Investigations 4
- 1.6 Technical Approach 6
- 1.7 Acknowledgments 7

2.0 FIELD SETTING AND CONCEPTUAL MODEL 7
- 2.1 Methods of Investigation 7
  - 2.1.1 Geomorphic Mapping 7
  - 2.1.2 Physical Characterization of Young Sediments 9
  - 2.1.3 Characterization of Potential Contamination 9
  - 2.1.4 Radiological Field Measurements 9
- 2.2 Physical Characteristics and Geomorphic Processes 9
- 2.3 Conceptual Model for Contamination 11

3.0 ANALYTICAL RESULTS AND DATA REVIEW 12
- 3.1 Data Review 12
- 3.2 Comparisons of Data to Background 12
  - 3.2.1 Comparison of Inorganic Chemical Data with Sediment Background Data 14
  - 3.2.2 Comparison of Radionuclide Data with Sediment Background Data 15
  - 3.2.3 Evaluation of Organic Chemicals in Sediments 17

4.0 SITE ASSESSMENTS 19
- 4.1 Human Health Screening Assessment 19
  - 4.1.1 Scoping 19
  - 4.1.2 Screening Evaluation 20
  - 4.1.3 Uncertainty Analysis 23
  - 4.1.4 Interpretation 25
- 4.2 Ecological Assessment 25
- 4.3 Estimated Contaminant Inventories and Reportable Quantities 25
  - 4.3.1 Contaminant Inventories 26
  - 4.3.2 Reportable Quantities 26

5.0 CONCLUSIONS AND RECOMMENDATIONS 26

6.0 REFERENCES 27

Appendixes

Appendix A Acronyms and Conversion Units

Appendix B Characterization of Geomorphic Units

Appendix C Summary of Quality Assurance/Quality Control

Appendix D Target Analytes and Detection Limits

Appendix E Statistical Analyses

List of Figures

Figure 1.1-1 Map of the Pueblo Canyon watershed showing TA-74-1 West land transfer sub-parcel, sampling reaches mentioned in text, and other features 2

Figure 2.0-1 Map showing geomorphic units in the TA-74-1 West land transfer sub-parcel 8

Figure 4.1-1 Results of the screening assessment: comparisons of maximum COPC values to SALs 22

List of Tables

Table 2.2-1 Post-1942 Geomorphic Units in TA-74-1 West Land Transfer Sub-Parcel 10

Table 3.1-1 Analytical Suites, Data Source, and Number of Samples Used for the Land Transfer Sub-Parcel Assessment 13

Table 3.2-1 Inorganic Constituents Frequency of Detects and Comparisons to Sediment Background Values 14

Table 3.2-2 Results of Inorganic Chemical Data Review 16

Table 3.2-3 Radionuclide Constituents Frequency of Detects and Comparisons to Sediment Background Values 16

Table 3.2-4 Results of Radionuclide Constituent Data Review 17

Table 3.2-5 Organic Chemical Frequency of Detects 18

Table 3.2-6 Results of Organic Chemical Data Review 19

Table 4.1-1 Comparison of Pueblo Canyon Maximum Contaminant Values and SALs 21

1.0 INTRODUCTION

1.1 Purpose

This report evaluates a 5.6 acre sub-parcel of land within Technical Area (TA) 74 of Los Alamos National Laboratory (the Laboratory) that is proposed for transfer from the Department of Energy (DOE) to Los Alamos County. The sub-parcel is herein referred to as "TA-74-1 West," and is located in the bottom of Pueblo Canyon (Figure 1.1-1). The planned use of this sub-parcel is for a new municipal wastewater treatment plant. This evaluation is an assessment of potential human health risk from contaminants within sediments in the canyon bottom and was conducted to support a decision on whether the land can be released for unrestricted use. The evaluation is supported by previous investigations that were conducted upstream and downstream in Pueblo Canyon from 1996 through 2001 by personnel from the Canyons Focus Area as part of the Laboratory's Environmental Restoration (ER) Project (Reneau et al. 1998, 59159, and subsequent unpublished work). While those field investigations have addressed contamination along the entire length of the canyon downstream from former Laboratory sites, the emphasis of this report is on potential human health risk in the TA-74-1 West sub-parcel, relying primarily on previously collected data.

1.2 Legislative and Regulatory Context

Congress enacted legislation in November 1997 that required the Secretary of Energy to identify land at the Laboratory for potential conveyance and transfer to either Los Alamos County or to the Secretary of the Interior, to be held in trust for the Pueblo of San Ildefonso (Public Law 105-119, the Departments of Commerce, Justice, and State, the Judiciary, and Related Agencies Appropriations Act, 1998). The TA-74 sub-parcel was one of ten areas identified by the Secretary and the DOE for possible land transfer (DOE 1998, 58671). Public Law 105-119 also directed the DOE to identify any environmental restoration or remediation that these parcels would require prior to transfer. "Environmental Restoration Report to Support Land Conveyance and Transfer under Public Law 105-119" (LANL 1999, 63037) presents those evaluations. The sub-parcel under consideration in this report is a 5.6-acre piece of the larger, 2715-acre TA-74 parcel. The evaluation presented in this report was conducted to support the conclusion, based on prior work (Reneau et al. 1998, 59159), that no remediation is required prior to the transfer of this sub-parcel to Los Alamos County and to support DOE's covenant that all necessary remedial action prior to transfer has been taken (i.e., no further action).

The requirements that control land transfers from federal facilities to other government or private entities are promulgated in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 120. Compliance with these regulations includes an assessment and documentation of past storage or release of hazardous substances on the site.

The evaluation presented in this report is also designed to be consistent with the approach used in other ER Project reports, and to help satisfy additional regulatory requirements. The regulatory requirements governing the ER Project canyons investigations are discussed in Section 1.4 of the core document (LANL 1997, 55622; LANL 1998, 57666). In particular, these investigations address requirements of Module VIII of the Laboratory's Hazardous Waste Facility Permit (the "HSWA module") (EPA 1990, 01585) under the Resource Conservation and Recovery Act (RCRA). These requirements include addressing "the existence of contamination and the potential for movement or transport to or within Canyon watersheds." In addition to federal and state regulations, DOE Order 5400.5, "Radiation Protection of the Public and the Environment" (DOE 1990, 58980) provides guidance on evaluating residual radioactivity at DOE facilities.

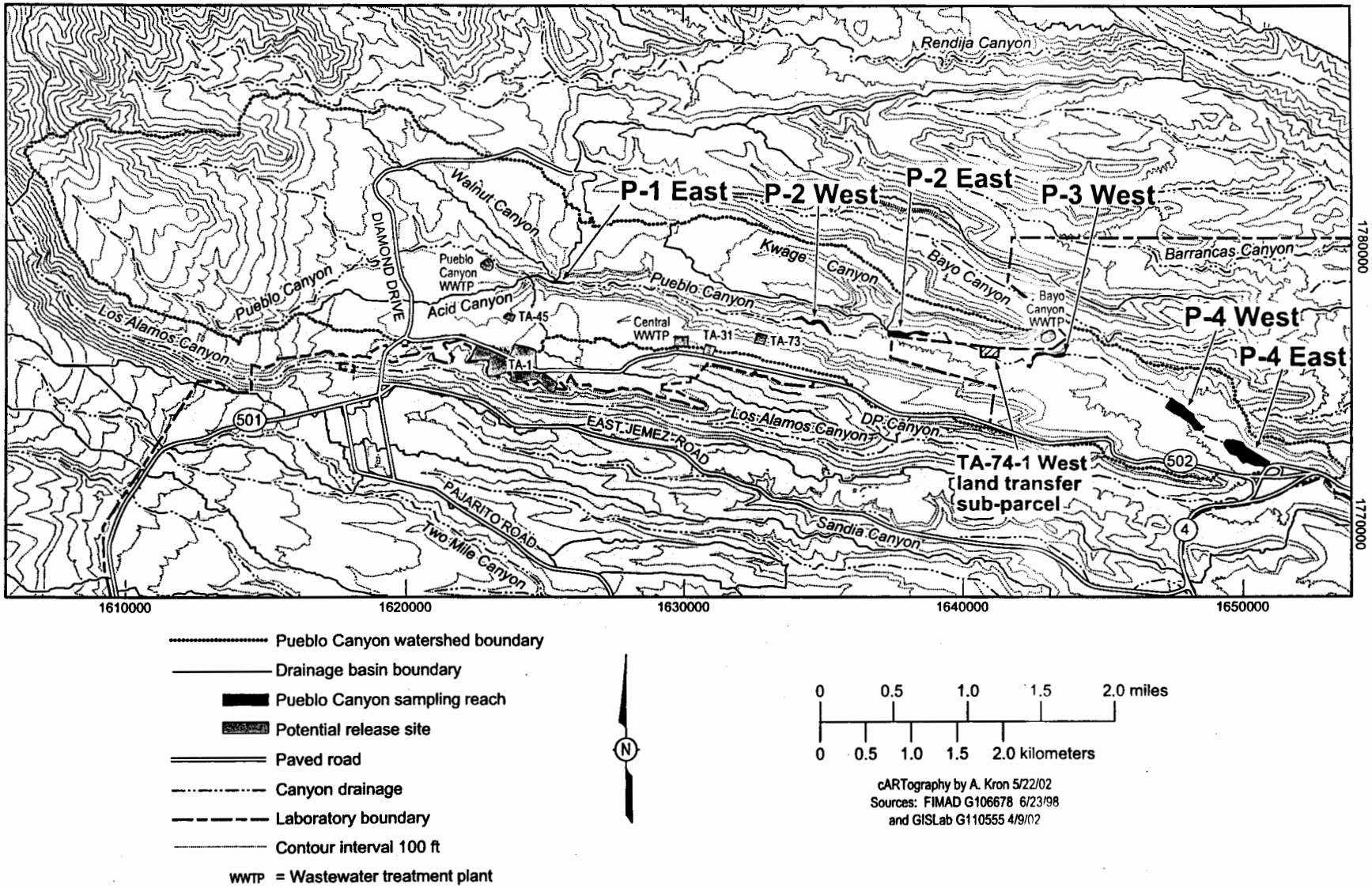


Figure 1.1-1. Map of the Pueblo Canyon watershed showing TA-74-1 West land transfer sub-parcel, sampling reaches mentioned in text, and other features

1.3 Background

1.3.1 Geography and Hydrology

Pueblo Canyon heads on the flanks of the Sierra de los Valles on Santa Fe National Forest land (Figure 1.1-1). It extends across land owned by Los Alamos County and crosses the northeast corner of the Laboratory to its confluence with Los Alamos Canyon. Pueblo Canyon has a drainage area of 21.7 km^2 and a basin length of approximately 16 km. The TA-74-1 West sub-parcel is located 5 km upstream from the confluence with Los Alamos Canyon.

Stream flow in Pueblo Canyon consists of ephemeral runoff from rainstorms and snowmelt, and discharges from the Bayo Canyon Wastewater Treatment Plant (WWTP). Historically, two other WWTPs discharged to the canyon upstream of the TA-74-1 West sub-parcel. The westernmost plant was the Pueblo Canyon WWTP upstream of Acid Canyon, which operated from 1951 until 1991. The Central WWTP was located farther east on the south rim of Pueblo Canyon and operated from 1947 until 1966. The Bayo Canyon WWTP, located between lower Pueblo Canyon and Bayo Canyon about 1 km downstream of the TA-74-1 West sub-parcel, began operating in 1963 and is the active sewage treatment plant for the town of Los Alamos. The magnitude and frequency of floods in Pueblo Canyon increased dramatically after the Cerro Grande fire of May 2000, which caused high severity burn in 4.9 km^2 of the headwaters in the Sierra de los Valles and major changes in hydrologic conditions (BAER 2000, 72659). The largest flood since the fire occurred on July 2, 2001, and left new sediment deposits along the entire length of Pueblo Canyon including the land transfer sub-parcel.

1.3.2 Laboratory History and Operations

Several former Laboratory sites within the Pueblo Canyon watershed have or may have contributed contaminants to the main channel of Pueblo Canyon upstream of the TA-74-1 West land transfer sub-parcel, including some of the original Manhattan Project facilities that were located within the current Los Alamos townsite and that date back to 1943. Treated and untreated radioactive liquid waste derived from many separate facilities was discharged from former TA-1 and TA-45 into Acid Canyon, a small tributary to Pueblo Canyon (Figure 1.1-1), constituting the principal source of contamination in the watershed. Liquid releases from septic tank outfalls and from municipal wastewater treatment plants and surface runoff from contaminated sites constitute additional potential sources of Laboratory-derived contaminants for the main channel. Summaries of pertinent information for key contaminant release sites are provided in "Evaluation of Sediment Contamination in Pueblo Canyon: Reaches P-1, P-2, P-3, and P-4" (Reneau et al. 1998, 59159). A synopsis of this information is extracted from those summaries and provided below, supplemented by more recent work.

The principal sources of contamination in the Pueblo Canyon watershed were outfalls from TA-1 and TA-45 at the head of the South Fork of Acid Canyon (Figure 1.1-1) (LANL 1981, 6059; LANL 1992, 7668). Untreated radioactive liquid waste was released from 1944 to 1951 from an outfall draining TA-1. Treated radioactive liquid waste was released from 1951 to 1964 from outfalls at TA-45, the first radioactive liquid waste treatment facility at the Laboratory (PRS 45-001). Radionuclides detected above background values (BVs) downstream from the outfalls (PRSs 1-002 and 45-004) in sediment samples collected during ER Project investigations include americium-241; cesium-137; plutonium-238; plutonium-239,240; strontium-90; tritium; uranium-234; uranium-235; and uranium-238 (LANL 1996, 54468; Reneau et al. 2000, 66867). Americium-241; cesium-137; and plutonium-239,240 locally exceed screening action levels (SALs). In addition lead, mercury, and silver were detected above BVs but below SALs (LANL 1995, 48856). Demolition of structures at TA-45 and excavation of contaminated soils occurred in 1966 before

the land was released to Los Alamos County in 1967; additional remediation occurred in 1982 and in 2001.

Additional releases into Acid Canyon occurred from the outfall of a septic tank that was installed in the 1940s and operated until 1947 [PRS 0-030(g)]. Plutonium-239,240 and polychlorinated biphenyls (PCBs) above SALs were found below the outfall during ER Project investigations (LANL 1995, 51983; LANL 2000, 70273).

Pueblo Canyon may also have received contaminants from operations at former TA-31 and TA-73 near the Los Alamos Airport. TA-31 was known as the east receiving yard, and PCBs at levels above SALs were found at the mouth of a former septic tank outfall pipe (PRS 31-001) (LANL 1995, 57050). Operations at TA-73 included incinerating classified documents and disposing of various types of waste; steam-cleaning garbage cans, trucks, and dumpsters; operating a landfill and burning municipal and laboratory waste; disposing of waste oil; storing high explosives (HE); operating a surface disposal facility; and operating an asphalt batch plant (LANL 1992, 7667). Outfalls, drainlines, and septic systems were associated with a number of former operations at TA-73. An ash pile from the former incinerator (PRS 73-002) contains several analytes above SALs (antimony, barium, cadmium, copper, lead, silver, thallium, and PCBs) (LANL 1997, 56606), and surface runoff from this site may have provided an additional source of contaminants for Pueblo Canyon.

Effluent from the two former municipal wastewater treatment plants upstream in the watershed could have provided Laboratory-derived contaminants to this part of Pueblo Canyon, although contaminants from these plants could also have non-Laboratory sources. In particular, sludge from the Pueblo Canyon WWTP upstream of Acid Canyon [PRS 0-018(a)] contains a series of analytes above background values (barium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, vanadium, zinc, and uranium-235), although none of these are above SALs (LANL 1997, 56614). The other facility upstream of the TA-74-1 West sub-parcel was the Central WWTP (PRS 0-019). The contaminants of concern at this site included lead, the PCBs Aroclor-1254 and Aroclor-1260, benzo(a)pyrene, and dibenz(a,h)anthracene. A Voluntary Corrective Action (VCA) was conducted at this site to remove above-ground structures, select underground structures, and some contaminated soils in the outfall drainages (LANL 2001, 71417).

1.4 Current Land Use

Pueblo Canyon downstream from Acid Canyon includes land owned by Los Alamos County and the DOE, all of which is open to the public. Present land use includes various recreational activities such as hiking and bicycle riding. There is good trail access into Pueblo Canyon near Acid Canyon from nearby residential areas in Los Alamos, and trails and dirt roads continue down the length of the canyon (Kron 1993, 58665). Sewer lines from the Los Alamos townsite are buried beneath the narrow canyon floor for 4 km downstream from Acid Canyon. The lower canyon is used as a discharge site for treated effluent from the Bayo Canyon WWTP. In the Los Alamos County Comprehensive Plan, the county-owned part of Pueblo Canyon, which includes the confluence with Acid Canyon, has been designated as "scenic open space" since 1964 (Los Alamos Planning Commission 1964, 56873). The part of Pueblo Canyon on DOE land (TA-74), extending upstream from the confluence with Los Alamos Canyon, is presently being considered for potential land transfer to either Los Alamos County, the New Mexico Highway Department, or San Ildefonso Pueblo (DOE 1998, 58671).

1.5 Previous Sediment Investigations

Contaminants associated with sediments in Pueblo Canyon have been investigated in many studies since the initial contaminant releases from TA-45. The first sediment sampling, in 1946, indicated the presence

of plutonium along the full length of Pueblo Canyon downstream from Acid Canyon, documenting transport along a distance of 11 km from the source (Kingsley 1947, 4186). Subsequent work has included repeated sediment sampling at a series of stations as part of the Laboratory Environmental Surveillance Program since 1970 (e.g., Environmental Surveillance and Compliance Programs 1997, 56684) and more intensive studies in the 1970s. Work in the 1970s included studies by the Laboratory Environmental Sciences Group (e.g., Hakonson and Bostick 1975, 29678; Nyhan et al. 1976, 11747; Nyhan et al. 1982, 7164) and investigations under the Formerly Utilized Sites Remedial Action Program (FUSRAP) (LANL 1981, 6059). More recently, existing data on plutonium in sediments were combined with geomorphic mapping of Pueblo Canyon to provide an improved estimate of the inventory of plutonium in the canyon (Graf 1995, 48851; Graf 1996, 55537). This work formed the basis for a preliminary conceptual model of contaminant distribution and transport and for design of a technical approach for the investigations previously conducted by the ER Project (Reneau et al. 1998, 59159).

The most recent investigation focused on contaminant concentrations, inventories, and transport processes in Pueblo Canyon from Acid Canyon to the confluence with Los Alamos Canyon (Reneau et al. 1998, 59159). A brief overview of the results from that investigation follows. The primary chemicals of potential concern (COPCs) in the sediments of Pueblo Canyon are radionuclides discharged from former TA-1 and TA-45 into Acid Canyon. The most significant radionuclide in terms of potential human health risk is plutonium-239,240. Radionuclides that clearly have the same source and are collocated with plutonium-239,240 include americium-241, plutonium-238, and possibly tritium; the potential risks associated with these other radionuclides are minor relative to plutonium-239,240. Cesium-137 and strontium-90 are also known to have been released into Acid Canyon and were detected above BVs in a single sample in Pueblo Canyon.

Eight inorganic COPCs (antimony, cadmium, copper, lead, mercury, selenium, silver, and zinc) have been identified in the sediments of Pueblo Canyon (Reneau et al. 1998, 59159). These COPCs are not clearly collocated with plutonium-239,240 and appear to have been derived from multiple sources.

Twenty-nine organic COPCs have been detected at low concentrations in sediment in Pueblo Canyon and appear to have been derived from multiple sources (Reneau et al. 1998, 59159). These chemicals include PCBs, pesticides, plasticizers, and polycyclic aromatic hydrocarbons (PAHs). Sources of these chemicals could include former Laboratory sites and urban areas of the Los Alamos townsite.

Concentrations of plutonium-239,240 in post-1942 (Laboratory era) sediment deposits have a range of more than two orders of magnitude within some reaches with the maximum value for the canyon being 502 pCi/g. The highest concentrations of plutonium-239,240 and associated radionuclides occur in fine-grained sediments that were probably deposited concurrently with or soon after the peak contaminant releases into Acid Canyon.

The previous assessments of potential human health and ecological risk indicated that levels of contamination in the sediments of Pueblo Canyon do not require immediate remedial actions with regard to present-day risk (Reneau et al. 1998, 59159). Similarly, previous geomorphic assessments indicate that the concentrations of contaminants in sediments carried by floods have been stable or have declined for decades.

Additional sampling of sediment in the Pueblo Canyon watershed has occurred since 1998 that pertains to understanding potential contamination in the TA-74-1 West sub-parcel. Some of these data have yet to be formally presented in a report. Sampling in Pueblo Canyon upstream and downstream of the confluence with Acid Canyon, and in Acid Canyon, was partly designed to reduce uncertainties in the sources and concentrations of organic and inorganic COPCS identified in Reneau et al. (1998, 59159). These samples provide information necessary to distinguish townsite effects and Laboratory effects in

Pueblo Canyon. In addition, sampling along the length of Pueblo Canyon since the Cerro Grande fire has been designed to evaluate the effects of both the transport of ash from the burn area and the remobilization of Laboratory-derived contaminants resulting from large floods.

1.6 Technical Approach

The technical approach for assessing the TA-74-1 West land transfer sub-parcel relies upon four sources of information. They are 1) field investigations and interpretations presented in Reneau et al. (1998, 59159), 2) field investigations that followed this work to fill data gaps, 3) post-Cerro Grande fire sampling, and 4) limited field investigations (geomorphic mapping, radiation measurements, description of postfire sediment deposits) within the land transfer sub-parcel.

Recent investigations of sediment in Pueblo Canyon followed the technical strategy described in the "Core Document for Canyons Investigations" (the "core document") (LANL 1997, 55622; LANL 1998, 57666) and were largely conducted during implementation of the "Task/Site Work Plan for Operable Unit 1049: Los Alamos Canyon and Pueblo Canyon" (LANL 1995, 50290; LANL 1997, 56421) . The core document strategy is to investigate and characterize key reaches, or subsections, of the canyon that provide data sufficient to evaluate contamination, potential risk, and sediment transport processes along the entire length of canyon downstream from PRSs. Pueblo Canyon has been characterized in nine investigation reaches. The report for Pueblo Canyon (Reneau, et al. 1998, 59159) gives detailed descriptions of the reaches and makes inferences about contaminant concentrations in the intervening areas. Six of the nine reaches provide data for this assessment and are identified in Figure 1.1-1

The land transfer sub-parcel is situated between investigation reaches P-2 East and P-3 West (Figure 1.1-1). Data from these two reaches indicate very similar levels of contamination (Reneau et al. 1998, 59159). Consequently, the analytical results from those reaches are used to interpolate contaminant concentrations and inventories for the land transfer sub-parcel. Field measurements of alpha radiation were collected in 2002 in the land transfer sub-parcel in order to support the validity of this interpolation as applies to plutonium-239,240, which is a major contaminant in Pueblo Canyon.

Because no data are available for tritium or semivolatile organic compounds (SVOCs) in P-2 East or P-3 West, or for strontium-90 in prefire sediment deposits, the potential concentrations of these analytes in the TA-74-1 West sub-parcel are evaluated in this report using data from reaches farther upstream and downstream (P-1 East and P-4). These data cover the concentration ranges that are likely to be found in Pueblo Canyon. Reach P-1 East, located immediately below the confluence of Acid Canyon with Pueblo Canyon, aggregates the effects of historic Laboratory effluents and townsite runoff. Reach P-4 is located above the confluence of Pueblo and Los Alamos canyons and represents the effects of transport processes upon contaminant concentrations in the lower canyon. These reaches are labeled in Figure 1.1-1.

Investigations after the Cerro Grande fire provide additional information on the effect of postfire floods on sediment transport in the canyon, the influence of the fire on contaminant concentrations, and validation of the general conceptual model presented in previous reports. Relatively large postfire floods have partially remobilized Laboratory-derived contaminants and mixed them with sediment from the burn area, creating recent sediment deposits with different concentrations of potential contaminants than the older deposits. In particular, the concentrations of various analytes in ash and sediment deposits containing reworked ash exceed prefire background levels, affecting interpretations of possible Laboratory-derived contamination. These post fire data will be used to describe the current conditions in the TA-74-1 West sub-parcel

1.7 Acknowledgments

The following individuals contributed to this report by providing advice on content, approach, and reviews: Kim Birdsall, Dave Gregory, Danny Katzman, Rich Mirenda, Randy Ryti, and Paul Schumann. Jared Lyman provided Global Positioning System (GPS) support to the geomorphic mapping, Shannon Purdue performed the field radiation measurements, Theresa Mercier assembled the data set for the assessment, Marcia Jones provided Geographic Information System (GIS) support, Andi Kron provided drafting support, and Pam Maestas provided compositing support.

2.0 FIELD SETTING AND CONCEPTUAL MODEL

The TA-74-1 West land transfer sub-parcel includes a 130-m long stretch of the active channel of Pueblo Canyon and adjacent abandoned channel deposits and floodplains. Geomorphic investigations in canyons for the ER Project focus on sediment deposits and associated geomorphic units that are younger than 1942, and which therefore post-date initial operations at the Laboratory. These young sediments and geomorphic units are where contamination is likely to be present resulting from Laboratory releases and subsequent transport by floods.

Geomorphic units within the land transfer sub-parcel have not been previously mapped, but the general characteristics of young geomorphic units in this sub-parcel are similar to those occurring 0.8–1.3 km upstream in reach P-2 East and 0.5–1.0 km downstream in reach P-3 West. The location of the land transfer sub-parcel within the Pueblo Canyon watershed is shown in Figure 1.1-1, and the extent of post-1942 channels and floodplains within the sub-parcel is shown in Figure 2.0-1. The young geomorphic units are topographically lower than older stream terraces that occupy most of the canyon bottom. The general nomenclature for the geomorphic units used in this report is discussed in Section 2.2.1, and the specific units in the sub-parcel are discussed in Section 2.3.

2.1 Methods of Investigation

2.1.1 Geomorphic Mapping

A geomorphic map of the TA-74-1 West land transfer sub-parcel was made to show the area affected by post-1942 flooding and potentially containing contaminants derived from upstream sources (Figure 2.0-1). This map delineates the horizontal extent of the three basic post-1942 units that had been previously mapped in upstream and downstream reaches (Reneau et al. 1998, 59159): the active stream channel (unit c1), abandoned post-1942 channels (c2–c4 units), and post-1942 floodplains (unit f1). Other geomorphic units that occur within the sub-parcel include pre-1942 stream terraces (unit Qt), hillslope colluvium (Qc), and anthropogenic fill along the dirt road.

In upstream and downstream reaches (P-2 East and P-3 West), abandoned stream channels were subdivided into units of different ages (c2, c3, and c4, from youngest to oldest). This distinction was not made in the land transfer sub-parcel because levels of contaminants in all units in P-2 East and P-3 West were relatively low from the perspective of potential human health risk (Reneau et al. 1998, 59159). Consequently, there was no benefit to subdividing these units within the land transfer sub-parcel.

The largest flood in Pueblo Canyon since the Cerro Grande fire occurred on July 2, 2001. The high water line from this flood was mapped in the land transfer sub-parcel to document the horizontal extent of possible postfire sediments at the time this report was prepared. This flood inundated areas that had not been flooded since 1942, and therefore is inferred to be the largest flood in Pueblo Canyon since initial contaminant releases. The high water line from this flood was used to represent the extent of post-1942 floodplains (f1).

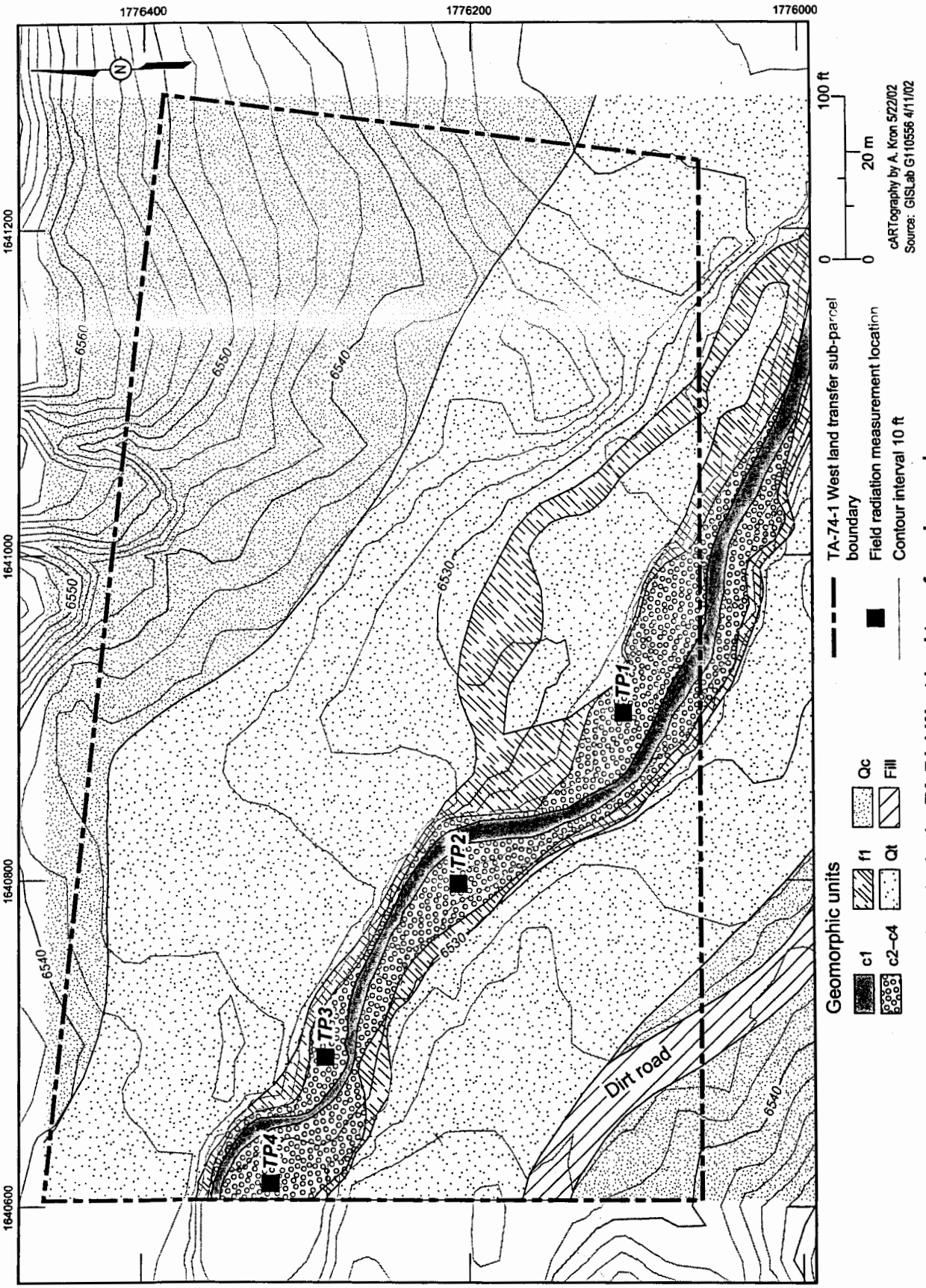


Figure 2.0-1. Map showing geomorphic units in the TA-74-1 West land transfer sub-parcel

Geomorphic mapping in the land transfer sub-parcel utilized a global positioning system (GPS) to record the x,y locations of points along the boundaries between the different geomorphic units. These points were plotted on a topographic base map at a scale of 1:200, and intervening unit boundaries were drawn in the field.

2.1.2 Physical Characterization of Young Sediments

The physical characterization of young sediments in the TA-74-1 West land transfer sub-parcel primarily relied on previous detailed work in upstream and downstream reaches (P-2 East and P-3 West; Reneau et al. 1998, 59159). Because unit characteristics (e.g., particle size and sediment thickness) were similar in nearby reaches, direct interpolation is considered to provide a reasonable approximation of conditions in the land transfer sub-parcel.

The interpolation from nearby reaches was supplemented by field measurements of the thickness of postfire sediment deposits on the c2–c4 and f1 units, and by descriptions of the general particle size characteristics of these deposits.

2.1.3 Characterization of Potential Contamination

Characterization of potential contamination in the TA-74-1 West land transfer sub-parcel relied on results from sediment samples collected in upstream and downstream reaches of Pueblo Canyon. Sample locations were selected through geomorphic characterization and mapping to identify post-1942 sediment deposits and the ranges of sediment grain size. Sampling and analysis were biased towards finer-grained sediment deposits in order to capture the higher contaminant concentrations. Later sampling designs were influenced by the results of previous investigations. Sample collection and data analysis related to this work is consistent with the technical approach presented in Chapter 5 of the "Core Document for Canyons Investigations" (LANL 1997, 55622; LANL 1998, 57666). Work that had been performed up to 1998 is discussed in Reneau et al. (1998, 59159).

2.1.4 Radiological Field Measurements

Field screening for alpha radiation was used to test the inference that levels of plutonium-239,240 in the TA-74-1 West land transfer sub-parcel were similar to that occurring in upstream and downstream reaches. Representative locations were chosen on the c2–c4 units, and sediment was obtained from 15–25-cm increments to depths of 50–75 cm. This sediment was homogenized and spread onto a surface for measurement following methods previously applied in Acid Canyon, using a Model 2221 ratemeter with a 43-1 alpha scintillator probe (LANL 2001, 70188). These measurements are presented in Appendix B-3.0 and support the inference that levels of plutonium-239,240 in the land transfer sub-parcel are similar to that in upstream and downstream reaches.

2.2 Physical Characteristics and Geomorphic Processes

Within the TA-74-1 West land transfer sub-parcel, the active channel (c1 unit) ranges from 1 to 4 m in width and has a bed dominated by coarse sand and gravel. The active channel is bordered by abandoned post-1942 channels (c2–c4 units) that are up to 17 m in combined width and that include both fine-grained and coarse-grained sediment layers. These surfaces were abandoned following lateral channel migration and/or vertical channel incision. Following abandonment, fine-grained sediments have been deposited on c2–c4 surfaces during overbank flooding, both before and after the Cerro Grande fire. The c2–c4 surfaces have an average thickness of about 5–6 cm of postfire sediments that are dominated by

very fine sand to fine sand, but that also include coarse and medium sand, silt, and muck (ash-rich fine-grained sediment) (Appendix B-1.0).

Bordering the abandoned channel deposits are areas of post-1942 floodplain (f1 unit) that are up to 15 m wide. The f1 unit is variable in character. It includes sloping banks between abandoned channel deposits and higher stream terraces (Qt) that are below the July 2, 2001, high-water line. In some places f1 consists of flatter surfaces that were flooded on July 2, 2001, and that are separated from the main channel by a higher stream terrace that constituted "islands" during the flood. Pre- and postfire sediments deposited on f1 are typically fine-grained. Postfire deposits on f1 are dominated by ashy silt and very fine sand (Appendix B-1.0).

Using unit areas measured from the geomorphic map (Figure 2.0-1), thicknesses of prefire sediment estimated in upstream and downstream reaches, and measurements of postfire sediment thickness in the sub-parcel, it is estimated that approximately 4200 m^3 of post-1942 sediment is present in the TA-74-1 West land transfer sub-parcel (Table 2.2-1). Approximately 77% of this is coarse-grained sediment, and 23% is fine-grained sediment. Less than 10% of this estimate consists of sediment deposited by floods since the Cerro Grande fire.

Table 2.2-1
Post-1942 Geomorphic Units in TA-74-1 West Land Transfer Sub-Parcel

Unit	Unit Area (m^2)	Sediment Facies	Estimated Average Thickness, Prefire Sediments (m)	Estimated Volume, Prefire Sediments (m^3)	Estimated Average Thickness, Postfire Sediments (m)	Estimated Volume, Postfire Sediments (m^3)	Typical Median Particle Size Class (<2 mm fraction)	Notes
c1	376	coarse	1.5	564	0.5	188	coarse sand	active channel
c2–c4	1564	fine	0.38	594	0.05	78	very fine sand	abandoned post-1942 channel
c2–c4	1564	coarse	1.6	2502	0.01	16	coarse sand	
f1	1350	fine	0.17	230	0.04	54	very fine sand or silt	active floodplain

Geomorphic processes since the Cerro Grande fire within the TA-74-1 West land transfer sub-parcel have been similar to those that were active before the fire. These processes include vertical scour and fill along the main channel, some lateral bank erosion along the channel, and the inundation of abandoned channel surfaces and floodplains accompanied by sediment deposition (Reneau et al. 1998, 59159). Repeat surveying of cross sections before and after the fire indicates that the land transfer sub-parcel is in a transition zone between an area of net vertical channel incision (upstream, in reach P-2 East) and net vertical channel aggradation (downstream, in reach P-3 West) (Lyman et al. 2002, 72659). If more floods of the same general size as July 2, 2001, occur, available evidence indicates that the channel will either stay near its current elevation or that it will incise, as has occurred upstream. Conversely, with smaller floods the channel is expected to either remain near its current elevation or aggrade associated with net sediment deposition. The size of future floods is dependant on both specific rainfall patterns and the degree of recovery of the upper watershed and cannot be predicted with confidence. It is possible that no floods as large as July 2, 2001, will occur in the upcoming years or decades as watershed conditions continue to improve, and the probability of such events should become smaller each year. It is also

possible that one or more floods in the future will be larger than that on July 2, 2001, in which case the floodwaters could inundate a larger area and extend beyond the mapped f1 boundaries onto pre-1942 terraces (Qt).

2.3 Conceptual Model for Contamination

A conceptual model for contamination in the sediments of Pueblo Canyon has been developed based on previous work, and includes the nature and history of contaminant releases and the nature, extent, and variability of contaminants in downstream reaches resulting from subsequent transport. Key aspects of this conceptual model as pertains to the assessment in this report for the TA-74-1 West land transfer sub-parcel are discussed below.

Available data on contaminants in Pueblo Canyon sediments indicate that plutonium-239,240 discharged into the South Fork of Acid Canyon between 1944 and 1964 is the primary COPC resulting from Laboratory operations (Reneau et al. 1998, 59159). Other radionuclides and metals have also been reported above BVs. Because of its geochemical characteristics, nearly all the plutonium was adsorbed onto sediment particles, and sediment transport processes have largely controlled subsequent transport of plutonium. Other contaminants released into the South Fork of Acid Canyon are expected to behave similarly and to be collocated with plutonium. These contaminants have been dispersed by floods along the 10-km section of Pueblo Canyon downstream from Acid Canyon since initial development of the Laboratory in 1943, and are expected to be present at low concentrations in the TA-74-1 West sub-parcel.

Contaminants derived from other sources, including the former Pueblo Canyon WWTP and runoff from the Los Alamos townsite, are also present in Pueblo Canyon sediments. These contaminants are expected to be present at low concentrations in the TA-74-1 West sub-parcel.

Contaminant concentrations in post-1942 sediments vary greatly, related to factors such as the distance from the source, sediment particle size, and the age of the deposit. Contaminant concentrations are generally higher in sediment deposits closer to the source and in finer-grained sediments than in downstream deposits or in coarser-grained sediments. Concentrations tend to decrease downstream due to mixing of contaminated sediment with noncontaminated sediment in floods. In addition, available data indicate that contaminant concentrations related to Laboratory operations are highest in sediment deposits that are relatively close to the age of the peak contaminant releases and lower in younger sediments. It is expected that erosion and redeposition of contaminated sediment will continue to cause contaminant concentrations to decrease over time.

Investigations in reaches upstream and downstream from the TA-74-1 West sub-parcel indicate that concentrations of plutonium-239,240 and other contaminants are relatively low in this part of Pueblo Canyon. These relatively low concentrations are associated with sediment deposits that largely post-date the original effluent releases into the South Fork of Acid Canyon. In addition, concentrations have been reduced further by the addition of noncontaminated sediment derived from Kwage Canyon, which is located 1.3 km upstream (Figure 1.1-1; Reneau et al. 1998, 59159).

Analysis of postfire sediment deposits and ash in the burn area has demonstrated that the redistribution of ash in flood deposits has increased the concentration of some fallout radionuclides and inorganic chemicals in Pueblo Canyon relative to prefire conditions. For example, sediment with concentrations of cesium-137, barium, cobalt, and manganese above prefire sediment background values is widespread in upper Pueblo Canyon and other canyons affected by the fire (e.g., Katzman et al. 2001, 72660; Kraig et al. 2001, 72658). Because most of the easily eroded ash has been stripped from the headwaters of

Pueblo Canyon, it is expected that the concentrations of analytes associated with ash will decrease in subsequent postfire floods.

3.0 ANALYTICAL RESULTS AND DATA REVIEW

3.1 Data Review

Sediment samples used for evaluating potential contamination in the TA-74-1 West land transfer sub-parcel were collected as part of ER Project Canyons investigations or Cerro Grande Fire Recovery investigations between 1996 and 2001. The majority of the data relevant for this assessment are presented in Reneau et al. (1998, 59159). Subsequent sampling was performed to address data gaps that were identified in that report, or to collect data to evaluate the effects of the Cerro Grande fire upon contaminant concentrations and inventories in Pueblo Canyon and other canyons affected by the fire.

The geographic scale of the prior ER Project and Cerro Grande fire field investigations is substantially larger than the land transfer sub-parcel. Data for these investigations were collected from representative reaches as described in the "Task/Site Work Plan for Operable Unit 1049: Los Alamos Canyon and Pueblo Canyon" (LANL 1995, 50290; LANL 1997, 56421) and the core document (LANL 1997, 55622; LANL 1998, 57666).

Pueblo Canyon has been investigated in nine reaches. The assessment in this report utilizes data from six of those reaches and relevant unpublished data for the specific objective of assessing the potential human health effects associated with unrestricted use of the land transfer sub-parcel. Where sufficient data are available from adjacent reaches (6 or more samples) (P-2 East and P-3 West), only data from those reaches are considered in this assessment. If data are not available from adjacent reaches, then data from reaches farther upstream and downstream are utilized. Table 3.1-1 presents the data sources, the number of samples, and the analytical suites that were used to perform this assessment.

The objective of this review is to evaluate the data relevant to the TA-74-1 West land transfer sub-parcel in the context of detected chemicals and Laboratory background concentrations. The outcome of the review is a subset of COPCs that warrant further evaluation in Section 4.0 regarding their potential for adverse human health effects.

3.2 Comparisons of Data to Background

The Laboratory sediment background values (BVs) are upper tolerance limits (UTLs) of sediment background data distributions, or detection limits for infrequently detected analytes (Ryti et al. 1998, 59730). These values are intended for comparisons to investigation data maxima, which can be either detected or nondetected sample results. Following ER Project procedures (ER-SOP-15, 12; ER-SOP-15.13; LANL, 2002, 72639), if the investigation data maximum for an analyte does not exceed its BV, then that analyte is not considered a COPC and is not evaluated further.

One category of analytes, in the context of background, is fallout radioisotopes. Worldwide distributions of analytes such as cesium-137 are the consequence of above-ground nuclear weapons testing and other sources. Although these isotopes are man-made, reference concentrations are used to separate local facility effects from regional concentrations related to fallout. Fallout values are calculated the same way as BVs for naturally-occurring analytes, and for simplicity the phrase "background value" will also be applied to these radioisotopes in this report.

Table 3.1-1
Analytical Suites, Data Source, and Number of Samples Used for the Land Transfer Sub-Parcel Assessment

Analytical Suite	Data Source	Investigation Reaches	Number of Samples
Isotopic Plutonium	Reneau et al. 1998	P-2 East, P-3 West	66
	Cerro Grande Recovery Project	P-2 West, P-3 West	14
		Total number of samples	80
TAL* metals	Reneau et al. 1998	P-3 West	8
	Cerro Grande Recovery Project	P-2 West, P-3 West	14
		Total number of samples	22
SVOC	Reneau et al. 1998	P-1 East, P-4 East, P-4 West	14
	1999 ER Project Sampling	P-1 East	1
		Total number of samples	15
Gamma Spectroscopy	Reneau et al. 1998	P-3 West	8
	Cerro Grande Recovery Project	P-2 West, P-3 West	14
		Total number of samples	22
Pesticides and PCBs	Reneau et al. 1998	P-3 West	6
		Total number of samples	6
Strontium-90	Reneau et al. 1998	P-1 East, P-4 East, P-4 West	14
	Cerro Grande Recovery Project	P-2 West, P-3 West	14
		Total number of samples	28
Tritium	Reneau et al. 1998	P-1 East, P-4 East, P-4 West	14
		Total number of samples	14

*TAL = Target analyte list.

Organic chemicals do not have BVs, either because they are not naturally occurring or because they were not analyzed in the background data set. If organic chemicals are detected then they are carried forward to the human health assessment.

The Cerro Grande fire resulted in increases in the concentrations of a variety of constituents in sediments in areas that were affected by postfire flooding (e.g., Katzman et al. 2001, 72660; Kraig et al. 2001, 72658). Examples include the presence of cesium-137, cobalt, lead, and manganese in postfire sediments at concentrations above prefire background levels. Although some analytes with relatively high postfire sediment concentrations were reported below BVs in the prefire sediment data, the postfire sediment data are compared to Laboratory BVs in this report. This approach is protective, in that COPCs identified by the background comparisons in this report are not necessarily associated with Laboratory releases.

The process of comparing analytical results to background data is conducted in accordance with ER Project procedures (ER-SOP-15.12 and ER-SOP-15.13) and guidance (LANL 1998, 59596). The sediment background data and the derivation of the BVs are presented in "Inorganic and Radionuclide Background Data for Soils, Canyon Sediments, and Bandelier Tuff at Los Alamos National Laboratory" (Ryti et al. 1998, 59730). The analytical methods used to generate the field investigation data are generally comparable to those that generated the Laboratory background data, giving the comparisons a

common basis. There are three exceptions. The background measurements for americium-241 were conducted using alpha spectrometry. The Pueblo Canyon characterization data for americium-241 were produced using gamma spectroscopy. The basis for the BVs for thallium and antimony are soil measurements using inductively coupled plasma mass spectrometry (ICPMS). The site data for these analytes are from different analytical methods, some of which resulted in elevated detection limits. Data from Reneau et al. (1998, 59159) are reviewed for quality in that report. Data collected since that report listed in Table 3.1-1 do not have known quality problems.

3.2.1 Comparison of Inorganic Chemical Data with Sediment Background Data

Table 3.2-1 presents the frequency of detects and comparisons of investigation sample results with sediment BVs for inorganic chemicals. Prefire and postfire data are combined in the table. The discussion below addresses prefire and postfire concentrations for those analytes that exceed BVs. This is useful for inferring whether the concentrations are influenced by runoff from areas affected by the Cerro Grande fire. Box plots are provided in Appendix E that show the prefire and postfire data subsets.

Table 3.2-1
Inorganic Constituents Frequency of Detects and Comparisons to Sediment Background Values

Analyte	Number of Analyses	Number of Detects	Concentration Range (mg/kg)	Background Value (BV) (mg/kg)	Frequency of Detects Above BV	Frequency of Nondetects Above BV
Aluminum	22	22	1000–10600	15400.00	0/22	0/22
Antimony	22	1	[0.27]–[1.3]	0.83	0/22	9/22
Arsenic	22	17	[0.11]–2.6	3.98	0/22	0/22
Barium	22	22	14–248	127.00	8/22	0/22
Beryllium	22	19	0.18–1.3	1.31	0/22	0/22
Cadmium	22	12	[0.015]–[0.69]	0.40	1/22	8/22
Chromium	22	22	1.2–7.8	10.5	0/22	0/22
Cobalt	22	20	0.98–6.4	4.73	6/22	0/22
Copper	22	22	1.3–20.5	11.20	3/22	0/22
Iron	22	22	3170–12600	13800.00	0/22	0/22
Lead	22	22	3.7–33.9	19.70	7/22	0/22
Manganese	22	22	120–1140	543.00	9/22	0/22
Mercury	22	12	[0.002]–[0.14]	0.10	0/22	6/22
Nickel	22	17	1.2–10.4	9.38	3/22	0/22
Selenium	22	12	[0.21]–0.84	0.30	11/22	6/22
Silver	22	3	[0.043]–[1.7]	1.00	2/22	13/22
Thallium	22	5	[0.044]–[1.4]	0.73	1/22	8/22
Vanadium	22	22	3.4–18.1	19.70	0/22	0/22
Zinc	22	22	15.8–51.8	60.20	0/22	0/22

Ten metals were detected with maximum concentrations that exceed Laboratory sediment BVs. They are barium, cadmium, cobalt, copper, lead, manganese, nickel, selenium, silver and thallium. Of these ten, only copper and selenium exceeded BVs in samples of prefire sediment (Appendix E). The detected

value exceedances for barium, cadmium, cobalt, lead, manganese, nickel, silver and thallium are associated with samples of postfire sediment.

Statistical comparisons were conducted between the site investigation data and the background data set. These analyses are presented in Appendix E. The statistical comparisons confirmed the results of the comparisons of the maximum values to BVs, with one exception. Nickel results are not different from background, based upon a comparison of the background data distribution and the site data distribution using a Gehan test and a quantile test. Therefore, nickel is not evaluated further. The remaining nine inorganic chemicals are evaluated in the human health screening assessment section.

Two other inorganic chemicals had maximum detection limits that exceeded BVs (antimony and mercury). In the background data set, UTLs could not be calculated for these chemicals because there were a large number of nondetect results. The BVs for these constituents are the analytical method detection limits. These constituents had previously been considered COPCs in Pueblo Canyon because of sample results exceeding BVs (Reneau et al 1998, 59159). Antimony and mercury will be assessed in the human health screening assessment.

One chemical that was a COPC in the assessment of Pueblo Canyon (Reneau et al 1998, 59159) that is not a COPC in this report is zinc. None of the zinc data for this report exceed the BV. The values that exceeded the BV in the previous report were from reach P-1. Those data are not being used in this assessment because metals data from reaches adjacent to the land transfer sub-parcel are available.

In summary, the inorganic chemical data review identified eleven analytes as COPCs. All analytes that were compared to BVs are listed in Table 3.2-2 along with the rationale for decisions to retain or eliminate them as COPCs. A complete presentation of the data for detected inorganic chemicals, which includes inorganic chemicals identified as COPCs, is provided in Appendix D. The statistical analyses for comparisons to background are presented in Appendix E.

3.2.2 Comparison of Radionuclide Data with Sediment Background Data

Table 3.2-3 presents the frequency of detects and comparisons of investigation sample results with sediment BVs for radionuclides. As with the inorganic chemical evaluation, prefire and postfire data are combined.

The data for plutonium-238 and plutonium-239,240 are significantly above the background data concentrations (Appendix E). The cesium-137 maximum value exceeds the BV and cesium-137 is significantly different from background using Gehan and quantile tests. The cesium-137 data that exceed the BV are from postfire samples. Strontium-90 has two values that exceed the BV. The statistical testing of the site data versus the background data give equivocal results. Cesium-134 was detected in six postfire samples. A BV or background data are not available for this radionuclide. Plutonium-238, plutonium-239,240, cesium-137, and cesium-134 and strontium-90 are assessed for potential human health effects in Section 4.0.

The maximum tritium value exceeds the BV but the data are not different from background using distributional tests (Appendix E). The results of these background comparisons differ from those reported previously (Reneau et al. 1998, 59159). The reason is that data from across reaches are combined in this assessment to evaluate potential radionuclide concentrations for the TA-74-1 West land transfer sub-parcel, and statistical evaluations of the combined data sets do not show significant differences from background. The previous report evaluated data against background for each reach. The data that exceeded background were from reach P-1. Tritium is not evaluated further in this report.

Table 3.2-2
Results of Inorganic Chemical Data Review

Analyte	Result	Rationale
Aluminum	Eliminated	No values exceeded the BV
Antimony	Retained	Nondetects exceed BV and there are insufficient detects to conduct comparisons of distributions
Arsenic	Eliminated	No values exceeded the BV
Barium	Retained	Maximum value exceeded the BV and the data distributions are different
Beryllium	Eliminated	No values exceeded the BV
Cadmium	Retained	Maximum nondetect value exceeds BV
Chromium	Eliminated	No values exceeded the BV
Cobalt	Retained	Maximum value exceeded the BV and the data distributions are different.
Copper	Retained	Maximum value exceeded the BV and the data distributions are different.
Iron	Eliminated	No values exceeded the BV
Lead	Retained	Maximum value exceeded the BV and the data distributions are different.
Manganese	Retained	Maximum value exceeded the BV and the data distributions are different.
Mercury	Retained	Maximum nondetect exceeds the BV
Nickel	Eliminated	Maximum value exceeded the BV but the data distributions are not different.
Selenium	Retained	Maximum value exceeds the BV
Silver	Retained	Maximum nondetect value exceeds
Thallium	Retained	Maximum value exceeds BV and there are insufficient detects to conduct comparisons of distributions
Vanadium	Eliminated	No values exceeded the BV
Zinc	Eliminated	No values exceeded the BV

Note: Details of statistical testing and results are presented in Appendix E.

Table 3.2-3
Radionuclide Constituents Frequency of Detects and Comparisons to Sediment Background Values

Analyte	Number of Analyses	Number of Detects	Concentration Range (pCi/g)	Background Value (BV) (pCi/g)	Frequency of Detects Above BV
Americium-241	22	2	[-0.227]–[0.972]	0.040	2/22
Cesium-134	22	6	[-0.0572]–[0.42]	na*	6/22
Cesium-137	22	15	[0]–2.33	0.90	10/22
Plutonium-238	80	4	[-0.014]–0.136	0.006	4/80
Plutonium-239,240	80	80	0.04–44.9	0.068	79/80
Strontium-90	28	14	[-0.2]–1.4	1.04	2/28
Tritium	14	13	0.0026–1.21	0.093	2/14

*na = not available.

Americium-241 was measured using gamma spectroscopy in the reaches closest to the TA-74-1 West land transfer sub-parcel. The background study produced americium-241 data using alpha spectroscopy. This is problematic for conducting statistical comparisons because the detection limits for these investigation data are consistently higher than the detection limits for the background data. Americium-241 was determined to be a COPC for Pueblo Canyon previously based on alpha spectroscopy analyses in P-1 and P-4 (Reneau et al. 1998, 59159) and will be evaluated in the human health screening assessment in Section 4.0.

In summary, the radionuclide data review identified five analytes as COPCs. All analytes that were compared to BVs are listed in Table 3.2-4 along with the rationale for decisions to retain or eliminate them as COPCs. A complete presentation of the data for detected radionuclides, which includes radionuclides identified as COPCs, is provided in Appendix D.

Table 3.2-4
Results of Radionuclide Constituent Data Review

Analyte	Result	Rationale
Americium-241	Retained	Analytical methods differ between reach investigation data and background data. Statistical comparisons are not advised.
Cesium-134	Retained	Detected in six postfire samples. BV and background data not available.
Cesium-137	Retained	Maximum value exceeded the BV and the data distributions are different.
Plutonium-238	Retained	Site data exceed BV by a wide margin.
Plutonium-239,240	Retained	Site data exceed BV by a wide margin.
Strontium-90	Retained	Some differences between background and site data distributions.
Tritium	Eliminated	No difference between background and site data distributions.

3.2.3 Evaluation of Organic Chemicals in Sediments

Organic chemicals evaluated in this data review include SVOCs, pesticides, and PCBs. Six sets of SVOC sample results from reach P-1 East and nine sets of SVOC sample results from reach P-4 are used to bound the range of SVOC concentrations at the TA-74-1 West land transfer sub-parcel. Six samples were collected in reach P-3 West for pesticide and PCB analysis. These data are used to estimate concentrations of those contaminants in the land transfer sub-parcel. Table 3.2-5 presents the frequency of detects for the SVOC, pesticide and PCB suites. Because there are no BVs for SVOCs, pesticides, or PCBs, analytes that are detected in one or more samples are identified as COPCs and evaluated by the human health screen in Section 4.0.

Table 3.2-6 documents the rationale for decisions to retain organic chemicals as COPCs. In summary, eighteen SVOCs were detected and identified as COPCs. None of the analytes included in the pesticide and PCB analytical suite were detected in these samples.

Table 3.2-5
Organic Chemical Frequency of Detects

Analyte	Number of Analyses	Number of Detects	Concentration Range (mg/kg)	Frequency of Detects
SVOCs				
Acenaphthene	15	4	0.13–[0.344]	4/15
Anthracene	15	4	0.23–0.369	4/15
Benz(a)anthracene	15	5	0.035–1	5/15
Benzo(a)pyrene	15	5	0.052–1.8	5/15
Benzo(b)fluoranthene	15	6	0.05–2.5	6/15
Benzo(g,h,i)perylene	15	4	0.19–0.86	4/15
Benzo(k)fluoranthene	15	4	0.114–1.1	4/15
Benzoic Acid	15	4	0.088–[3.3]	4/15
Carbazole	6	3	0.14–[0.34]	3/6
Chrysene	15	6	0.034–1.2	6/15
Dibenzofuran	15	4	0.064–[0.344]	4/15
Fluoranthene	15	7	0.056–1.9	7/15
Fluorene	15	4	0.11–[0.344]	4/15
Indeno(1,2,3-cd)pyrene	15	4	0.22–0.88	4/15
Methylnaphthalene[2-]	15	4	0.038–[0.344]	4/15
Naphthalene	15	4	0.099–0.374	4/15
Phenanthrene	15	5	0.064–1.505	5/15
Pyrene	15	7	0.051–2.2	7/15
Pesticides and PCBs				
Aroclor-1254	6	0	[0.036]–[0.046]	0/6
Aroclor-1260	6	0	[0.036]–[0.046]	0/6
Chlordane[alpha-]	6	0	[0.0018]–[0.0023]	0/6
Chlordane[gamma-]	6	0	[0.0018]–[0.0023]	0/6
DDD[4,4'-]	6	0	[0.0036]–[0.0046]	0/6
DDE[4,4'-]	6	0	[0.0036]–[0.0046]	0/6
DDT[4,4'-]	6	0	[0.0036]–[0.0046]	0/6
Dieldrin	6	0	[0.0036]–[0.0046]	0/6
Heptachlor Epoxide	6	0	[0.0018]–[0.0023]	0/6

Table 3.2-6
Results of Organic Chemical Data Review

Analyte	Result	Rationale
SVOCs		
Acenaphthene	Retained	Detected in 4 of 15 samples
Anthracene	Retained	Detected in 4 of 15 samples
Benz(a)anthracene	Retained	Detected in 5 of 15 samples
Benzo(a)pyrene	Retained	Detected in 5 of 15 samples
Benzo(b)fluoranthene	Retained	Detected in 6 of 15 samples
Benzo(g,h,i)perylene	Retained	Detected in 4 of 15 samples
Benzo(k)fluoranthene	Retained	Detected in 4 of 15 samples
Benzoic Acid	Retained	Detected in 4 of 15 samples
Carbazole	Retained	Detected in 3 of 6 samples
Chrysene	Retained	Detected in 6 of 15 samples
Dibenzofuran	Retained	Detected in 4 of 15 samples
Fluoranthene	Retained	Detected in 7 of 15 samples
Fluorene	Retained	Detected in 4 of 15 samples
Indeno(1,2,3-cd)pyrene	Retained	Detected in 4 of 15 samples
Methylnaphthalene[2-]	Retained	Detected in 4 of 15 samples
Naphthalene	Retained	Detected in 4 of 15 samples
Phenanthrene	Retained	Detected in 5 of 15 samples
Pyrene	Retained	Detected in 7 of 15 samples

4.0 SITE ASSESSMENTS

4.1 Human Health Screening Assessment

The scope of this assessment is the evaluation of potential human health risks arising from the unrestricted release of the TA-74-1 West land transfer sub-parcel. This human health screening assessment follows the general ER Project protocol described in "Human Health Risk-Based Screening Methodology" (LANL 2002, 72639). There are four components of the screening assessment: scoping, screening evaluation, uncertainty analysis, and interpretation. In scoping, the types of land uses at the TA-74-1 West land transfer sub-parcel and associated potential receptors are described. In the screening evaluation, the origin and basis of the human health screening action levels (SALs) employed for screening assessment are discussed. A numerical comparison of site data and human health SALs is performed to identify COPCs associated with potential unacceptable human health risk. In the uncertainty analysis, the results of the numerical comparisons are evaluated relative to bias and uncertainty in the environmental data and the applicability of the SALs for TA-74-1 West land transfer sub-parcel land uses. A summary of the results of the screening assessment is provided in the interpretation.

4.1.1 Scoping

The intended use of the land transfer sub-parcel is a location for a new wastewater treatment plant for Los Alamos County. Under such a land use, two types of potential receptors have been identified.

Construction workers may be exposed to contaminants in soils and sediments during construction of the plant, and workers may be exposed at the new plant during its operation. Potential exposure pathways to contaminated soil and sediment, for both receptors, include incidental ingestion, dust inhalation, dermal absorption, and external irradiation.

Soil and sediment are the exposure media of concern. As described in Section 2, chemical and radiological contamination in this area of Pueblo Canyon is associated with releases to the canyon from upstream sources. These sources include Laboratory-related releases, such as from outfalls into Acid Canyon, and runoff from urbanized areas in the Los Alamos townsite. Some analytes are also elevated above background levels due to the deposition of sediment containing ash produced during the Cerro Grande fire. Surface water in this portion of Pueblo Canyon exists only as ephemeral flow following significant precipitation events.

4.1.2 Screening Evaluation

The screening assessment employs SALs that represent chemical and radionuclide concentrations in soils and sediments below which potential health effects are considered negligible. The SALs are based on a residential land use and therefore reflect a greater fraction of time spent on-site than would realistically be associated with either a construction worker or an employee of the wastewater treatment plant. The chemical SALs were calculated based on the methodology described in LANL (2002, 72639), which is based on the guidance in NMED (2000, 68554) and EPA region VI (2001, 71466). The chemical SALs are based on a target risk of 10^{-6} for carcinogens and a hazard quotient (the ratio of soil concentration and reference dose) of one for noncarcinogens. Exposure pathways that are incorporated into the calculation of chemical SALs include incidental soil ingestion, dust inhalation, inhalation of gas-phase volatile organic compounds emanating from soil, and dermal absorption.

Radionuclide SALs were calculated using the RESRAD computer code for a target dose rate of 15 mrem/year. RESRAD incorporates the dose assessment methodology described in DOE Order 5400.5, "Radiation Protection of the Public and the Environment" (DOE 1990, 58980) and is used to implement residual radioactive material guidelines contained in this DOE Order. The ER Project methodology for calculating SALs is presented in "Derivation and Use of Radionuclide Screening Action Levels" (LANL 2001, 69683). Exposure pathways that are incorporated into the calculation of radionuclide SALs include incidental soil ingestion, dust inhalation, ingestion of homegrown produce, and external irradiation.

There are 6 radionuclides, 11 inorganic chemicals, and 18 organic chemicals identified as COPCs in Section 3. The maximum reported concentrations of these COPCs are compared with their SALs in Table 4.1-1. The result of the comparison is presented as the ratio of the maximum value to the SAL, and is entitled the SAL ratio in Table 4.1-1. Exceedance of the SAL is indicated by SAL ratios of greater than one.

A graphical summary of the information in Table 4.1-1 is shown in Figure 4.1-1. The line of equality separates the plot regions into two areas. Points that plot to the right of the line of equality are maximum COPC values that are less than the corresponding SAL (SAL ratio <1). Points that plot to the left of the line of equality exceed the SAL (SAL ratio >1). The COPCs with maximum detected concentrations exceeding their SALs are plutonium-239,240 and the SVOCs benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene.

Table 4.1-1
Comparison of Pueblo Canyon Maximum Contaminant Values and SALs

COPC	Effect Basis of Screening Value	Maximum Value[a,b]	SAL[a]	SAL Ratio[c]
Radionuclides				
Americium-241	Dose Rate	[0.97][d]	39	0.025
Cesium-134	Dose Rate	[0.42]	2.3	0.18
Cesium-137	Dose Rate	2.3	5.3	0.44
Plutonium-238	Dose Rate	0.14	49	0.0028
Plutonium-239,240	Dose Rate	44.9	44	**1**
Strontium-90	Dose Rate	1.4	5.7	0.25
Organic Chemicals				
Acenaphthene	Noncarcinogen	[0.34]	2800	0.00012
Anthracene	Noncarcinogen	0.37	16000	0.000023
Benz(a)anthracene	Carcinogen	1.0	0.62	**1.6**
Benzo(a)pyrene	Carcinogen	1.8	0.06	**29**
Benzo(b)fluoranthene	Carcinogen	2.5	0.62	**4.0**
Benzo(g,h,I)perylene[e]	Noncarcinogen	0.86	1800	0.00048
Benzo(k)fluoranthene	Carcinogen	1.1	6.2	0.18
Benzoic Acid	Maximum Value	[3.3]	100000	0.000033
Carbazole	Carcinogen	[0.34]	240	0.0014
Chrysene	Carcinogen	1.2	610	0.0020
Dibenzofuran	Noncarcinogen	[0.34]	290	0.0012
Fluoranthene	Noncarcinogen	1.9	2300	0.00083
Fluorene	Noncarcinogen	[0.34]	2100	0.00016
Indeno(1,2,3-cd)pyrene	Carcinogen	0.88	0.62	**1.4**
Methylnaphthalene[2-][f]	Noncarcinogen	[0.34]	53	0.0065
Naphthalene	Noncarcinogen	0.37	53	0.0071
Phenanthrene	Noncarcinogen	1.51	1800	0.00084
Pyrene	Noncarcinogen	2.2	1800	0.0012
Inorganic Chemicals				
Antimony	Noncarcinogen	[1.3]	30	0.043
Barium	Noncarcinogen	248	5200	0.048
Cadmium	Noncarcinogen	[0.69]	70	0.0099
Cobalt	Noncarcinogen	6.4	4500	0.0014
Copper	Noncarcinogen	20.5	2800	0.0073
Lead	Noncarcinogen	33.9	400	0.085
Manganese	Noncarcinogen	1140	7800	0.15
Mercury	Noncarcinogen	[0.14]	23	0.0061
Selenium	Noncarcinogen	0.84	380	0.0022

Table 4.1-1 (continued)

COPC	Effect Basis of Screening Value	Maximum Value[a,b]	SAL[a]	SAL Ratio[c]
Silver	Noncarcinogen	[1.7]	380	0.0045
Thallium	Noncarcinogen	[1.4]	6.1	0.23

[a] Values for organic and inorganic chemicals are expressed in mg/kg; values for radionuclides are expressed in pCi/g.

[b] Maximum values for detects and nondetects combined and are rounded to two significant figures.

[c] SAL ratio is the ratio of maximum value to SAL. Values are rounded to two significant figures.

[d] Square brackets indicate that the maximum value is a nondetect.

[e] Toxicity evaluated using pyrene as a chemical surrogate.

[f] Toxicity evaluated using naphthalene as a chemical surrogate.

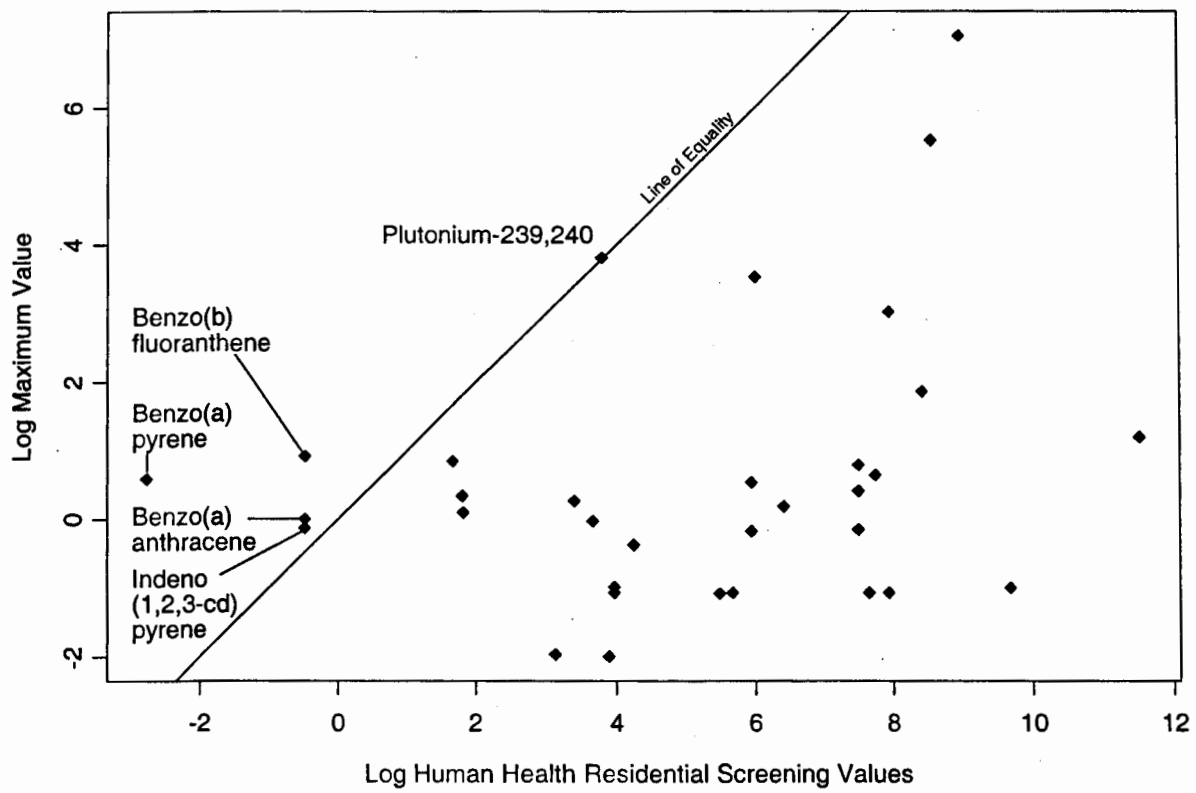


Figure 4.1-1. Results of the screening assessment: comparisons of maximum COPC values to SALs

Although only five of thirty-four COPCs had maximum concentrations exceeding their respective SALs, it is possible that exposure to multiple chemicals detected below a screening threshold may result in adverse health effects. The potential for such adverse effects was evaluated by summing the ratios shown in Table 4.1-1 for COPCs whose SALs are based on the same type of effect (radiation dose, cancer risk, or noncancer hazard). The ratio sums (excluding the five COPCs that exceed SALs), were 0.90, 0.32, and 0.60 for radionuclides, chemical carcinogens, and noncarcinogens, respectively. These

results indicate that the other radionuclides represent a combined potential health effect based upon their maximum values equivalent to the maximum plutonium-239,240 value (SAL ratio of 1.0 versus ratio sum of 0.90). For the carcinogens, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene present the bulk of the potential chemical cancer risk and the other carcinogens do not pose an unacceptable cancer risk. These results also indicate that noncarcinogenic effects do not adversely affect human health at this site.

4.1.3 Uncertainty Analysis

The screening evaluation identified plutonium-239,240, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene as posing potential human health risks in the TA-74-1 West land transfer sub-parcel based on a residential land use scenario. Sources of uncertainty in the evaluation of potential risk from these analytes are discussed in this section.

As indicated in Section 4.1, the residential land use scenarios that form the basis for the SALs used in this assessment assume a higher intensity of exposure than would be expected for either a construction worker or a wastewater treatment plant worker. For example, while occupational receptors are generally assumed to be on-site for 250 days/year, the SALs assume an exposure frequency of 350 days/year. Similarly, construction workers are present only during the actual period of construction whereas an exposure duration of 30 years is used in the calculation of the SALs. Construction worker scenarios typically have higher dust inhalation rates and soil ingestion rates. These higher rates are offset at least partially by the fewer days per year on-site and an exposure duration much shorter than 30 years. For chemical COPCs, the use of child receptors in the exposure calculations for the residential scenario further increases the protective bias for an occupational setting because the chemical intake rate of a child (the rate of chemical exposure normalized to body weight) commonly exceeds that of an adult.

The use of COPC concentration data from channel and floodplain sediments is likely to result in a protective bias for potential receptors at the location of the wastewater treatment plant because the plant will presumably not be constructed in the zone of historic or active flooding. There are no known sources of direct chemical or radionuclide contamination in the part of the sub-parcel outside of the modern channel and floodplain. Hence, employing sediment data for the purpose of screening potential effects on the developable portion of the land transfer sub-parcel is expected to be protective.

The maximum plutonium-239,240 concentration of 44.9 pCi/g in reach P-3 West far exceeds plutonium-239,240 concentrations reported in other samples from reaches adjacent to the land transfer sub-parcel. Because people are not likely to remain in only one location for the duration of exposure, using reach-wide averages of plutonium-239,240 concentrations rather than the maximum provides more representative values of what people may be exposed to in the land transfer sub-parcel. The sampled reaches above and below the land transfer sub-parcel have similar concentrations for plutonium-239,240. Samples from the reach above the sub-parcel average 1.9 pCi/g with a 95% upper confidence level (UCL) on the mean of 2.7 pCi/g. Samples from the reach below the sub-parcel have an average plutonium-239,240 concentration of 3.1 pCi/g and a UCL on the mean of 5.4 pCi/g. These UCLs are well below the screening value of 44 pCi/g and result in potential doses of 0.9 and 1.8 mrem/yr.

As previously mentioned, the default residential exposure scenario for radionuclides includes the garden produce pathway (ingestion of homegrown fruits and vegetables). Because this site will be used for the construction and operation of a wastewater treatment plant, a plutonium-239,240 screening value without the garden produce pathway (110 pCi/g) is a more realistic screening value for the land transfer sub-parcel. Given the intended land use it is highly unlikely that anyone will obtain any of his or her produce from a garden located on the site. If the latter screening value is used, the SAL ratio for maximum

plutonium-239,240 value is 0.45. Combining the UCL concentrations of 3.1 and 5.4 pCi/g for the adjacent reaches and the 110 pCi/g SAL, the SAL ratios are 0.028 and 0.049 which represent a potential dose of 0.42 mrem/yr and 0.73 mrem/yr respectively.

Within the sampled reaches, which represent 35% of the total length of Pueblo Canyon downstream from Acid Canyon, it is considered unlikely that plutonium concentrations in any area greatly exceed those measured at the sample sites. In addition, if higher levels of plutonium exist in certain sediment layers within the reaches than were sampled, the area and volumes of such sediment would be small and unlikely to significantly affect average concentrations for the reach. This is because the sampling strategy for the canyon reaches involved the identification and sampling of sites judged likely to contain the highest levels of contamination. Also, the investigation approach was iterative with the results of previous phases being used to plan the next set of samples, one emphasis being to characterize the higher contaminant concentration values.

The ratio sum for radionuclides that did not exceed SALs is 0.90. This sum is sufficiently high to suggest that these radionuclides in combination with plutonium-239,240 may represent an unacceptable risk at the land transfer sub-parcel. Much like plutonium-239,240, the americium-241, plutonium-238, and strontium-90 SALs are influenced by the garden produce pathway. As discussed previously, this pathway is a very unlikely contributor to risk for the land transfer sub-parcel, given the intended use of the property. In addition, the external radiation exposure, that drives the risk from cesium-137, is also conservative because the residential scenario assumes 24 hours/day and 350 days/year onsite exposure, while the construction worker and site worker would have less onsite exposure. Based upon this assessment, the concentrations of other radionuclides in combination with plutonium-239,240 would result in potential doses below the 15 mrem/yr dose limit, permitting unrestricted use of the TA-74-1 West land transfer sub-parcel.

Four SVOCs have concentrations that exceed their respective SALs (Table 4.1-1), i.e., SAL ratios that exceed one. These COPCs are benz(a)anthracene (SAL ratio = 1.6), benzo(a)pyrene (SAL ratio = 29), benzo(b)fluoranthene (SAL ratio = 4.0), and indeno(1,2,3-cd)pyrene (SAL ratio = 1.4) The SVOC data for this assessment are from nine samples collected in reaches P-4 East and P-4 West and six samples collected in P-1 East. Reach P-1 East is immediately downstream from Laboratory PRSs and the Los Alamos townsite. These data can reasonably be expected to provide the upper bound concentrations for SVOCs originating from those sources. Reaches P-4 East and P-4 West are the farthest downstream investigation reaches in the canyon. Contaminant concentrations in these reaches represent the aggregated influences of fate, transport, mixing, and deposition in the Pueblo Canyon system.

The SVOC data from reaches P-1 East and P-4 are being used to describe a bounding condition at the land transfer sub-parcel. This is likely to be a conservative assumption because processes that transport contaminants down canyon also entrain clean sediments, thereby reducing contaminant concentrations. Kwage Canyon also delivers large amounts of clean sediment into Pueblo Canyon upstream of the TA-74-1 West sub-parcel, thus further diluting contaminant concentrations. Consequently, the P-1 East data provide elevated upper bounding values for the channel and floodplain sediments in the area of the land transfer sub-parcel.

As with the radionuclides, comparing SALs to the maximum concentrations is a conservative evaluation to determine potential human health risk. Because people are not likely to remain in only one location for the duration of exposure, the full data set for each SVOC is used to evaluate the potential for unacceptable human health risk. The SAL for each SVOC was compared to the 95% UCL of the site data median for each SVOC. Using medians and UCLs on medians is a nonparametric approach that is necessary because the data are highly censored (from 60% to 73% nondetects) and parametric methods typically require that data censorship be less than 15% (EPA 1989, 72731). The method employed for

calculating the upper bounds is from Helsel and Hirsch (1992, 72723). The calculations are provided in Appendix E. The nondetects were used at their reported detection limits. The UCLs on the median values for the four SVOC COPCs are benz(a)anthracene, 0.50 mg/kg; benzo(a)pyrene, 0.54 mg/kg; benzo(b)fluoranthene, 0.76 mg/kg; and indeno(1,2,3-cd)pyrene, 0.34 mg/kg.

The SAL ratios using the 95% UCLs of the medians are: benz(a)anthracene, 0.8; benzo(a)pyrene, 8.7; benzo(b)fluoranthene, 1.2; and indeno(1,2,3-cd)pyrene, 0.6. The sum of these is 11.3, which corresponds to a potential incremental cancer risk of 1.1×10^{-5} for a hypothetical resident at the site. This cancer risk level meets the NMED target cancer risk of 10^{-5} (NMED 2000, 68554). The combination of sediment dilution, the residential exposure scenario over representing realistic exposures for the sub-parcel, and the contaminants being located away from the likely activity areas at the sub-parcel all combine to suggest that the risk associated with exposure to organic carcinogens is well below 1×10^{-5}.

4.1.4 Interpretation

Five COPCs had maximum detected concentrations that exceeded their SALs. These COPCs are plutonium-239,240, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene. The potential for additive effects from other detected radionuclides was determined to be equivalent to be 0.9 by summing the SAL ratios. The potential additive effects for other detected carcinogen and noncarginogen constituents was determined to be small. In the case of plutonium-239,240, the maximum detected concentration and the SAL are essentially the same. For benzo(a)pyrene, the maximum detected concentration exceeds the SAL by approximately a factor of thirty. Maximum values for benz(a)anthracene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene exceed their SALs by factors of 1.4 to 4.

It is unlikely that unacceptable human health effects associated with contaminated sediment deposits would result from future uses of the TA-74-1 West land transfer sub-parcel. The upper-bound estimates of the average plutonium-239,240 and median SVOC concentrations in the sampled reaches, which are more representative exposure concentrations than maximum values, are equivalent to or below the criteria of 15 mrem/yr for radionuclides and 1×10^{-5} for carcinogens, indicating that there is no unacceptable risk to human health at this site. The use of data from samples of contaminated channel and floodplain sediments in Pueblo Canyon to screen potential effects in the developable area of the land transfer sub-parcel is highly protective because no potential contaminant sources exist to directly impact the developable area. The SALs are also protective when applied to a site intended for industrial development.

In summary, the results of the human health screening assessment support the transfer of the TA-74-1 West land transfer sub-parcel in its present state from DOE to the County of Los Alamos.

4.2 Ecological Assessment

Ecological assessment is not in the scope of this document because the size of the sub-parcel is too small for the assessment of population-level adverse ecological effects. Ecological risk will be addressed for the Pueblo and Los Alamos canyon system in the Los Alamos and Pueblo Canyons Surface Aggregate Report that is scheduled for preparation in 2003.

4.3 Estimated Contaminant Inventories and Reportable Quantities

The requirements that control land transfers from federal facilities to other government or private entities are promulgated in the Comprehensive Environmental Response, Compensation, and Liability Act

(CERCLA) Section 120. One of those requirements is to report the release or spill of any hazardous material if the amount of material exceeds its reportable quantity. Reportable quantities are listed in 40 CFR 302, Table 302.4. The presence of contaminants on the TA-74-1 West land transfer sub-parcel can be interpreted as a release or spill from Laboratory facilities upstream or from other sites in the watershed (i.e., urbanized areas within the Los Alamos townsite). This section presents estimated inventories for plutonium-239,240; benz(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; and indeno(1,2,3-cd)pyrene, which are the only COPCs where maximum values exceed screening levels in this assessment, and compares them to reportable quantities.

4.3.1 Contaminant Inventories

Contaminant inventories in the land transfer sub-parcel were estimated following a process used previously in Pueblo Canyon (Reneau et al. 1998, 59159) and using a combination of data presented in that report and more recent data. An overview of the data is presented in Tables 3.2-1, 3.2-3, and 3.2-5. The inventory calculations are presented in Appendix B. The estimated average concentrations and inventory are most reliable for plutonium-239,240 because a primary focus of the field investigations was to define the variations in plutonium concentration and inventory within the different reaches. The estimated average concentrations and inventories for SVOCs should be considered to be only general approximations because of 1) the absence of sample data for these analytes in the reaches closest to the sub-parcel, 2) the relatively small sample set, and 3) the high percentage of nondetects in the data set.

The estimated plutonium-239,240 inventory in the TA-74-1 West land transfer sub-parcel is 4.9 mCi, of which half is in coarse sediment and half in fine sediment (Table B-2.0-3). Only about 3% is estimated to be contained in postfire sediment deposits.

The estimated inventories for the SVOCs in the land transfer sub-parcel range from 1.0–1.5 kg, or 2.2–3.3 lb, for each analyte using mid-range estimates of average concentration multiplied by the estimated sediment mass, as presented in Appendix B. The range in the estimated inventories using upper and lower bound estimates of average concentration is about ±50% of the mid-range values. The resultant range in possible SVOC inventories is 0.5–1.9 kg, or 1.1–4.2 lb, for the different analytes. About 70–80% of the SVOC inventory is estimated to be in coarse sediment.

4.3.2 Reportable Quantities

The reportable quantities (RQs) are 10 mCi for plutonium-239,240 and 1 lb for each of the SVOCs. The estimated plutonium inventory, 4.9 mCi, is approximately 50% of the RQ. The estimated inventories for benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene of 2.2–3.3 lb using mid-range estimates of average concentrations exceed the RQs by a factor of 2.2–3.3. There are no known releases of CERCLA hazardous substances on this sub-parcel. However, for certain constituents released historically from upstream locations, the total mass now present on the sub-parcel may exceed the CERCLA RQs.

5.0 CONCLUSIONS AND RECOMMENDATIONS

An assessment of the TA-74 -1 West land transfer sub-parcel has been conducted using investigation data from several sources. There is evidence that contaminants are present in sediments in the sub-parcel resulting from Laboratory releases and runoff from the Los Alamos townsite. In addition, there are elevated levels of constituents associated with Cerro Grande Fire effects. The average concentrations of these chemicals are below SALs.

Plutonium-239,240 is the only contaminant with a maximum value above SALs (44.9 pCi/g maximum versus 44 pCi/g SAL) that has a confirmed source in Laboratory releases. The concentrations of plutonium-239,240 in Pueblo Canyon reaches have been declining since effluent releases stopped, and are expected to continue declining. This decline is the result of the mixing of contaminated and noncontaminated sediment during floods that remobilize and transport the sediment. Samples of sediment deposits from the July 2, 2001, flood demonstrate that this trend persists even during large floods.

Four organic chemicals are estimated to have inventories in the sub-parcel that exceeds their reportable quantities of 1 lb under CERCLA. The contaminants are benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene. Their primary source is inferred to be runoff from the Los Alamos townsite. The estimated inventories in the land transfer sub-parcel are 2.2–3.3 lb for each of these SVOCs, with considerable uncertainty on these estimates. The estimated plutonium-239,240 inventory is 50% of its reportable quantity of 10 mCi.

This assessment supports the transfer of the TA-74-1 West sub-parcel from DOE to Los Alamos County with no additional assessment or remediation.

6.0 REFERENCES

The following list includes all references cited in this document. The parenthetical information following the reference provides the author, publication date, and Environmental Restoration (ER) Project identification (ER ID) number. This information is also included in the citation in the text and can be used to locate the document.

ER ID numbers are assigned by the Laboratory's ER Project to track all material associated with Los Alamos National Laboratory potential release sites. These numbers can be used to locate copies of the documents at the ER Project's Records Processing Facility and, where applicable, within the ER Project reference library. The references cited in this report can be found in the volumes of the reference library titled "Reference Set for Canyons."

Copies of the reference library are maintained at the New Mexico Environment Department Hazardous and Radioactive Materials Bureau, the Los Alamos Area Office of the US Department of Energy, and the ER Project Office. This library is a living document that was developed to ensure that the administrative authority has all the necessary material to review the decisions and actions proposed in this report. However, documents previously submitted to the administrative authority are not included in the reference library.

BAER (Burned Area Emergency Rehabilitation), 2000, Cerro Grande Fire, Burned Area Emergency Rehabilitation (BAER) Plan: Interagency Burned Area Emergency Rehabilitation Team. (BAER 2000, 72659)

DOE (US Department of Energy), 1990. "Radiation Protection of the Public and the Environment." DOE Order 5400.5. (DOE 1990, 58980)

DOE (US Department of Energy), October 1997. "Cross-Cut Guidance on Environmental Requirements for DOE Real Property Transfers," DOE/EH-413/9712, Office of Environmental Policy and Assistance, RCRA/CERCLA Division (EH-413) Washington, DC. (DOE 1997, 72720)

DOE (US Department of Energy), April 1998. "Infrastructure and Facilities Revitalization, U.S. DOE Report to Congress under Public Law 105-119, A Preliminary Identification of Parcels of land in Los Alamos, New Mexico for Conveyance or Transfer." (DOE 1998, 58671)

Emerson J. D. and J. Strenio, 1983. "Boxplots and Batch Comparisons," in *Understanding Robust and Exploratory Data Analysis*, Hoaglin, D. C, F. Mosteller, and J. W. Tukey, Eds. John Wiley & Sons, Inc. New York, New York, pp. 58–96. (Emerson and Sterenio 1983, 72721)

Environmental Surveillance and Compliance Programs, September 1997. "Environmental Surveillance and Compliance at Los Alamos during 1996," Los Alamos National Laboratory Report LA-13343-ENV, Los Alamos, New Mexico. (Environmental Surveillance and Compliance Programs 1997, 56684)

EPA (US Environmental Protection Agency), February 1989, "Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities, Interim Final Guidance," EPA/530-SW-89-02L, Office of Solid Waste, Waste Management Division, Washington, DC, p. 8-2. (EPA 1989, 72731)

EPA (US Environmental Protection Agency), April 10, 1990. Module VIII of RCRA Permit No. NM0890010515, EPA Region VI, issued to Los Alamos National Laboratory, Los Alamos, New Mexico, effective May 23, 1990, EPA Region VI, Hazardous Waste Management Division, Dallas, Texas. (EPA 1990, 01585)

EPA (US Environmental Protection Agency), February 1994. "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review," EPA 540/R-94/013, Washington, DC. (EPA 1994, 48639)

EPA (US Environmental Protection Agency), July 2001, "Designation, Reportable Quantities, and Notification," 40 CFR 302.4, Washington, DC. (EPA 2001, 72722)

Gehan, E. A. 1965. "A Generalized Wilcoxon Test for Comparing Arbitrarily Singly-Censored Samples," *Biometrika* Vol. 52, No. 1 and 2, pp. 203–223. (Gehan 1965, 54950)

Gilbert, R. O., and J. C. Simpson, 1992. "Statistical method for Evaluating the Attainment of Cleanup Standards, Volume 3: Reference-Based Standards for Soils and Solid Media," Pacific Northwest Laboratory, Richland, Washington. (Gilbert and Simpson 1992, 54952)

Graf, W. L., 1994. *Plutonium and the Rio Grande: Environmental Change and Contamination in the Nuclear Age,* Oxford University Press, New York, New York. (Graf 1994, 55536)

Graf, W. L., June 1995. "Fluvial Dynamics of Plutonium in the Los Alamos Canyon System, New Mexico," Los Alamos National Laboratory Contract No. 9-X38-2886P-1, Los Alamos, New Mexico. (Graf 1995, 48851)

Hakonson, T. E., and K. V. Bostick, May 1975. "Cesium-137 and Plutonium in Liquid Waste Discharge Areas at Los Alamos," in *Radioecology and Energy Resources, Proceedings of the Fourth National Symposium on Radioecology,* Dowden, Hutchinson and Ross, Inc., Strowdsburg, Pennsylvania. (Hakonson and Bostick 1975, 29678)

Helsel, D. R, and R. M. Hirsch, 1992. Statistical Methods in Water Resources, Elsevier Sciences B. V. Amsterdam, The Netherlands, pp. 70-72. (Helsel and Hirsch 1992, 72723)

Katzman, D., R. Ryti, and S. Reneau, 2001. "Cerro Grande Ash as a Source of Elevated Radionuclides and Metals" in Water, Watersheds, and Land Use in New Mexico, Impacts of Population Growth on Natural Resources: Johnson, P. (Ed.), New Mexico Bureau of Mines and Mineral Resources, Decision-Makers Field Guide 1, p. 45–47. (Katzman et al. 2001, 72660)

Kingsley, W. H., February 20, 1947. "Survey of Los Alamos and Pueblo Canyon for Radioactive Contamination and Radioassay Tests Run on Sewer-Water Samples and Water and Soil Samples Taken From Los Alamos and Pueblo Canyons," Los Alamos Scientific Laboratory Report LAMS-516, Los Alamos, New Mexico. (Kingsley 1947, 4186)

Kraig, D., R. Ryti, D. Katzman, T. Buhl, B. Gallaher, and P. Fresquez, December 2001. "Radiological and Nonradiological Effects after the Cerro Grande Fire," Los Alamos National Laboratory Report LA-UR-01-6868, Los Alamos, New Mexico. (Kraig et al. 2001, 72658)

Kron, A., 1993. "Hiking Trails & Jeep Roads of Los Alamos County, Bandelier National Monument, and vicinity," Otowi Station Science Museum Shop and Book Store, Los Alamos, New Mexico. (Kron 1993, 58665)

LANL (Los Alamos National Laboratory), May 1981. "Formerly Utilized MED/AEC Sites Remedial Action Program, Radiological Survey of the Site of a Former Radioactive Liquid Waste Treatment Plant (TA-45) and Effluent-Receiving Areas of Acid, Pueblo, and Los Alamos Canyons, Los Alamos, New Mexico," Los Alamos National Laboratory Report LA-8890-ENV (DOE/EV-0005/30), Los Alamos, New Mexico. (LANL 1981, 6059)

LANL (Los Alamos National Laboratory), May 1992. "RFI Work Plan for Operable Unit 1071," Los Alamos National Laboratory Report LA-UR-92-810, Los Alamos, New Mexico. (LANL 1992, 7667)

LANL (Los Alamos National Laboratory), May 1992. "RFI Work Plan for Operable Unit 1079," Los Alamos National Laboratory Report LA-UR-92-850, Los Alamos, New Mexico. (LANL 1992, 7668)

LANL (Los Alamos National Laboratory), July 1993. "Health and Environmental Chemistry: Analytical Techniques, Data Management, and Quality Assurance," Los Alamos National Laboratory Report LA-10300-M, Vol. 1, Los Alamos, New Mexico. (LANL 1993, 31793)

LANL (Los Alamos National Laboratory), May 1995. "RFI Report for PRSs 31-001," Los Alamos National Laboratory Report LA-UR-95-1542, Los Alamos, New Mexico. (LANL 1995, 57050)

LANL (Los Alamos National Laboratory), June 12, 1995. "RFI Report for PRSs 1-002 45-001 45-002 45-003 45-004 C-45-001," Los Alamos National Laboratory Report LA-UR-95-1542, Los Alamos, New Mexico. (LANL 1995, 48856)

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

LANL (Los Alamos National Laboratory), September 1995. "RFI Report for Solid Waste Management Units 0-030(g)," Los Alamos National Laboratory Report LA-UR-95-3263, Los Alamos, New Mexico. (LANL 1995, 51983)

LANL (Los Alamos National Laboratory), November 1995. "Task/Site Work Plan for Operable Unit 1049: Los Alamos Canyon and Pueblo Canyon," Los Alamos National Laboratory Report LA-UR-95-2053, Los Alamos, New Mexico. (LANL 1995, 50290)

LANL (Los Alamos National Laboratory), March 1996. "Quality Assurance Project Plan Requirements for Sampling and Analysis"(QAPP) Los Alamos National Laboratory Report LA-UR-96-441, Los Alamos, New Mexico. (LANL 1996, 54609)

LANL (Los Alamos National Laboratory), March 1996. "Radiological Addendum to the RFI Report for Potential Release Sites 1-002, 45-001, 45-002, 45-003, 45-004, C-45-001," Los Alamos National Laboratory Report LA-UR-95-3692, Los Alamos, New Mexico. (LANL 1996, 54468)

LANL (Los Alamos National Laboratory), August 1997. "Sampling and Analysis Plan for Phase II RFI for PRS 73-002," Los Alamos National Laboratory Report LA-UR-97-3167, Los Alamos, New Mexico. (LANL 1997, 56606)

LANL (Los Alamos National Laboratory), September 1997. "RFI Report for PRSs 0-018(a,b) Wastewater Treatment Plants," Los Alamos National Laboratory Report LA-UR-97-3392, Los Alamos, New Mexico. (LANL 1997, 56614)

LANL (Los Alamos National Laboratory), April 1997. "Core Document for Canyons Investigations," Los Alamos National Laboratory Report LA-UR-96-2083, Los Alamos, New Mexico. (LANL 1997, 55622)

LANL (Los Alamos National Laboratory), January 23, 1998. "Supplement to Response to Request for Supplemental Information for the Canyons Investigation Core Work Plan (Former OU 1049)," Los Alamos National Laboratory Letter EM/ER:98-020 to Benito Garcia (NMED-HRMB) from Julie A. Canepa (Program Manager, LANL/ER Project) and Theodore J. Taylor (Program Manager, DOE/LAAO), Los Alamos, New Mexico. (LANL 1998, 57666)

LANL (Los Alamos National Laboratory), September 1998. "Statistical Methods for Background Comparisons (draft)," Los Alamos National Laboratory Report LA-UR-99-1707, Los Alamos, New Mexico. (LANL 1998, 59596)

LANL (Los Alamos National Laboratory), August 1999. "Environmental Restoration Report to Support Land Conveyance and Transfer under Public Law 105-119," Los Alamos National Laboratory Report LA-UR-99-796, Los Alamos, New Mexico. (LANL 1999, 63037)

LANL (Los Alamos National Laboratory), 2000. "RFI Report for SWMU 0-030(g)," Los Alamos National Laboratory Report LA-UR-00-5378. (LANL 2000, 70273)

LANL (Los Alamos National Laboratory), 2001. "Derivation and Use of Radionuclide Screening Action Levels," Los Alamos National Laboratory Report LA-UR-01-0075, Los Alamos, New Mexico. (LANL 2001, 69683)

LANL (Los Alamos National Laboratory), August 2001. "Interim Action Plan for the South Fork of Acid Canyon," Los Alamos National Laboratory Report LA-UR-01-4538, Los Alamos, New Mexico. (LANL 2001, 70188)

LANL (Los Alamos National Laboratory), September 2001. "Voluntary Corrective Action Completion Report for Potential Release Site 0-019 (Former Central Wastewater Treatment Plant)," Los Alamos National Laboratory Report LA-UR-01-4140, Los Alamos, New Mexico. (LANL 2001, 71417)

LANL (Los Alamos National Laboratory), April 2002. "Human Health Risk-Based Screening Methodology," Los Alamos National Laboratory Report LA-UR-02-1563, Los Alamos, New Mexico. (LANL 2002, 72639]

Los Alamos Planning Commission, 1964. "Los Alamos New Mexico: A Comprehensive Plan Report," Los Alamos, New Mexico. (Los Alamos Planning Commission 1964, 56873)

Lyman, J., S. Reneau, D. Malmon, A. Lavine, H. E. Canfield, and D. Katzman, 2002. "Geomorphic Response of Pueblo Canyon, Los Alamos, New Mexico, to Flooding After the Cerro Grande Fire," Proceedings Volume, New Mexico Geological Society Spring Meeting, Socorro, New Mexico, p. 36. (Lyman et al. 2002, 72659)

Millard, W. P., and S. J. Deveret, 1988. "Nonparametric Statistical Methods for Comparing Two Sites Based on Data with Multiple Nondetect Limits," in *Water Resources Research*, Vol. 24, No. 12, pp. 2087–2098. (Millard and Deveret 1988, 54953)

NMED (New Mexico Environment Department), December 2000. "Technical Background Document for Development of Soil Screening Levels," New Mexico Environment Department, Hazardous Waste Bureau and Ground Water Quality Bureau, Santa Fe, New Mexico. (NMED 2000, 68544)

Nyhan, J. W., F. R. Miera, Jr., and R. J. Peters, 1976. "Distribution of Plutonium in Soil Particle Size Fractions of Liquid Effluent-Receiving Areas at Los Alamos," in *Journal of Environmental Quality*, Vol. 5, No. 1, pp. 50–56. (Nyhan et al. 1976, 11747)

Nyhan, J. W., G. C. White, and G. Trujillo, October 1982. "Soil Plutonium and Cesium in Stream Channels and Banks of Los Alamos Liquid Effluent-Receiving Areas," in *Health Physics*, Vol. 43, No. 4, pp. 531–541. (Nyhan et al. 1982, 7164)

Reneau, S.L., R.T. Ryti, M. Tardiff, and J. Linn, 1998, "Evaluation of Sediment Contamination in Pueblo Canyon (Reaches P-1, P-2, P-3, and P-4)," Los Alamos National Laboratory Report LA-UR-98-3324, Los Alamos, New Mexico. (Reneau et al. 1998, 59159)

Ryti, R., P. Longmire, and E. McDonald, March 29, 1996. "Application of LANL Background Data to ER Project Decision-Making, Part I: Inorganics in Soils, Sediments, and Tuff," Los Alamos National Laboratory Report LA-UR-96-1534, Los Alamos, New Mexico. (Ryti et al. 1996, 53953)

Ryti, R., P. A. Longmire, and D. E. Broxton, S. L. Reneau, and E. V. McDonald, May 7, 1998. "Inorganic and Radionuclide Background Data for Soils, Canyon Sediments, and Bandelier Tuff at Los Alamos National Laboratory," Los Alamos National Laboratory report LA-UR-98-4847, Los Alamos, New Mexico. (Ryti et. al. 1998, 59730)

Zar, Jerrold H. 1984. Biostatistical Analysis, Prentice-Hall, Inc. Englewool Cliffs, New Jersey. pp. 138–141. (Zar 1984, 72724)

Appendix A

Acronyms and Unit Conversions

APPENDIX A ACRONYMS AND UNIT CONVERSIONS

BAER	burned area emergency rehabilitation
BV	background value
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COPC	chemical of potential concern
CRDL	contract required detection limit
CRQL	contract required quantitation limit
CVAA	cold vapor atomic absorption
DOE	US Department of Energy
EPA	US Environmental Protection Agency
EQL	estimated quantitation limit
ER	environmental restoration
FIMAD	Facility for Information Management, Analysis, and Display
FUSRAP	Formerly Utilized Sites Remedial Action Program
GPS	global positioning system
HE	high explosives
HSWA	Hazardous and Solid Waste Amendments (Act)
ICPES	inductively coupled plasma emission spectroscopy
ICPMS	inductively coupled plasma mass spectroscopy
IDL	instrument detection limit
LANL	Los Alamos National Laboratory
LAPSAR	Los Alamos and Pueblo Canyon Surface Aggregate Report
LCS	laboratory control sample
MDA	minimum detectable activity
MDC	minimum detectable concentration
MDL	method detection limit
NFG	national functional guideline
NMED	New Mexico Environment Department
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PRS	potential release site
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFI	RCRA facility investigation

RN	request number
RQ	reportable quantity
SAL	screening action level
SOP	standard operating procedure
SOW	statement of work
SVOC	semivolatile organic compound
TA	technical area
TAL	target analyte list
TPU	total propagated uncertainty
UCL	upper confidence limit
UTL	upper tolerance limit
VCA	voluntary corrective action
WWTP	wastewater treatment plant

Metric to English Conversions

Multiply SI (Metric) Unit	by	To Obtain US Customary Unit
kilometers (km)	0.622	miles (mi)
kilometers (km)	3281	feet (ft)
meters (m)	3.281	feet (ft)
meters (m)	39.37	inches (in.)
centimeters (cm)	0.03281	feet (ft)
centimeters (cm)	0.394	inches (in.)
millimeters (mm)	0.0394	inches (in.)
micrometers or microns (μm)	0.0000394	inches (in.)
square kilometers (km^2)	0.3861	square miles (mi^2)
hectares (ha)	2.5	acres
square meters (m^2)	10.764	square feet (ft^2)
cubic meters (m^3)	35.31	cubic feet (ft^3)
kilograms (kg)	2.2046	pounds (lb)
grams (g)	0.0353	ounces (oz)
grams per cubic centimeter (g/cm^3)	62.422	pounds per cubic foot (lb/ft^3)
milligrams per kilogram (mg/kg)	1	parts per million (ppm)
micrograms per gram (μg/g)	1	parts per million (ppm)
liters (L)	0.26	gallons (gal.)
milligrams per liter (mg/L)	1	parts per million (ppm)
degrees Celsius (°C)	9/5 + 32	degrees Fahrenheit (°F)

Appendix B

Characterization of Geomorphic Units

APPENDIX B CHARACTERIZATION OF GEOMORPHIC UNITS

This appendix presents supplemental information on the characteristics of the geomorphic units in Pueblo Canyon that pertain to the TA-74-1 West land transfer sub-parcel. Tables for this appendix are placed at the end of the appendix.

B-1.0 THICKNESS OF POST-1942 SEDIMENT DEPOSITS

The thickness of post-1942 sediment in the TA-74-1 West land transfer sub-parcel was estimated using data previously obtained in upstream and downstream reaches for sediment deposits that pre-date the Cerro Grande fire (reaches P-2 East and P-3 West; Reneau et al. 1998, 59159), and using new measurements for postfire deposits.

Table B-1.0-1 presents the prefire thickness estimates from P-2 East and P-3 West and estimates for the land transfer sub-parcel, which constitute the average of values in the adjacent reaches. The estimated thickness for the c2–c4 units utilized a weighted average process, weighting the thickness of sediment in the c2, c3, and c4 units in the adjacent reaches by the area of these units in each reach. The estimated thickness for the c1 unit also utilized a weighted average process, combining data from the c1 and c1b units in P-2 East. Note that for calculating contaminant inventories (Appendix B-2.0), the prefire thickness of c1 was reduced from 2.0 to 1.5 m to account for an estimated 0.5 m of scour and fill during postfire floods.

Table B-1.0-2 and B-1.0-3 present measurements of postfire sediment thickness in five transects across the c2–c4 and f1 units in the land transfer sub-parcel. Transect distances were measured downstream from the west boundary of the sub-parcel. The measurements were made in March 2002 and represent the combined effects of floods in 2000 and 2001.

B-2.0 ESTIMATED AVERAGE CONTAMINANT CONCENTRATIONS AND CONTAMINANT INVENTORIES

Estimates of the average concentrations of plutonium-239,240; benz(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene in the different geomorphic units and sediment facies in TA-74-1 West land transfer sub-parcel were made using data from upstream and downstream reaches. These analytes were chosen because they are the only COPCs whose maximum values exceed screening action levels (SALs) (Section 4.1). These calculations are consistent with the approach in Reneau et al. (1998, 59159) and provide estimated contaminant inventories for comparison with reportable quantities in Section 4.3. The estimated average concentrations and inventory are most reliable for plutonium-239,240 because a primary focus of the field investigations was to define the variations in plutonium concentration within the different reaches. The estimated average concentrations and inventories for SVOCs should be considered to be only general approximations because of 1) the absence of sample data for these analytes in the reaches closest to the sub-parcel, 2) the relatively small sample set, and 3) the high percentage of non-detects in the data set.

Table B-2.0-1 presents the estimated average concentrations of plutonium-239,240 in post-1942 pre-2000 sediment deposits in the land transfer sub-parcel, which constitute the average of estimated concentrations values in the adjacent reaches (P-2 East and P-3 West). Average concentrations for each geomorphic unit and sediment facies in the adjacent reaches are from Reneau et al. (1998, 59159). The estimated concentrations for the c2–c4 units utilized a weighted average process, weighting the thickness of sediment in the c2, c3, and c4 units in the adjacent reaches by the volume of these units in each reach.

Table B-2.0-2 presents the concentrations of SVOCs in sediment in Pueblo Canyon downstream from Acid Canyon, and estimated average concentrations in coarse and fine facies sediment. These data were obtained from reaches P-1 East, P-4 West, and P-4 East (Reneau et al. 1998, 59159, plus one sample collected in 1999). Averages were calculated three ways to constrain the uncertainty in average SVOC concentrations resulting from the high percentage of non-detects. An upper bound was calculated using the detection limit as the sample value for non-detected (U-qualified) results. A lower bound was calculated using zero as the sample value for non-detected results. A mid-range value was calculated using one-half of the detection limit as the sample value for non-detected results. Data were not broken out by geomorphic unit because the sample size was too small to reliably identify differences in SVOC concentration between different units. No analyses for SVOCs have been obtained for postfire sediments, and concentrations of SVOCs in postfire sediment are assumed to be equal to that in prefire sediment.

Table B-2.0-3 presents estimated contaminant inventories in the TA-74-1 West sub-parcel for plutonium-239,240 and the four SVOCs whose maximum values exceed SALs. For each geomorphic unit and sediment facies, estimates of sediment volume, density, and average contaminant concentration are combined. Because the gravel (>2 mm) fraction of sediment deposits is not expected to contain significant concentrations of contaminants, volumes are adjusted to represent the estimated non-gravel portion. The volume estimates are taken from Table 2.2-1, which combines thicknesses estimated for prefire sediment in upstream and downstream reaches (P-2 East and P-3 West), with estimates of postfire sediment thickness and unit area in the land transfer sub-parcel. Estimates of gravel fraction and sediment densities are from Reneau et al. (1998, 59159). Estimated average contaminant concentrations are from Tables B-2.0-1 and B-2.0-2.

The average concentrations for SVOCs in Table B-2.0-3 are the mid-range of values in Table B-2.0-2. Table B-2.0-3 also shows upper and lower bounds for estimated SVOC inventories using the ranges in estimated average concentrations from Table B-2.0-2. The estimated inventory of the SVOCs varies by ±50% around the mid-range value as a result of the uncertainty in average SVOC concentrations. Because about 70% to 80% of the estimated SVOC inventory is in coarse facies sediment, uncertainties in the volume of coarse sediment impart significant additional uncertainties in these inventory estimates. The estimated SVOC inventories are therefore very approximate.

B-3.0 FIELD ALPHA RADIATION MEASUREMENTS

Field screening measurements of alpha radiation were made from the most areally extensive and volumetrically largest unit in the TA-74-1 West land transfer sub-parcel to provide estimates of plutonium-239,240 concentration. Representative locations were chosen on the c2–c4 units, and sediment was obtained from 15–25-cm increments to depths of 50–75 cm. This sediment was homogenized and spread on pie tins for measurement following methods previously applied in Acid Canyon, using a Model 2221 ratemeter with a 43-1 alpha scintillator probe (LANL 2001, 70188). Triplicate measurements were made on each sample. These measurements are presented in Table B-3.0-1. Single measurements ranged from 1 to 13 counts per minute (cpm), equivalent to an estimated 0 to 23 pCi/g plutonium-239,240 using a previously developed correlation between cpm and plutonium-239,240 concentration (Figure C-2, equation (b), LANL 2001, 70188). The average of the triplicate measurements from the same layers provide lower values of 4–10 cpm, equivalent to an estimated 4 to 15 pCi/g plutonium-239,240. These measurements thus support the estimated levels of plutonium-239,240 in the TA-74-1 West land transfer sub-parcel based on analytical results from upstream and downstream reaches.

Table B-1.0-1
Estimated Thickness of Post-1942, Pre-2000 Sediments in TA-74 West Land Transfer Parcel

Geomorphic Unit	Sediment Facies	Estimated Average Thickness, P-2 East (m)	Area, P-2 East (m^2)	Estimated Average Thickness, P-3 West (m)	Area, P-3 West (m^2)	Estimated Average Thickness, TA-74 West Parcel (m)
c1	coarse	2.0	3114	2.0	2888	—*
c1b	coarse	2.1	297	0	0	—
c1 (+clb)	coarse	2.0	3411	2.0	2888	2.0
c2	coarse	1.8	5798	1.9	3471	—
c3	coarse	0.5	743	1.0	1908	—
c4	coarse	0	0	1.0	340	—
c2–c4	coarse	1.7	6541	1.5	5719	1.6
f1	coarse	0	7613	0	3855	0
c1	fine	0	3114	0.04	2888	—
c1b	fine	0.13	297	0	0	—
c1 (+clb)	fine	0.01	3411	0.04	2888	0.03
c2	fine	0.50	5798	0.29	3471	—
c3	fine	0.25	743	0.28	1908	—
c4	fine	0	0	0.22	340	—
c2–c4	fine	0.47	6541	0.28	5719	0.38
f1	fine	0.13	7613	0.20	3855	0.17

* A dash in the tables indicates "not measured."

Table B-1.0-2
Thickness Measurements for
Postfire Main Channel Sediments in TA-74-1 West Land Transfer Sub-Parcel

Channel Distance (m)	Side of Channel	Distance From Channel (m)	c2–c4 Thickness Silt, Ashy Silt, or Muck (cm)	c2–c4 Thickness Fine Sand to Very Fine Sand (cm)	c2–c4 Thickness Medium Sand (cm)	c2–c4 Thickness Coarse to Medium Sand + Gravel (cm)	c2–c4 Thickness Litter + Pumice (cm)	Total Post-Fire Thickness, c2–c4 (excluding litter + pumice) (cm)
4	south	2.5	1	3	0	11	0	15
4	south	5	1	0	0	0	0	1
4	south	7.5	0	0	0	0	0	0
4	south	9	0	2	0	0	0	2
4	south	11	1	9	0	0	0	10
4	south	13	1	0	5	0	0	6
4	south	15	1	9	0	0	0	10
4	south	16.5	0	6	0	0	0	6
28	north	1	1	0	0	0	0	1
28	north	2.5	2	3	0	0	0	5
28	north	4	4	14	0	1	0	19
28	north	5.5	1	3	0	4	1	8
28	north	7	0	1	0	0	0	1
70	south	bank	3	2	0	0	0	5
70	south	2	1	3	0	0	0	4
70	south	4	1	2	2	0	0	5
70	south	6	1	5	0	0	0	6
70	south	8	0	4	0	0	0	4
70	south	10	0	6	0	0	0	6
70	south	12	0	0	0	0	3	0
107	north	2	1	0	0	5	0	6
107	north	4	0	0	0	0	0	0
107	north	6	0	1	0	0	0	1
107	north	8	0	2	0	0	0	2
107	north	10	0	0	0	0	0	0
107	north	12	0	0	0	0	0	0
107	north	14	1	3	0	0	0	4
130	north	2	0	7	0	0	0	7
130	north	4	0	13	5	0	0	18
130	north	6	0	11	3	0	0	14
130	north	8	2	2	0	0	0	4
130	north	10	1	2	0	0	0	3
		Average	**0.8**	**3.5**	**0.5**	**0.7**	**0.1**	**5.4**

Table B-1.0-3
Thickness Measurements for
Postfire Trough Sediments in TA-74-1 West Land Transfer Sub-Parcel

Channel Distance (m)	Side of Channel	Distance From High Water Line (m)	f1 Trough Thickness Ashy Silt + Very Fine Sand (cm)
110	north	1.5	5
110	north	3	5
110	north	4.5	4
110	north	6	4
110	north	8	2
		Average	**4.0**

Table B-2.0-1
Estimated Average Plutonium-239,240 Concentrations,
Post-1942, Pre-2000 Sediments in TA-74-1 West Land Transfer Parcel

Geomorphic Unit	Sediment Facies	Estimated Average Plutonium-239,240 Concentration, P-2 East (pCi/g)	Estimated Sediment Volume, P-2 East (m^3)	Estimated Average Plutonium-239,240 Concentration, P-3 West (pCi/g)	Estimated Sediment Volume, P-3 West (m^3)	Estimated Average Plutonium-239,240 Concentration, TA-74 West Parcel (pCi/g)
c1	coarse	0.38	6228	0.89	5776	—*
c1b	coarse	0.38	624	—	0	—
c1 (+clb)	coarse	0.38	6852	0.89	5776	0.63
c2	coarse	0.38	10436	0.89	6595	—
c3	coarse	0.38	372	3.11	1908	—
c4	coarse	0	0	0.56	340	—
c2–c4	coarse	0.38	10808	1.35	8843	0.86
f1	coarse	—	0	—	0	—
c1	fine	—	0	1.54	116	—
c1b	fine	2.42	39	0	—	—
c1 (+clb)	fine	2.42	39	1.54	116	1.98
c2	fine	2.42	2889	1.54	1007	—
c3	fine	5.31	186	8.65	534	—
c4	fine	0	0	8.65	75	—
c2–c4	fine	2.60	3075	4.22	1616	3.41
f1	fine	2.42	990	1.54	771	1.98

* A dash in the tables indicates "not measured."

Table B-2.0-2
Estimated Average SVOC Concentrations, Post-1942 Pre-2000 Sediments in Pueblo Canyon

Reach	Sample ID	Sediment Facies	Benz(a)anthracene Concentration (mg/kg)	Benzo(a)pyrene Concentration (mg/kg)	Benzo(b)fluoranthene Concentration (mg/kg)	Indeno(1,2,3-cd)pyrene Concentration (mg/kg)
P-4 East	04PU-96-0026	coarse	0.332 (U)	0.332 (U)	0.332 (U)	0.332 (U)
P-4 East	04PU-96-0028	coarse	0.333 (U)	0.333 (U)	0.333 (U)	0.333 (U)
P-4 West	04PU-96-0032	coarse	0.609	0.675	0.91	0.455
P-1 East	04PU-96-0111	coarse	0.33 (U)	0.052 (J)	0.07 (J)	0.33 (U)
Average (upper bound)[a]			**0.401**	**0.348**	**0.411**	**0.363**
Average (mid range)[b]			**0.277**	**0.265**	**0.328**	**0.238**
Average (lower bound)[c]			**0.152**	**0.182**	**0.245**	**0.114**
P-4 East	04PU-96-0025	fine	0.344 (U)	0.344 (U)	0.344 (U)	0.344 (U)
P-4 East	04PU-96-0027	fine	0.329 (U)	0.329 (U)	0.329 (U)	0.329 (U)
P-4 East	04PU-96-0029	fine	0.035 (J)	0.331 (U)	0.331 (U)	0.331 (U)
P-4 West	04PU-96-0030	fine	0.344 (U)	0.344 (U)	0.05 (J)	0.05 (J)
P-4 West	04PU-96-0031	fine	0.331 (U)	0.331 (U)	0.331 (U)	0.331 (U)
P-4 West	04PU-96-0033	fine	0.337 (U)	0.337 (U)	0.337 (U)	0.337 (U)
P-1 East	04PU-96-0110	fine	0.55 (J)	0.67	0.86	0.28 (J)
P-1 East	04PU-96-0112	fine	1.0	1.8	2.5	0.88
P-1 East	04PU-96-0113	fine	0.50	0.54	0.76	0.22 (J)
P-1 East	04PU-96-0114	fine	0.34 (U)	0.34 (U)	0.34 (U)	0.34 (U)
P-1 East	CAPU-99-0020	fine	0.34 (U)	0.34 (U)	0.34 (U)	0.34 (U)
Average (upper bound)[a]			**0.405**	**0.519**	**0.593**	**0.344**
Average (mid range)[b]			**0.297**	**0.396**	**0.486**	**0.237**
Average (lower bound)[c]			**0.190**	**0.274**	**0.379**	**0.130**

[a] Uses detection limit for U-qualified results

[b] Uses one-half of detection limit for U-qualified results

[c] Uses zero for U-qualified results.

Table B-2.0-3
Estimated Contaminant Inventories in TA-74-1 West Land Transfer Parcel

Geomorphic Unit	Sediment Facies	Estimated Volume (m^3)	Estimated Nongravel Portion	Estimated Density (g/cm^3)	Estimated Average Plutonium-239,240 Concentration (pCi/g)	Estimated Plutonium-239,240 Inventory (mCi)	Estimated Average Benz(a)anthracene Concentration (mg/kg)	Estimated Benz(a)anthracene Inventory (kg)	Estimated Average Benzo(a)pyrene Concentration (mg/kg)	Estimated Benzo(a)pyrene Inventory (kg)	Estimated Average Benzo(b)fluoranthene Concentration (mg/kg)	Estimated Benzo(b)fluoranthene Inventory (kg)	Estimated Average Indeno(1,2,3-cd)pyrene Concentration (mg/kg)	Estimated Indeno(1,2,3-cd)pyrene Inventory (kg)
c1	coarse, pre-fire	564	0.8	1.23	0.63	0.3	0.277	0.15	0.265	0.15	0.328	0.18	0.238	0.13
c1	coarse, post-fire	188	0.8	1.23	0.25	0.05	0.277	0.05	0.265	0.05	0.328	0.06	0.238	0.04
c2–c4	coarse, pre-fire	2502	0.8	1.23	0.86	2.1	0.277	0.68	0.265	0.65	0.328	0.81	0.238	0.59
c2–c4	coarse, post-fire	16	0.8	1.23	0.25	0.004	0.277	0.004	0.265	0.004	0.328	0.005	0.238	0.004
	Subtotal[a]	**3270**				**2.5**		**0.9**		**0.9**		**1.1**		**0.8**
c2–c4	fine, pre-fire	594	0.9	1.04	3.41	1.9	0.297	0.17	0.350	0.19	0.486	0.27	0.237	0.13
c2–c4	fine, post-fire	78	0.9	1.04	0.67	0.05	0.297	0.02	0.350	0.03	0.486	0.04	0.237	0.02
f1	fine, pre-fire	230	0.9	1.04	1.98	0.4	0.297	0.06	0.350	0.08	0.486	0.10	0.237	0.05
f1	fine, post-fire	54	0.9	1.04	0.67	0.03	0.297	0.02	0.350	0.02	0.486	0.02	0.237	0.01
	Subtotal[a]	**956**				**2.4**		**0.3**		**0.3**		**0.4**		**0.2**
	Total[a]	**4226**				**4.9**		**1.2**		**1.2**		**1.5**		**1.0**
	Total (upper bound)[b]							**1.7**		**1.6**		**1.9**		**1.5**
	Total (lower bound)[c]							**0.7**		**0.8**		**1.1**		**0.5**

[a] Uses one-half of detection limit for U-qualified SVOC results

[b] Uses detection limit for U-qualified SVOC results

[c] Uses zero for U-qualified SVOC results.

Table B-3.0-1
Field Alpha Radiation Measurements

Location	Depth (cm)	Alpha Radiation, Count 1 (cpm)	Alpha Radiation, Count 2 (cpm)	Alpha Radiation, Count 3 (cpm)	Average Alpha Radiation (cpm)
TP1	0–25	7	7	4	6
TP1	25–50	11	9	6	9
TP1	50–75	5	3	5	4
TP2	0–25	2	11	9	7
TP2	25–50	7	9	13	10
TP3	0–25	7	3	4	5
TP3	25–50	12	6	6	8
TP3	50–75	7	3	6	5
TP4	0–25	12	12	4	9
TP4	25–50	2	9	8	6
TP4	50–65	1	6	5	4

Appendix C

Summary of Quality Assurance/Quality Control

C-1.0 SUMMARY OF QUALITY ASSURANCE/QUALITY CONTROL

This appendix consists of a description of the quality assurance (QA) and quality control (QC) activities that supports the data quality for this report. The data are from three sources: Reneau, et al. (1998, 59158); 1999 ER Project sampling: and the Cerro Grande Recovery Project. The QA and QC activities are consistent across these data sources. Only data with sufficient quality to support the assessment are used. Table C-1.0-1 presents the analytical suites for the samples used to support this assessment.

Table C-1.0-1
Analytical Suites

Chemical Category	Analytical Suite
Radionuclides	Gamma-emitting radionuclides
	Isotopic plutonium
	Strontium-90
	Tritium
Inorganic chemicals	Target analyte list (TAL) metals
	Mercury
Organic chemicals	Organochlorine pesticides
	Polychlorinated biphenyls (PCBs)
	Semivolatile organic compounds (SVOCs)

QA, QC, and data validation procedures were implemented in accordance with the requirements of the "Quality Assurance Project Plan Requirements for Sampling and Analysis" (LANL 1996, 54609), and the Laboratory ER Project analytical services statement of work (SOW) for contract laboratories (LANL 1995, 49738) that was in place at the time of these analyses. The results of the QA/QC activities were used to estimate accuracy, bias, and precision of the analytical measurements. QC samples used to assess accuracy and bias included method blanks, blank spikes, matrix spikes, interference check samples, and analytical laboratory control samples. Internal standards, external standards, surrogates, and tracers were also used to assess accuracy. Matrix spike duplicates and analytical laboratory control sample duplicates are used to assess precision. The type and frequency of QC analyses are described in the ER Project analytical services SOW (LANL 1995, 49738). Other QC factors, such as sample preservation and holding times, were also assessed. The requirements for sample preservation and holding times are given in an ER Project standard operating procedure (SOP): ER-SOP-1.02, Rev. 0, "Sample Containers and Preservation."

C-1.1 Baseline Data Validation

Sample results were qualified using the ER Project baseline data validation qualifiers. The ER Project's baseline data validation process adheres to two guidance documents written by the EPA: "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review" (EPA 1994, 48639) and "USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review" (EPA 1999, 66649) (NFG). The validation process also incorporates Laboratory-specific reason codes for qualifying data. The validation qualifiers and their explanations are provided in Table C-1.1-1. Data packages received from the analytical laboratory were reviewed with respect to the NFG as well as Laboratory quality procedures for data validation.

Table C-1.1-1
Explanation of Data Qualifiers Used in the 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 reported value should be regarded as estimated.
J+	The reported value should be regarded as estimated and biased high.
J-	The reported value should be regarded as estimated and 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 were rejected because of serious deficiencies in the ability to analyze the sample and meet quality control criteria; presence or absence cannot be verified.

* For radionuclide analyses, the reported value is the best estimate of the analyte concentration, even when that estimate is less than the detection limit. For statistical reasons, the estimates may sometimes be given as negative results.

C-1.2 Focused Data Validation

A focused data validation was also performed for data if the baseline validation identified issues. The focused validation followed the same procedure discussed above and included a more detailed review of the raw data results generated by the analytical laboratory.

Analytical laboratory control samples (LCSs), method blanks, matrix spike samples, and interference check samples were analyzed to assess accuracy, precision, and potential bias for inorganic chemical analyses. Each of these QA/QC sample types is defined in the ER Project analytical services SOW (LANL 1995, 49738) and described briefly in the sections below. The LCS serves as a monitor of the overall performance of each step during the analysis, including sample digestion. The analytical results for the samples were qualified according to NFG (EPA 1994, 48639) if the individual LCS recovery indicated an unacceptable bias in the measurement of individual analytes. The LCS recoveries should fall within the control limits of 80% to 120%. Results of the LCS are used to support the focused data validation.

Preparation blanks are used as a measurement of bias and potential cross contamination. All target analytes should be below the contract required detection limit (CRDL) in the preparation blank.

A matrix spike sample is designed to provide information about the effect of each sample matrix on the sample preparation procedures and analytical technique. The spike sample recoveries should be within the acceptance range of 75% to 125%.

For radionuclides, those samples qualified by the analytical laboratory as not detected (U) because the results were either less than the minimum detectable concentration (MDC), or less than the minimum detectable activity (MDA) without further qualification (R9a or R9b), were not subject to focused validation. Radionuclide results qualified as not detected (U) with an additional qualification (R9b) were examined to see if the result was greater than three times the total propagated uncertainty (TPU).

All data, including the qualified data, are usable for evaluation and interpretive purposes. The entire data set meets the standards set for use in this report, with no exceptions.

C-2.0 INORGANIC CHEMICAL METHODS

Twenty-two samples analyzed for target analyte list (TAL) metals were used for this report. The analytical methods for this data set are shown in Table C-2.0-1. Holding times were met for all inorganic chemical digestions and analyses. Validation qualifiers associated with these data are "no flag," U, UJ, J-, and J.

Table C-2.0-1
Analytical Methods for Inorganic Chemical Analyses

Analytical Method	Analytical Description	Analytical Suite
EPA SW-846 Method 6010B	Inductively coupled plasma emission spectroscopy (ICPES)	Aluminum, antimony, arsenic, barium, beryllium, calcium, cadmium, cobalt, chromium, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, sodium, silver, thallium, vanadium and zinc. (TAL metals)
EPA SW-846 Method 7471A	Cold vapor atomic absorption (CVAA)	Mercury (TAL metal)

C-3.0 ORGANIC CHEMICAL ANALYSES

A total of 15 samples were used for SVOC data to support this assessment. The samples were analyzed using EPA SW-846 Method 8270. Six samples were used for pesticides and PCBs. These samples were analyzed using EPA SW-846 Method 8081. The analytical methods used for this data set are shown in Table C-3.0-1. All QC procedures were followed as required in the ER Project analytical services SOW (LANL 1995, 49738). All extraction and analysis holding times were met. Validation qualifiers associated with these data are "no flag," U, and J.

Table C-3.0-1
Analytical Methods for Organic Chemical Analyses

Analytical Method	Analytical Description	Target Compound List
EPA SW-846 Method 3540—Extraction EPA SW-846 Method 8270—Analysis	SVOCs	ER Project analytical services SOW (LANL 1995, 49738). Also in Appendix D of this report.
EPA SW-846 Method 3540—Extraction EPA SW-846 Method 8081—Analysis	Pesticides and PCBs	ER Project analytical services SOW (LANL 1995, 49738). Also in Appendix D of this report.

C-4.0 RADIONUCLIDE ANALYSES

Samples were analyzed for radionuclides by the methods listed in Table C-4.0-1. Eighty samples were analyzed for isotopic plutonium, twenty-two were analyzed for gamma-emitting radionuclides, twenty-eight samples were analyzed for strontium-90 and fourteen samples were analyzed for tritium. Americium-241 was quantified with gamma spectroscopy. The maximum allowable reporting limits, as defined in the ER Project analytical services SOW, for radionuclides are provided in Appendix D. Validation qualifiers associated with these data are "no flag" and U.

Table C-4.0-1
Analytical Methods for Radionuclide Analyses

Radionuclides	Analytical Technique
Gamma-emitting radionuclides	Gamma spectroscopy
Strontium-90	Gas proportional counting
Isotopic plutonium	Chemical separation/alpha spectroscopy
Tritium	Liquid scintillation

Radionuclides with reported values less than the MDC were qualified as not detected (U). Each radionuclide result was also compared with the corresponding 1-sigma TPU. If the result was not greater than three times the TPU, it was qualified as not detected.

Appendix D

Target Analytes and Detection Limits

D-1.0 TARGET ANALYTES AND DETECTION LIMITS

This section summarizes the target analytes and detection limits for all analyses used in this assessment. Analyte suites that did not yield COPCs in the previous report on sediment contamination in Pueblo Canyon (Reneau et al. 1998, 59159) have been excluded (isotopic uranium, isotopic thorium, and cyanide). Table D-1.0-1 lists the analytical suite and the contract-required detection limits (CRDLs) for inorganic chemicals, in accordance with the ER Project analytical services statement of work (SOW) that was in place for contract laboratories at the time of sample analysis (LANL 1995, 49738) and the Quality Assurance Project Plan (LANL 1996, 54609). In many cases, a laboratory's reporting limits for the target analytes were significantly lower than the CRDLs. Tables D-1.0-2 through D-1.0-4 list the analytical suites and estimated quantitation limits (EQLs) for radionuclides and organic chemicals. The EQLs are provided by EPA in the analytical method documentation and make allowances for matrix effects and interferences. The sample-specific reporting limit for each analyte that is reported as not detected (U) is available in section D-4.0 of this appendix. The Laboratory's FIMAD database also contains the sample-specific reporting limits for each analyte.

D-1.1 Inorganic Chemical Analyses

Table D-1.0-1 shows target analytes for inorganic chemical analyses and associated detection limits, which are CRDLs. Some of the CRDLs listed in Table D-1.0-1 exceed Laboratory background values (BVs). For these analytes, the contract laboratories were contacted and, whenever possible, reporting limits and analytical techniques (use of axial view ICPES instead of radial view ICPES) were changed to be at or below the Laboratory BVs.

D-1.2 Radionuclide Analyses

The EQLs for radionuclides are summarized in Table D-1.0-2. The Laboratory methods for these analytes are contained in "Health and Environmental Chemistry: Analytical Techniques, Data Management, and Quality Assurance" (LANL 1993, 31793).

D-1.3 Organic Chemical Analyses

Table D-1.0-3 summarizes the SVOC target analytes and the associated EQLs. Samples were analyzed using either EPA SW-846 Method 8270 or Contract Laboratory Method OLM04.2. These methods use solvent extraction. The sample extracts are analyzed using gas chromatography/mass spectroscopy.

Table D-1.0-4 summarizes the pesticide/PCB analytes and the associated EQLs. Samples were analyzed using either EPA SW-846 Method 8081/8082 or Contract Laboratory Program Method OLM04.2. These methods use solvent extraction. The sample extracts are analyzed using gas chromatography.

D-2.0 ANALYTE SUITES AND REQUEST NUMBERS

Table D-2.0-1 presents the analytical suites and request numbers (RNs) for sediment samples collected at selected locations in Pueblo Canyon. Only those samples and analytes included in this assessment are included in Table D-2.0-1. The RN identifies a batch of samples that have been sent to a specific off-site analytical laboratory for a specific suite of analyses. RNs can be used to track the original data packages from the off-site analytical laboratories. Table D-2.0-1 also presents some field information (e.g., reach/subreach, location ID and sample collection depth). Table D-2.0-2 presents the analytical laboratory that analyzed each request number.

Table D-1.0-1
Target Analytes and Maximum Required Detection Limits for Inorganic Chemical Analyses

Analyte	EPA Sample Preparation Method	Analytical Technique	EDL[a] (mg/kg) ICPES[b]/ICPMS[c]	EDL (mg/kg) GFAA[d]/other
Aluminum	3050A	ICPES	40	
Antimony	3050A	ICPES	12	
Arsenic	7060/3050A	GFAA/ICPES	NR[e]	2
Barium	3050A	ICPES	40	
Beryllium	3050A	ICPES	1	
Cadmium	3050A	ICPES	1	
Calcium	3050A	ICPES	1000	
Chromium	3050A	ICPES	2	
Cobalt	3050A	ICPES	10	
Copper	3050A	ICPES	5	
Iron	3050A	ICPES	20	
Lead	7421/3050A	GFAA/ICPES	0.6	0.2
Magnesium	3050A	ICPES	1000	
Manganese	3050A	ICPES	3	
Mercury	7471	CVAA[f]	n/a[g]	0.1
Nickel	3050A	ICPES	8	
Potassium	3050A	ICPES	1000	
Selenium	7740/3050A	GFAA/ICPES	NR	1
Silver	3050A	ICPES	2	
Sodium	3050A	ICPES	1000	
Thallium	7841/3050A	GFAA/ICPES	NR	2
Uranium	3050A	ICPMS	0.5	
Vanadium	3050A	ICPES	10	
Zinc	3050A	ICPES	4	

[a] EDL = estimated detection limit.
[b] ICPES = inductively coupled plasma emission spectroscopy by EPA Method 6010.
[c] ICPMS = inductively coupled plasma mass spectrometry by EPA Method 6020.
[d] GFAA = graphite furnace atomic absorption spectroscopy by EPA Methods 7000-series.
[e] NR = not recommended, EDLs are sample-specific.
[f] CVAA = cold vapor atomic absorption spectroscopy.
[g] n/a = not applicable.

Table D-1.0-2
Target Analytes and Maximum Required Quantitation Limits for Radiochemical Analyses

Analyte	Sediment/Soil EQL (pCi/g)	EPA Preparation Method (if applicable)	Analytical Technique[a]
Gross alpha/beta	10.0	n/a[b]	Gas-proportional
Strontium-90[c]	2.0	n/a	Gas-proportional
Americium-241	0.1	n/a	Alpha spectroscopy
Plutonium-238; -239,240	0.1	n/a	Alpha spectroscopy
Tritium	300 pCi/L	n/a	Liquid scintillation
Gamma-emitting isotopes[d]	Am-241: 1 Cs-137: 1 Pb-210: 2 Ra-226: 1 Th-234: 1	n/a	Gamma spectroscopy
Total and extractable uranium	0.5 mg/kg	EPA SW-846 200.8/3050	ICPMS[e]

[a] The Los Alamos National Laboratory methods for these analytes are contained in *Health and Environmental Chemistry: Analytical Techniques, Data Management, and Quality Assurance* (LANL 1993, 31793).

[b] n/a = not applicable.

[c] It may be presumed that strontium-89 is not present.

[d] Estimated quantitation limits (EQLs) are not specified for the other 41 gamma-emitting isotopes commonly analyzed; they are determined on a case-specific basis.

[e] ICPMS = inductively coupled plasma mass spectrometry

Table D-1.0-3
Target Analytes and Maximum Required Quantitation Limits for SVOC Analyses[a]

Target Analyte	Sediment/Soil EQL[b] (µg/kg)	Target Analyte	Sediment/Soil EQL[b] (µg/kg)
Acenaphthene	330	4,6-Dinitro-2-methylphenol	1600
Acenaphthylene	330	2,4-Dinitrotoluene	330
Aniline	660	2,6-Dinitrotoluene	330
Anthracene	330	Di-n-octyl phthalate	330
Azobenzene	660	Bis(2-ethylhexyl)phthalate	330
Benz(a)anthracene	330	Fluoranthene	330
Benzoic acid	3300	Fluorene	330
Benzo(b)fluoranthene	330	Hexachlorobenzene	330
Benzo(K)fluoranthene	330	Hexachlorobutadiene	330
Benzo(g,h,i)perylene	330	Hexachlorocyclopentadiene	330
Benzo(a)pyrene	330	Hexachloroethane	330
Benzyl alcohol	1300	Indeno(1,2,3-cd)pyrene	330
Bis(2-chloroethoxy)methane	330	Isophorone	330
Bis(2-chloroethyl)ether	330	2-Methylnaphthalene	330
4-Bromophenyl phenylether	330	2-Methylphenol	330
Butylbenzylphthalate	330	4-Methylphenol	330
4-Chloroaniline	1300	Naphthalene	330
4-Chloro-3-methylphenol	660	2-Nitroaniline	1600
2-Chloronaphthalene	330	3-Nitroaniline	1600
2-Chlorophenol	330	4-Nitroaniline	660
4-Chlorophenyl phenylether	330	Nitrobenzene	330
Chrysene	330	2-Nitrophenol	330
Dibenz(a,h)anthracene	330	4-Nitrophenol	1600
Dibenzofuran	330	N-Nitrosodimethylamine	330
1,2-Dichlorobenzene	330	N-Nitrosodiphenylamine	330
1,3-Dichlorobenzene	330	N-Nitroso-di-n-propylamine	330
1,4-Dichlorobenzene	330	2,2'-oxybis(1-Chloropropane)	330
3,3'-Dichlorobenzidine	660	Pentachlorophenol	1600
2,4-Dichlorophenol	330	Phenanthrene	330
Diethylphthalate	330	Phenol	330
Dimethyl phthalate	330	Pyrene	330
2,4-Dimethylphenol	330	1,2,4-Trichlorobenzene	330
2,4-Dinitrophenol	1600	2,4,5-Trichlorophenol	1600
Di-n-butylphthalate	330	2,4,6-Trichlorophenol	330

[a] All analyses were done by EPA contract laboratory program Method OLM02.0 or the equivalent EPA Method 8270. These methods are based on solvent extraction, concentration, and gas chromatography/mass spectrometry detection and quantitation.

[b] Estimated quantitation limits (EQLs) for the sediment samples are based on no gel permeation chromatography (GPC) cleanup being performed. The laboratories' GPC equipment determines the sample-specific EQL based on the volume of extract the GPC equipment uses. However, the laboratories are requested, if possible, to report sample-specific EQLs of no more than twice the value listed in the table.

Table D-1.0-4
EQLs for Pesticides and PCBs

Analyte	Sediments/Soils[b] EQL (μg/kg)
Aldrin	1.65
α-BHC	1.65
β-BHC	1.65
δ-BHC	1.65
γ-BHC (lindane)	1.65
α-Chlordane	1.65
γ-Chlordane	1.65
4,4'-DDD	3.3
4,4'-DDE	3.3
4,4'-DDT	3.3
Dieldrin	3.3
Endosulfan I	1.65
Endosulfan II	3.3
Endosulfan sulfate	3.3
Endrin	3.3
Endrin ketone	3.3
Endrin aldehyde	3.3
Heptachlor	1.65
Heptachlor epoxide	1.65
Methoxychlor	16.5
Toxaphene	165
Aroclor-1016	33
Aroclor-1221	66
Aroclor-1232	33
Aroclor-1242	33
Aroclor-1248	33
Aroclor-1254	33
Aroclor-1260	33

[a] All analyses were done by EPA contract laboratory program Method OLM01.8 or the equivalent EPA Method 8081. These methods are based on solvent extraction, concentration, and gas chromatography/electron capture detection and quantitation.

[b] Estimated quantitation limits (EQLs) for the sediment samples are based on no gel permeation chromatography (GPC) cleanup being performed. The laboratories' GPC equipment determines the sample-specific EQL based on the volume of extract the GPC equipment uses. However, the laboratories are requested, if possible, to report sample-specific EQLs of no more than twice the value listed in the table.

Table D-2.0-1
Pueblo Canyon Sediment Samples, Analytical Suites, and RNs For TA-74-1 West Assessment

Reach	Sample ID	Location ID	Depth (cm)	Gamma Spec	Isotopic Pu	Sr-90	Tritium	Pesticides/ PCBs	SVOCs	TAL Metals
P-1E	04PU-96-0110	PU-00018	0–8	—*	—	—	—	—	2184	—
P-1E	04PU-96-0111	PU-00019	0–8	—	—	—	—	—	2184	—
P-1E	04PU-96-0112	PU-00020	0–30	—	—	—	—	—	2184	—
P-1E	04PU-96-0113	PU-00021	64–76	—	—	—	—	—	2184	—
P-1E	04PU-96-0114	PU-00022	0–5	—	—	—	—	—	2184	—
P-1E	04PU-96-0125	PU-00018	0–8	—	—	2252	2252	—	—	—
P-1E	04PU-96-0126	PU-00019	0–8	—	—	2252	2252	—	—	—
P-1E	04PU-96-0127	PU-00020	0–30	—	—	2252	2252	—	—	—
P-1E	04PU-96-0128	PU-00021	64–76	—	—	2252	2252	—	—	—
P-1E	04PU-96-0129	PU-00022	0–5	—	—	2252	2252	—	—	—
P-1E	CAPU-99-0020	PU-00106	54–67	—	—	—	—	—	6221R	—
P-2E	04PU-97-0153	PU-00134	0–5	—	3782R	—	—	—	—	—
P-2E	04PU-97-0154	PU-00135	0–8	—	3782R	—	—	—	—	—
P-2E	04PU-97-0155	PU-00135	8–25	—	3782R	—	—	—	—	—
P-2E	04PU-97-0156	PU-00136	0–8	—	3782R	—	—	—	—	—
P-2E	04PU-97-0157	PU-00136	8–15	—	3782R	—	—	—	—	—
P-2E	04PU-97-0158	PU-00136	15–23	—	3782R	—	—	—	—	—
P-2E	04PU-97-0159	PU-00137	0–19	—	3782R	—	—	—	—	—
P-2E	04PU-97-0160	PU-00137	19–37	—	3782R	—	—	—	—	—
P-2E	04PU-97-0161	PU-00137	44–57	—	3782R	—	—	—	—	—
P-2E	04PU-97-0162	PU-00137	64–83	—	3782R	—	—	—	—	—
P-2E	04PU-97-0163	PU-00137	105–122	—	3782R	—	—	—	—	—
P-2E	04PU-97-0164	PU-00138	0–13	—	3782R	—	—	—	—	—
P-2E	04PU-97-0165	PU-00138	42–91	—	3782R	—	—	—	—	—
P-2E	04PU-97-0166	PU-00139	0–15	—	3782R	—	—	—	—	—
P-2E	04PU-97-0167	PU-00139	15–29	—	3802R	—	—	—	—	—
P-2E	04PU-97-0168	PU-00139	29–39	—	3802R	—	—	—	—	—
P-2E	04PU-97-0169	PU-00140	0–25	—	3802R	—	—	—	—	—
P-2E	04PU-97-0170	PU-00140	25–43	—	3802R	—	—	—	—	—
P-2E	04PU-97-0172	PU-00140	43–57	—	3802R	—	—	—	—	—
P-2E	04PU-97-0173	PU-00140	57–85	—	3802R	—	—	—	—	—
P-2E	04PU-97-0174	PU-00140	85–110	—	3802R	—	—	—	—	—
P-2E	04PU-97-0175	PU-00140	110–132	—	3802R	—	—	—	—	—
P-2E	04PU-97-0231	PU-00163	0–13	—	3986R	—	—	—	—	—
P-2E	04PU-97-0233	PU-00164	18–30	—	3986R	—	—	—	—	—

Table D-2.0-1 (continued)

Reach	Sample ID	Location ID	Depth (cm)	Gamma Spec	Isotopic Pu	Sr-90	Tritium	Pesticides/ PCBs	SVOCs	TAL Metals
P-2E	04PU-97-0234	PU-00164	55–77	—	3986R	—	—	—	—	—
P-2E	04PU-97-0235	PU-00164	97–122	—	3986R	—	—	—	—	—
P-2E	04PU-97-0236	PU-00136	23–36	—	3986R	—	—	—	—	—
P-2E	04PU-97-0237	PU-00136	38–52	—	3986R	—	—	—	—	—
P-2E	04PU-97-0238	PU-00139	39–60	—	3986R	—	—	—	—	—
P-2E	04PU-97-0239	PU-00140	132–149	—	3986R	—	—	—	—	—
P-2E	04PU-97-0240	PU-00165	0–9	—	3986R	—	—	—	—	—
P-2E	04PU-98-0023	PU-00174	132–142	—	4107R	—	—	—	—	—
P-2E	04PU-98-0024	PU-00174	150–160	—	4107R	—	—	—	—	—
P-2W	CAPU-01-0049	PU-10202	0–10	9654R	9654R	9654R	—	—	—	9652R
P-2W	CAPU-01-0050	PU-10203	0–2	9654R	9654R	9654R	—	—	—	9652R
P-2W	CAPU-01-0051	PU-10203	2–10	9654R	9654R	9654R	—	—	—	9652R
P-2W	CAPU-01-0052	PU-10204	0–13	9654R	9654R	9654R	—	—	—	9652R
P-2W	CAPU-01-0053	PU-10205	0–2	9654R	9654R	9654R	—	—	—	9652R
P-2W	CAPU-01-0054	PU-10206	0–8	9654R	9654R	9654R	—	—	—	9652R
P-2W	CAPU-01-0055	PU-10207	0–3	9654R	9654R	9654R	—	—	—	9652R
P-2W	CAPU-01-0056	PU-10208	6–14	9654R	9654R	9654R	—	—	—	9652R
P-3W	04PU-97-0176	PU-00141	3–11	—	3802R	—	—	—	—	—
P-3W	04PU-97-0177	PU-00142	0–9	—	3802R	—	—	—	—	—
P-3W	04PU-97-0178	PU-00142	9–30	—	3802R	—	—	—	—	—
P-3W	04PU-97-0179	PU-00142	50–89	—	3802R	—	—	—	—	—
P-3W	04PU-97-0180	PU-00143	0–14	—	3802R	—	—	—	—	—
P-3W	04PU-97-0181	PU-00144	0–36	—	3802R	—	—	—	—	—
P-3W	04PU-97-0182	PU-00144	36–50	—	3802R	—	—	—	—	—
P-3W	04PU-97-0183	PU-00144	50–80	—	3802R	—	—	—	—	—
P-3W	04PU-97-0184	PU-00145	11–29	—	3802R	—	—	—	—	—
P-3W	04PU-97-0185	PU-00145	41–72	—	3802R	—	—	—	—	—
P-3W	04PU-97-0186	PU-00145	72–103	—	3802R	—	—	—	—	—
P-3W	04PU-97-0187	PU-00145	103–135	—	3802R	—	—	—	—	—
P-3W	04PU-97-0188	PU-00146	0–11	—	3802R	—	—	—	—	—
P-3W	04PU-97-0189	PU-00147	0–14	—	3802R	—	—	—	—	—
P-3W	04PU-97-0190	PU-00147	14–30	—	3802R	—	—	—	—	—
P-3W	04PU-97-0191	PU-00147	30–43	—	3802R	—	—	—	—	—
P-3W	04PU-97-0193	PU-00148	0–30	—	3802R	—	—	—	—	—
P-3W	04PU-97-0194	PU-00148	30–51	—	3802R	—	—	—	—	—
P-3W	04PU-97-0195	PU-00148	51–65	—	3802R	—	—	—	—	—

Table D-2.0-1 (continued)

Reach	Sample ID	Location ID	Depth (cm)	Gamma Spec	Isotopic Pu	Sr-90	Tritium	Pesticides/ PCBs	SVOCs	TAL Metals
P-3W	04PU-97-0196	PU-00148	65–85	—	3802R	—	—	—	—	—
P-3W	04PU-97-0244	PU-00157	0–50	3945R	3945R	—	—	3943R	—	3944R
P-3W	04PU-97-0246	PU-00144	0–36	3945R	—	—	—	3943R	—	3944R
P-3W	04PU-97-0247	PU-00144	36–50	3945R	—	—	—	3943R	—	3944R
P-3W	04PU-97-0248	PU-00142	9–30	3945R	—	—	—	3943R	—	3944R
P-3W	04PU-97-0250	PU-00141	3–11	3945R	—	—	—	3943R	—	3944R
P-3W	04PU-97-0251	PU-00142	0–9	3945R	—	—	—	3943R	—	3944R
P-3W	04PU-97-0252	PU-00166	0–17	—	3984R	—	—	—	—	—
P-3W	04PU-97-0253	PU-00166	17–33	—	3984R	—	—	—	—	—
P-3W	04PU-97-0254	PU-00166	33–50	—	3984R	—	—	—	—	—
P-3W	04PU-97-0255	PU-00166	50–58	—	3984R	—	—	—	—	—
P-3W	04PU-97-0256	PU-00166	58–70	—	3984R	—	—	—	—	—
P-3W	04PU-97-0257	PU-00167	8–23	—	3984R	—	—	—	—	—
P-3W	04PU-97-0258	PU-00141	13–25	—	3984R	—	—	—	—	—
P-3W	04PU-97-0259	PU-00141	36–64	—	3984R	—	—	—	—	—
P-3W	04PU-97-0266	PU-00168	0–5	3984R	3984R	—	—	—	—	3983R
P-3W	04PU-97-0267	PU-00142	50–89	3984R	—	—	—	—	—	3983R
P-3W	04PU-98-0016	PU-00173	183–203	—	4107R	—	—	—	—	—
P-3W	04PU-98-0017	PU-00173	109–132	—	4107R	—	—	—	—	—
P-3W	04PU-98-0018	PU-00173	79–97	—	4107R	—	—	—	—	—
P-3W	CAPU-01-0029	PU-10187	0–17	9536R	9536R	9536R	—	—	—	9535R
P-3W	CAPU-01-0030	PU-10188	0–3	9536R	9536R	9536R	—	—	—	9535R
P-3W	CAPU-01-0031	PU-10189	0–2	9536R	9536R	9536R	—	—	—	9535R
P-3W	CAPU-01-0046	PU-10188	1–5	9654R	9654R	9654R	—	—	—	9652R
P-3W	CAPU-01-0047	PU-10188	5–10	9654R	9654R	9654R	—	—	—	9652R
P-3W	CAPU-01-0048	PU-10201	0–1	9654R	9654R	9654R	—	—	—	9652R
P-4E	04PU-96-0025	PU-00032	71–86	—	—	1938	1938	—	1937	—
P-4E	04PU-96-0026	PU-00033	25–36	—	—	1938	1938	—	1937	—
P-4E	04PU-96-0027	PU-00034	0–6	—	—	1938	1938	—	1937	—
P-4E	04PU-96-0028	PU-00035	0–5	—	—	1938	1938	—	1937	—
P-4E	04PU-96-0029	PU-00036	0–5	—	—	1938	1938	—	1937	—
P-4W	04PU-96-0030	PU-00037	0–4	—	—	1938	1938	—	1937	—
P-4W	04PU-96-0031	PU-00038	0–6	—	—	1938	1938	—	1937	—
P-4W	04PU-96-0032	PU-00039	0–8	—	—	1938	1938	—	1937	—
P-4W	04PU-96-0033	PU-00040	0–6	—	—	1938	1938	—	1937	—

*A dash in the table indicates "not applicable."

Table D-2.0-2
Pueblo Canyon RNs, Analytical Suites, and Analytical Laboratories

Request Number	Number of Samples	Analytical Suite	Laboratory Name
1937	9 sediment samples	SVOC	Geotech
1938	9 sediment samples	H_3	Geotech
1938	9 sediment samples	SR_90	Geotech
2184	5 sediment samples	SVOC	ESE
2252	5 sediment samples	H_3	RUST GEOTECH
2252	5 sediment samples	SR_90	RUST GEOTECH
3782R	14 sediment samples	ISO_PU	ESE
3802R	28 sediment samples	ISO_PU	ESE
3943R	6 sediment samples	PESTPCB	ATI
3944R	6 sediment samples	TAL_METALS	ATI
3945R	6 sediment samples	GAMMA_SPEC	ATI
3945R	1 sediment samples	ISO_PU	ATI
3983R	2 sediment samples	TAL_METALS	ATI
3984R	2 sediment samples	GAMMA_SPEC	ATI
3984R	9 sediment samples	ISO_PU	ATI
3986R	9 sediment samples	ISO_PU	ATI
4107R	5 sediment samples	ISO_PU	ESE
6221R	1 sediment samples	SVOC	Paragon/ATI
9535R	3 sediment samples	TAL_METALS	Paragon Analytics, Inc.
9536R	3 sediment samples	GAMMA_SPEC	Paragon Analytics, Inc.
9536R	3 sediment samples	ISO_PU	Paragon Analytics, Inc.
9536R	3 sediment samples	SR_90	Paragon Analytics, Inc.
9652R	11 sediment samples	TAL_METALS	Severn Trent Laboratories, Inc., St. Louis
9654R	11 sediment samples	GAMMA_SPEC	Severn Trent Laboratories - Richland
9654R	11 sediment samples	ISO_PU	Severn Trent Laboratories - Richland
9654R	11 sediment samples	SR_90	Severn Trent Laboratories - Richland

D-3.0 SUMMARY OF PUEBLO CANYON ANALYSES

Tables D-3.0-1 through D-3.0-3 present summaries of the inorganic chemical, radionuclide, and organic chemical analyses for analytes with at least one detected value for sediment samples collected at selected locations in Pueblo Canyon. These tables show the number of samples, detection frequency, and concentration range for each analyte.

Table D-3.0-1
Summary of Inorganic Chemical Analyses in Pueblo Canyon

Analyte	Total Count	Nondetects			Detects		
		Count	Min.	Max.	Count	Min.	Max.
Target Analyte List Metals Analyzed by EPA method 6010 (mg/kg)							
Aluminum	22	0	—*	—	22	1000	10600
Antimony	22	21	0.27	1.3	1	0.55	0.55
Arsenic	22	5	0.11	1.4	17	0.31	2.6
Barium	22	0	—	—	22	14	248
Beryllium	22	3	0.5	0.56	19	0.18	1.3
Cadmium	22	10	0.015	0.69	12	0.06	0.44
Calcium	22	0	—	—	22	327	11400
Chromium, total	22	0	—	—	22	1.2	7.8
Cobalt	22	2	1	1.1	20	0.98	6.4
Copper	22	0	—	—	22	1.3	20.5
Iron	22	0	—	—	22	3170	12600
Lead	22	0	—	—	22	3.7	33.9
Magnesium	22	0	—	—	22	220	2080
Manganese	22	0	—	—	22	120	1140
Mercury	22	10	0.002	0.14	12	0.02	0.078
Nickel	22	5	1.3	2.8	17	1.2	10.4
Potassium	22	0	—	—	22	180	1960
Selenium	22	10	0.21	0.69	12	0.24	0.84
Silver	22	19	0.043	1.7	3	0.73	1.5
Sodium	22	8	34	138	14	58.5	157
Thallium	22	17	0.044	1.4	5	0.23	1.3
Vanadium	22	0	—	—	22	3.4	18.1
Zinc	22	0	—	—	22	15.8	51.8

*A dash in the table indicates "not applicable."

Table D-3.0-2
Summary of Radionuclide Analyses in Pueblo Canyon

Analyte	Total Count	Nondetects			Detects		
		Count	Min.	Max.	Count	Min.	Max.
Radionuclides Analyzed by Gamma Spectroscopy (pCi/g)							
Americium-241-by gamma spectroscopy	22	20	-0.227	0.972	2	0.0841	0.138
Cesium-134	22	16	-0.0572	0.42	6	0.0528	0.103
Cesium-137	22	7	0	0.2393	15	0.112	2.33
Tritium Analyzed by Liquid Scintillation (pCi/g)							
Tritium	14	1	0.121	0.121	13	0.0026	1.21
Isotopic Plutonium Analyzed by Chemical Separation/Alpha Spectroscopy(pCi/g)							
Plutonium-238	80	76	-0.014	0.071	4	0.031	0.136
Plutonium-239,240	80	0	—*	—	80	0.04	44.9
Strontium-90 Analyzed by Proportional Counting (pCi/g)							
Strontium-90	28	14	-0.2	0.76	14	0.245	1.4

*A dash in the table indicates "not applicable."

Table D-3.0-3
Summary of Organic Chemical Analyses in Pueblo Canyon

Analyte	Total Count	Nondetects			Detects		
		Count	Min.	Max.	Count	Min.	Max.
Pesticides and PCBs Analyzed by EPA Method 8081/8082 (mg/kg)							
No detected values. Total number of samples = 6.							
Semivolatile Organic Compounds Analyzed by EPA Method 8270 (mg/kg)							
Acenaphthene	15	11	0.329	0.344	4	0.13	0.219
Anthracene	15	11	0.329	0.344	4	0.23	0.369
Benz(a)anthracene	15	10	0.329	0.344	5	0.035	1
Benzo(a)pyrene	15	10	0.329	0.344	5	0.052	1.8
Benzo(b)fluoranthene	15	9	0.329	0.344	6	0.05	2.5
Benzo(g,h,i)perylene	15	11	0.329	0.344	4	0.19	0.86
Benzo(k)fluoranthene	15	11	0.329	0.344	4	0.114	1.1
Benzoic Acid	15	11	0.795	3.3	4	0.088	0.24
Carbazole	6	3	0.33	0.34	3	0.14	0.18
Chrysene	15	9	0.329	0.344	6	0.034	1.2
Dibenzofuran	15	11	0.329	0.344	4	0.064	0.18
Fluoranthene	15	8	0.329	0.344	7	0.056	1.9
Fluorene	15	11	0.329	0.344	4	0.11	0.294
Indeno(1,2,3-cd)pyrene	15	11	0.329	0.344	4	0.22	0.88
Methylnaphthalene[2-]	15	11	0.329	0.344	4	0.038	0.167
Naphthalene	15	11	0.329	0.344	4	0.099	0.374
Phenanthrene	15	10	0.329	0.344	5	0.064	1.505
Pyrene	15	8	0.329	0.344	7	0.051	2.2

D-4.0 ANALYTICAL RESULTS FOR INORGANIC AND ORGANIC CHEMICALS AND RADIONUCLIDES DETECTED IN PUEBLO CANYON

Tables D-4.0-1 through D-4.0-3 present analytical results for inorganic and organic chemicals and radionuclides that were detected at least one time in sediment samples collected at selected locations in Pueblo Canyon.

Table D-4.0-1
Analytical Results (mg/kg) for Detected Inorganic Chemicals in Sediment in Pueblo Canyon

Reach	Location ID	Geomorphic Unit	Sediment Facies	Depth (cm)	Sample ID	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium, total
P-2W	PU-10202	c2	Fine	0–10	CAPU-01-0049	4540	0.89 (U)	0.53 (J)	68.6	0.44 (J)	0.11 (J)	1780	3.7
P-2W	PU-10203	f1	Fine	0–2	CAPU-01-0050	9340	1.3 (U)	1.6 (J)	248	1.3	0.44 (J)	11400	7
P-2W	PU-10203	f1	Fine	2–10	CAPU-01-0051	5920	0.99 (U)	0.62 (J)	104	0.61 (J)	0.17 (J)	2870	5
P-2W	PU-10204	f1	Fine	0–13	CAPU-01-0052	4550	0.92 (U)	0.31 (J)	87.4	0.58 (J)	0.14 (J)	2930	3.9
P-2W	PU-10205	f1	Fine	0–2	CAPU-01-0053	10600	1.2 (U)	1.4 (J)	200	1.2	0.32 (J)	6890	7.8
P-2W	PU-10206	c1	Coarse	0–8	CAPU-01-0054	1340	0.81 (U)	0.11 (U)	21.3	0.21 (J)	0.065 (U)	749	2
P-2W	PU-10207	f1	Fine	0–3	CAPU-01-0055	9630	1.3 (U)	0.69 (J)	154	1.1	0.26 (J)	5780	7.4
P-2W	PU-10208	f1	Fine	6–14	CAPU-01-0056	6620	0.96 (U)	1.2 (J)	148	0.78	0.27 (J)	5700	5.4
P-3W	PU-00141	c4? (f1?)	Fine	3–11	04PU-97-0250	3390	0.64 (UJ)	1.7	51.1	0.81	0.64 (U)	874	3.2
P-3W	PU-00142	c3	Coarse	50–89	04PU-97-0267	1250	0.5 (UJ)	1 (U)	16.3	0.5 (U)	0.5 (U)	327	1.4
P-3W	PU-00142	c3	Fine	0–9	04PU-97-0251	3020	0.69 (UJ)	1.4 (U)	46.5	0.76	0.69 (U)	1190	3
P-3W	PU-00142	c3	Fine	9–30	04PU-97-0248	2910	0.56 (UJ)	1.4	52.8	0.68	0.56 (U)	1060	3.7
P-3W	PU-00144	c2	Coarse	0–36	04PU-97-0246	1490	0.56 (UJ)	1.1 (U)	20.8	0.56 (U)	0.56 (U)	477	1.3
P-3W	PU-00144	c2	Fine	36–50	04PU-97-0247	3010	0.6 (UJ)	1.4	42.3	0.72	0.6 (U)	997	2.7
P-3W	PU-00157	c1	Coarse	0–50	04PU-97-0244	1060	0.54 (UJ)	1.1 (U)	16.3	0.54 (U)	0.54 (U)	357	1.3
P-3W	PU-00168	f1	Fine	0–5	04PU-97-0266	3760	0.5 (UJ)	1.5	44.3	0.6	0.5 (U)	1250	3
P-3W	PU-10187	c3	Coarse	0–17	CAPU-01-0029	1000	0.27 (UJ)	0.71 (J)	14	0.18 (J)	0.015 (U)	510	1.2
P-3W	PU-10188	c1	Fine	0–3	CAPU-01-0030	6100	0.3 (UJ)	2.6	120	0.75	0.06 (J)	3500	6.1
P-3W	PU-10188	c1	Fine	1–5	CAPU-01-0046	8800	1.3 (U)	1.1 (J)	141	1.1	0.25 (J)	5970	7.3
P-3W	PU-10188	c1	Fine	5–10	CAPU-01-0047	9420	1.3 (U)	0.75 (J)	144	1.1	0.23 (J)	5520	7.3
P-3W	PU-10189	c3	Fine	0–2	CAPU-01-0031	6300	0.55 (J-)	2.5	150	0.65 (J)	0.11 (J)	4400	7.2
P-3W	PU-10201	c1	Fine	0–1	CAPU-01-0048	7630	0.81 (U)	1.1	129	0.97	0.19 (J)	4910	6.1

Table D-4.0-1 (continued)

Reach	Location ID	Geomorphic Unit	Sediment Facies	Depth (cm)	Sample ID	Cobalt	Copper	Iron	Lead	Magnesium	Manganese	Mercury	Nickel
P-2W	PU-10202	c2	Fine	0–10	CAPU-01-0049	3 (J)	4.5	6630	12.8	863	388	0.02 (J)	4 (J)
P-2W	PU-10203	f1	Fine	0–2	CAPU-01-0050	6.4 (J)	14.2	11100	33.9	2050	1140	0.078	10.4
P-2W	PU-10203	f1	Fine	2–10	CAPU-01-0051	3.7 (J)	6.3	7870	17.7	1170	517	0.027 (J)	4.4 (J)
P-2W	PU-10204	f1	Fine	0–13	CAPU-01-0052	3 (J)	5.1	6670	14.4	890	467	0.024 (J)	4.2 (J)
P-2W	PU-10205	f1	Fine	0–2	CAPU-01-0053	6.1 (J)	12.2	12600	29.1	2080	886	0.026 (U)	8.3
P-2W	PU-10206	c1	Coarse	0–8	CAPU-01-0054	1.4 (J)	3.6	6010	6.3	291 (J)	160	0.039	1.3 (U)
P-2W	PU-10207	f1	Fine	0–3	CAPU-01-0055	5.5 (J)	10.9	11200	23	1880	749	0.05 (J)	9.5
P-2W	PU-10208	f1	Fine	6–14	CAPU-01-0056	4.3 (J)	8.5	8570	23	1370	714	0.042	5.8
P-3W	PU-00141	c4? (f1?)	Fine	3–11	04PU-97-0250	2.5	10.4	6060	9.9	781	239	0.13 (U)	3.3
P-3W	PU-00142	c3	Coarse	50–89	04PU-97-0267	1 (U)	2	3170	3.7	346	224	0.1 (U)	2 (U)
P-3W	PU-00142	c3	Fine	0–9	04PU-97-0251	2	5.2	4360	14.2	588	239	0.14 (U)	2.8 (U)
P-3W	PU-00142	c3	Fine	9–30	04PU-97-0248	2.4	10.7	7570	13.5	604	247	0.11 (U)	3.2
P-3W	PU-00144	c2	Coarse	0–36	04PU-97-0246	1.1 (U)	7.6	3590	6.1	300	156	0.11 (U)	2.2 (U)
P-3W	PU-00144	c2	Fine	36–50	04PU-97-0247	1.9	20.5	5260	10.8	602	210	0.12 (U)	2.8
P-3W	PU-00157	c1	Coarse	0–50	04PU-97-0244	1.1	9.4	4910	5	220	165	0.11 (U)	2.2 (U)
P-3W	PU-00168	f1	Fine	0–5	04PU-97-0266	1.9	8.8	5390	12.5	757	232	0.1 (U)	4
P-3W	PU-10187	c3	Coarse	0–17	CAPU-01-0029	0.98 (J)	1.3	3800	3.7	300	120 (J-)	0.002 (U)	1.2 (J)
P-3W	PU-10188	c1	Fine	0–3	CAPU-01-0030	4.5	8	9200	18	1200	590 (J-)	0.058 (J)	7.1
P-3W	PU-10188	c1	Fine	1–5	CAPU-01-0046	5.8 (J)	10.5	11300	24.7	1850	659	0.06	9.5
P-3W	PU-10188	c1	Fine	5–10	CAPU-01-0047	5.3 (J)	10.1	11500	23.1	1880	681	0.043 (J)	8.4
P-3W	PU-10189	c3	Fine	0–2	CAPU-01-0031	4.5	8.4	8900	20	1300	650 (J-)	0.036 (J)	7.8
P-3W	PU-10201	c1	Fine	0–1	CAPU-01-0048	5 (J)	11.1	9790	19.6	1610	621	0.035	6.5

Table D-4.0-1 (continued)

Reach	Location ID	Geomorphic Unit	Sediment Facies	Depth (cm)	Sample ID	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
P-2W	PU-10202	c2	Fine	0–10	CAPU-01-0049	952	0.22 (UJ)	1.1 (U)	71.4 (J)	0.15 (U)	9.2	27.2
P-2W	PU-10203	f1	Fine	0–2	CAPU-01-0050	1860	0.69 (J-)	1.7 (U)	115 (J)	0.27 (J)	17.8	50.8
P-2W	PU-10203	f1	Fine	2–10	CAPU-01-0051	1230	0.25 (UJ)	1.3 (U)	82.1 (J)	0.16 (U)	11	31.4
P-2W	PU-10204	f1	Fine	0–13	CAPU-01-0052	908	0.24 (J-)	1.2 (U)	71.5 (J)	0.13 (U)	9.2	27.7
P-2W	PU-10205	f1	Fine	0–2	CAPU-01-0053	1960	0.62 (J-)	1.5 (J)	119 (J)	0.25 (J)	18.1	51.8
P-2W	PU-10206	c1	Coarse	0–8	CAPU-01-0054	340 (J)	0.21 (UJ)	1 (U)	58.5 (J)	0.044 (U)	5.3	28.3
P-2W	PU-10207	f1	Fine	0–3	CAPU-01-0055	1620	0.45 (J-)	1.7 (U)	157 (J)	0.23 (J)	16.7	42.8
P-2W	PU-10208	f1	Fine	6–14	CAPU-01-0056	1380	0.36 (J-)	1.2 (J)	83.9 (J)	0.16 (U)	12.6	36.5
P-3W	PU-00141	c4? (f1?)	Fine	3–11	04PU-97-0250	903	0.64 (U)	1.3 (U)	128 (U)	1.3 (U)	8.4	30.9
P-3W	PU-00142	c3	Coarse	50–89	04PU-97-0267	305	0.5 (U)	1 (U)	100 (U)	1 (U)	3.4	15.8
P-3W	PU-00142	c3	Fine	0–9	04PU-97-0251	821	0.69 (U)	1.4 (U)	138 (U)	1.4 (U)	6.1	28.6
P-3W	PU-00142	c3	Fine	9–30	04PU-97-0248	642	0.69	1.1 (U)	112 (U)	1.1 (U)	9	39.3
P-3W	PU-00144	c2	Coarse	0–36	04PU-97-0246	373	0.56 (U)	1.1 (U)	112 (U)	1.1 (U)	3.5	20.8
P-3W	PU-00144	c2	Fine	36–50	04PU-97-0247	746	0.6 (U)	1.2 (U)	120 (U)	1.2 (U)	6.6	31.4
P-3W	PU-00157	c1	Coarse	0–50	04PU-97-0244	272	0.55	1.1 (U)	108 (U)	1.1 (U)	4.7	24
P-3W	PU-00168	f1	Fine	0–5	04PU-97-0266	959	0.5 (U)	1 (U)	147	1 (U)	7.1	31
P-3W	PU-10187	c3	Coarse	0–17	CAPU-01-0029	180	0.22 (U)	0.043 (U)	34 (U)	0.23 (U)	3.4	17
P-3W	PU-10188	c1	Fine	0–3	CAPU-01-0030	1000	0.67	0.048 (U)	130	0.26 (U)	13	37
P-3W	PU-10188	c1	Fine	1–5	CAPU-01-0046	1480	0.34 (J-)	1.6 (U)	150 (J)	1.3 (J)	16.8	44.3
P-3W	PU-10188	c1	Fine	5–10	CAPU-01-0047	1560	0.55 (J-)	1.7 (U)	148 (J)	0.6 (J)	16.8	45.9
P-3W	PU-10189	c3	Fine	0–2	CAPU-01-0031	1200	0.84	0.069 (U)	100 (J)	0.37 (U)	13	41
P-3W	PU-10201	c1	Fine	0–1	CAPU-01-0048	1480	0.31 (J-)	0.73 (J)	152 (J)	0.22 (U)	14.6	39

Table D-4.0-2
Analytical Results (pCi/g) for Detected Radionuclides in Sediment in Pueblo Canyon

Reach	Location ID	Geomorphic Unit	Sediment Facies	Depth (cm)	Sample ID	Strontium-90	Tritium	Plutonium-238	Plutonium-239,240	Americium-241 by gamma spectroscopy	Cesium-134	Cesium-137
P-1E	PU-00018	c2	Fine	0–8	04PU-96-0125	0.36 (U)	0.049					
P-1E	PU-00019	c1	Coarse	0–8	04PU-96-0126	1.03	0.061					
P-1E	PU-00020	c2b	Fine	0–30	04PU-96-0127	0.76 (U)	0.051					
P-1E	PU-00021	c2b	Fine	64–76	04PU-96-0128	0.95	1.21					
P-1E	PU-00022	f1	Fine	0–5	04PU-96-0129	1.4	0.121 (U)					
P-2E	PU-00134	c1	Coarse	0–5	04PU-97-0153			-0.007 (U)	0.406			
P-2E	PU-00135	f1	Fine	0–8	04PU-97-0154			0.015 (U)	0.713			
P-2E	PU-00135	f1	Fine	8–25	04PU-97-0155			0.006 (U)	0.076			
P-2E	PU-00136	c3	Coarse	38–52	04PU-97-0237			-0.001 (U)	0.576			
P-2E	PU-00136	c3	Fine	0–8	04PU-97-0156			0.009 (U)	5.71			
P-2E	PU-00136	c3	Fine	8–15	04PU-97-0157			-0.008 (U)	0.362			
P-2E	PU-00136	c3	Fine	15–23	04PU-97-0158			0.032 (U)	7.11			
P-2E	PU-00136	c3	Fine	23–36	04PU-97-0236			0.028 (U)	8.07			
P-2E	PU-00137	c2	Fine	0–19	04PU-97-0159			-0.01 (U)	1.81			
P-2E	PU-00137	c2	Fine	19–37	04PU-97-0160			-0.014 (U)	0.492			
P-2E	PU-00137	c2	Fine	44–57	04PU-97-0161			-0.005 (U)	0.194			
P-2E	PU-00137	c2	Fine	64–83	04PU-97-0162			0.008 (U)	1.1			
P-2E	PU-00137	c2	Fine	105–122	04PU-97-0163			-0.002 (U)	1.14			
P-2E	PU-00138	c1b	Coarse	42–91	04PU-97-0165			0.002 (U)	1.11			
P-2E	PU-00138	c1b	Fine	0–13	04PU-97-0164			0.008 (U)	2.02			
P-2E	PU-00139	f1	Fine	0–15	04PU-97-0166			0.023 (U)	7.06			
P-2E	PU-00139	f1	Fine	15–29	04PU-97-0167			0.004 (U)	1.33			
P-2E	PU-00139	f1	Fine	29–39	04PU-97-0168			0 (U)	3.66			

Table D-4.0-2 (continued)

Reach	Location ID	Geomorphic Unit	Sediment Facies	Depth (cm)	Sample ID	Strontium-90	Tritium	Plutonium-238	Plutonium-239,240	Americium-241 by gamma spectroscopy	Cesium-134	Cesium-137
P-2E	PU-00139	f1	Fine	39–60	04PU-97-0238			0.022 (U)	2.09			
P-2E	PU-00140	c2	Fine	0–25	04PU-97-0169			0.012 (U)	1.14			
P-2E	PU-00140	c2	Fine	25–43	04PU-97-0170			-0.001 (U)	0.468			
P-2E	PU-00140	c2	Fine	43–57	04PU-97-0172			-0.005 (U)	2.19			
P-2E	PU-00140	c2	Fine	85–110	04PU-97-0174			0.024 (U)	5.59			
P-2E	PU-00140	c2	Fine	110–132	04PU-97-0175			0.046 (U)	4.49			
P-2E	PU-00140	c2	Fine	132–149	04PU-97-0239			0.072	6.92			
P-2E	PU-00140	c2	Fine?	57–85	04PU-97-0173			0.028 (U)	3.42			
P-2E	PU-00163	f1	Fine	0–13	04PU-97-0231			-0.0018 (U)	0.225			
P-2E	PU-00164	c2	Coarse	18–30	04PU-97-0233			-0.003 (U)	0.128			
P-2E	PU-00164	c2	Coarse	55–77	04PU-97-0234			-0.0047 (U)	0.131			
P-2E	PU-00164	c2	Coarse	97–122	04PU-97-0235			-0.0075 (U)	0.1			
P-2E	PU-00165	f1?	Fine	0–9	04PU-97-0240			0.0101 (U)	0.04			
P-2E	PU-00174	c1	Coarse	132–142	04PU-98-0023			0 (U)	0.19			
P-2E	PU-00174	c1	Coarse	150–160	04PU-98-0024			0.002 (U)	0.374			
P-2W	PU-10202	c2	Fine	0–10	CAPU-01-0049	0.245		0.00138 (U)	0.193	-0.00554 (U)	0.0506 (U)	0.778
P-2W	PU-10203	f1	Fine	0–2	CAPU-01-0050	1.16		0.0016 (U)	0.683	0.0222 (U)	0.08 (U)	2.33
P-2W	PU-10203	f1	Fine	2–10	CAPU-01-0051	0.267		0.00924 (U)	0.384	0.076 (U)	0.0692	1.23
P-2W	PU-10204	f1	Fine	0–13	CAPU-01-0052	0.269		0.00699 (U)	0.201	0.0841	0.0528	0.794
P-2W	PU-10205	f1	Fine	0–2	CAPU-01-0053	0.74		0.00974 (U)	0.277	0.0333 (U)	0.0648 (U)	2.18
P-2W	PU-10206	c1	Coarse	0–8	CAPU-01-0054	-0.00317 (U)		0 (U)	0.285	-0.227 (U)	0.0593 (U)	0.112
P-2W	PU-10207	f1	Fine	0–3	CAPU-01-0055	0.395		0.00185 (U)	0.734	0.0917 (U)	0.0684 (U)	1.38
P-2W	PU-10208	f1	Fine	6–14	CAPU-01-0056	0.591		0.0131 (U)	0.283	-0.047 (U)	0.0961	1.43
P-3W	PU-00141	c4? (f1?)	Coarse	36–64	04PU-97-0259			0.0106 (U)	0.224			

Table D-4.0-2 (continued)

Reach	Location ID	Geomorphic Unit	Sediment Facies	Depth (cm)	Sample ID	Strontium-90	Tritium	Plutonium-238	Plutonium-239,240	Americium-241 by gamma spectroscopy	Cesium-134	Cesium-137
P-3W	PU-00141	c4? (f1?)	Fine	3–11	04PU-97-0176			0.136	44.9			
P-3W	PU-00141	c4? (f1?)	Fine	3–11	04PU-97-0250					0.972 (U)	-0.0572 (U)	0.68
P-3W	PU-00141	c4? (f1?)	Fine	13–25	04PU-97-0258			0.0179 (U)	5.87			
P-3W	PU-00142	c3	Coarse	50–89	04PU-97-0179			-0.001 (U)	2.49			
P-3W	PU-00142	c3	Coarse	50–89	04PU-97-0267					0.211 (U)	0.0065 (U)	0 (U)
P-3W	PU-00142	c3	Fine	0–9	04PU-97-0177			0.012 (U)	3.51			
P-3W	PU-00142	c3	Fine	0–9	04PU-97-0251					-0.069 (U)	-0.0216 (U)	0.1922 (U)
P-3W	PU-00142	c3	Fine	9–30	04PU-97-0178			0.071 (U)	11.7			
P-3W	PU-00142	c3	Fine	9–30	04PU-97-0248					0.295 (U)	0.0055 (U)	0.3374
P-3W	PU-00143	f2	Coarse	0–14	04PU-97-0180			-0.001 (U)	0.072			
P-3W	PU-00144	c2	Coarse	0–36	04PU-97-0181			0.001 (U)	0.538			
P-3W	PU-00144	c2	Coarse	0–36	04PU-97-0246					-0.017 (U)	0.0052 (U)	0.0253 (U)
P-3W	PU-00144	c2	Coarse	50–80	04PU-97-0183			0.011 (U)	2.35			
P-3W	PU-00144	c2	Fine	36–50	04PU-97-0182			0.007 (U)	0.468			
P-3W	PU-00144	c2	Fine	36–50	04PU-97-0247					0.023 (U)	0.029 (U)	0.1834 (U)
P-3W	PU-00145	c2	Coarse	103–135	04PU-97-0187			0.006 (U)	1.75			
P-3W	PU-00145	c2	Fine	11–29	04PU-97-0184			-0.003 (U)	0.547			
P-3W	PU-00145	c2	Fine	41–72	04PU-97-0185			-0.005 (U)	1.29			
P-3W	PU-00145	c2	Fine	72–103	04PU-97-0186			0.007 (U)	2.28			
P-3W	PU-00146	c1	Coarse	0–11	04PU-97-0188			0.002 (U)	0.909			
P-3W	PU-00147	f1	Fine	0–14	04PU-97-0189			0.016 (U)	5.58			
P-3W	PU-00147	f1	Fine	14–30	04PU-97-0190			0 (U)	1.54			
P-3W	PU-00147	f1	Fine	30–43	04PU-97-0191			0.006 (U)	0.562			
P-3W	PU-00148	f1 (+c2)	Fine	0–30	04PU-97-0193			0.005 (U)	0.897			

Table D-4.0-2 (continued)

Reach	Location ID	Geomorphic Unit	Sediment Facies	Depth (cm)	Sample ID	Strontium-90	Tritium	Plutonium-238	Plutonium-239,240	Americium-241 by gamma spectroscopy	Cesium-134	Cesium-137
P-3W	PU-00148	f1 (+c2)	Fine	30–51	04PU-97-0194			0.007 (U)	1.08			
P-3W	PU-00148	f1 (+c2)	Fine	51–65	04PU-97-0195			0.008 (U)	1.12			
P-3W	PU-00148	f1 (+c2)	Fine	65–85	04PU-97-0196			0.005 (U)	3.33			
P-3W	PU-00157	c1	Coarse	0–50	04PU-97-0244			0.031	0.354	0.021 (U)	0.0237 (U)	0.0231 (U)
P-3W	PU-00166	c3	Coarse	17–33	04PU-97-0253			0.0209 (U)	1.54			
P-3W	PU-00166	c3	Coarse	58–70	04PU-97-0256			0.019 (U)	3.85			
P-3W	PU-00166	c3	Fine	0–17	04PU-97-0252			0.0074 (U)	2.62			
P-3W	PU-00166	c3	Fine	33–50	04PU-97-0254			0.022 (U)	1.88			
P-3W	PU-00166	c3	Fine	50–58	04PU-97-0255			0.073	8.31			
P-3W	PU-00167	c2	Coarse	8–23	04PU-97-0257			0.026 (U)	0.435			
P-3W	PU-00168	f1	Fine	0–5	04PU-97-0266			0.027 (U)	3.03	0.452 (U)	0.0653 (U)	0.2393 (U)
P-3W	PU-00173	c1	Coarse	79–97	04PU-98-0018			0.009 (U)	0.541			
P-3W	PU-00173	c1	Coarse	109–132	04PU-98-0017			-0.004 (U)	0.839			
P-3W	PU-00173	c1	Coarse	183–203	04PU-98-0016			-0.002 (U)	0.469			
P-3W	PU-10187	c3	Coarse	0–17	CAPU-01-0029	0.55 (U)		0.0022 (U)	0.249	-0.031 (U)	-0.01 (U)	0.062 (U)
P-3W	PU-10188	c1	Fine	0–3	CAPU-01-0030	0.29 (U)		0.009 (U)	0.86	0.18 (U)	0.42 (U)	1.06
P-3W	PU-10188	c1	Fine	1–5	CAPU-01-0046	0.459		0.00385 (U)	0.798	0.138	0.103	1.08
P-3W	PU-10188	c1	Fine	5–10	CAPU-01-0047	0.305		0.0114 (U)	0.652	-0.0356 (U)	0.0904	1.24
P-3W	PU-10189	c3	Fine	0–2	CAPU-01-0031	0.71		0.0012 (U)	0.403	-0.13 (U)	0.05 (U)	1.98
P-3W	PU-10201	c1	Fine	0–1	CAPU-01-0048	0.303		0.00612 (U)	0.529	0.073 (U)	0.0892	1.17
P-4E	PU-00032	c3	Fine	71–86	04PU-96-0025	0.3 (U)	0.039					
P-4E	PU-00033	c3	Coarse	25–36	04PU-96-0026	0 (U)	0.0057					
P-4E	PU-00034	c1b	Coarse	0–6	04PU-96-0027	0.4 (U)	0.0026					
P-4E	PU-00035	c3	Coarse	0–5	04PU-96-0028	-0.2 (U)	0.0026					

Table D-4.0-2 (continued)

Reach	Location ID	Geomorphic Unit	Sediment Facies	Depth (cm)	Sample ID	Strontium-90	Tritium	Plutonium-238	Plutonium-239,240	Americium-241 by gamma spectroscopy	Cesium-134	Cesium-137
P-4E	PU-00036	f1	Fine	0–5	04PU-96-0029	-0.2 (U)	0.016					
P-4W	PU-00037	c5	Fine	0–4	04PU-96-0030	0.1 (U)	0.032					
P-4W	PU-00038	f1	Fine	0–6	04PU-96-0031	0.5 (U)	0.006					
P-4W	PU-00039	c5	Coarse	0–8	04PU-96-0032	-0.1 (U)	0.011					
P-4W	PU-00040	c6	Fine	0–6	04PU-96-0033	0.4 (U)	0.12					

Table D-4.0-3
Analytical Results (mg/kg) for Detected Organic Chemicals in Sediment in Pueblo Canyon

Reach	Location ID	Geomorphic Unit	Sediment Facies	Depth (cm)	Sample ID	Acenaphthene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene
P-1E	PU-00018	c2	Fine	0–8	04PU-96-0110	0.17 (J)	0.3 (J)	0.55 (J)	0.67	0.86	0.25 (J)
P-1E	PU-00019	c1	Coarse	0–8	04PU-96-0111	0.33 (U)	0.33 (U)	0.33 (U)	0.052 (J)	0.07 (J)	0.33 (U)
P-1E	PU-00020	c2b	Fine	0–30	04PU-96-0112	0.17 (J)	0.29 (J)	1	1.8	2.5	0.86
P-1E	PU-00021	c2b	Fine	64–76	04PU-96-0113	0.13 (J)	0.23 (J)	0.5	0.54	0.76	0.19 (J)
P-1E	PU-00022	f1	Fine	0–5	04PU-96-0114	0.34 (U)	0.34 (U)	0.34 (U)	0.34 (U)	0.34 (U)	0.34 (U)
P-1E	PU-00106	c2b	fine	54–67	CAPU-99-0020	0.34 (U)	0.34 (U)	0.34 (U)	0.34 (U)	0.34 (U)	0.34 (U)
P-4E	PU-00032	c3	Fine	71–86	04PU-96-0025	0.344 (U)	0.344 (U)	0.344 (U)	0.344 (U)	0.344 (U)	0.344 (U)
P-4E	PU-00033	c3	Coarse	25–36	04PU-96-0026	0.332 (U)	0.332 (U)	0.332 (U)	0.332 (U)	0.332 (U)	0.332 (U)
P-4E	PU-00034	c1b	Coarse	0–6	04PU-96-0027	0.329 (U)	0.329 (U)	0.329 (U)	0.329 (U)	0.329 (U)	0.329 (U)
P-4E	PU-00035	c3	Coarse	0–5	04PU-96-0028	0.333 (U)	0.333 (U)	0.333 (U)	0.333 (U)	0.333 (U)	0.333 (U)
P-4E	PU-00036	f1	Fine	0–5	04PU-96-0029	0.331 (U)	0.331 (U)	0.035 (J)	0.331 (U)	0.331 (U)	0.331 (U)
P-4W	PU-00037	c5	Fine	0–4	04PU-96-0030	0.344 (U)	0.344 (U)	0.344 (U)	0.344 (U)	0.05 (J)	0.344 (U)
P-4W	PU-00038	f1	Fine	0–6	04PU-96-0031	0.331 (U)	0.331 (U)	0.331 (U)	0.331 (U)	0.331 (U)	0.331 (U)
P-4W	PU-00039	c5	Coarse	0–8	04PU-96-0032	0.219 (J)	0.369	0.609	0.675	0.91	0.473
P-4W	PU-00040	c6	Fine	0–6	04PU-96-0033	0.337 (U)	0.337 (U)	0.337 (U)	0.337 (U)	0.337 (U)	0.337 (U)

Table D-4.0-3 (continued)

Reach	Location ID	Geomorphic Unit	Sediment Facies	Depth (cm)	Sample ID	Benzo(k)fluoranthene	Benzoic Acid	Carbazole	Chrysene	Dibenzofuran	Fluoranthene
P-1E	PU-00018	c2	Fine	0–8	04PU-96-0110	0.43 (J)	0.2 (J)	0.14 (J)	0.62 (J)	0.096 (J)	1.3
P-1E	PU-00019	c1	Coarse	0–8	04PU-96-0111	0.33 (U)	0.088 (J)	0.33 (U)	0.056 (J)	0.33 (U)	0.093 (J)
P-1E	PU-00020	c2b	Fine	0–30	04PU-96-0112	1.1	0.22 (J)	0.18 (J)	1.2	0.097 (J)	1.9
P-1E	PU-00021	c2b	Fine	64–76	04PU-96-0113	0.34	3.3 (U)	0.14 (J)	0.55	0.064 (J)	1.2
P-1E	PU-00022	f1	Fine	0–5	04PU-96-0114	0.34 (U)	0.24 (J)	0.34 (U)	0.34 (U)	0.34 (U)	0.34 (U)
P-1E	PU-00106	c2b	fine	54–67	CAPU-99-0020	0.34 (U)	1.7 (U)	0.34 (U)	0.34 (U)	0.34 (U)	0.34 (U)
P-4E	PU-00032	c3	Fine	71–86	04PU-96-0025	0.344 (U)	0.833 (U)		0.344 (U)	0.344 (U)	0.344 (U)
P-4E	PU-00033	c3	Coarse	25–36	04PU-96-0026	0.332 (U)	0.805 (U)		0.332 (U)	0.332 (U)	0.332 (U)
P-4E	PU-00034	c1b	Coarse	0–6	04PU-96-0027	0.329 (U)	0.797 (U)		0.329 (U)	0.329 (U)	0.329 (U)
P-4E	PU-00035	c3	Coarse	0–5	04PU-96-0028	0.333 (U)	0.808 (U)		0.333 (U)	0.333 (U)	0.333 (U)
P-4E	PU-00036	f1	Fine	0–5	04PU-96-0029	0.331 (U)	0.803 (U)		0.034 (J)	0.331 (U)	0.059 (J)
P-4W	PU-00037	c5	Fine	0–4	04PU-96-0030	0.344 (U)	0.833 (U)		0.344 (U)	0.344 (U)	0.056 (J)
P-4W	PU-00038	f1	Fine	0–6	04PU-96-0031	0.331 (U)	0.803 (U)		0.331 (U)	0.331 (U)	0.331 (U)
P-4W	PU-00039	c5	Coarse	0–8	04PU-96-0032	0.114 (J)	0.795 (U)		0.6	0.18 (J)	1.277
P-4W	PU-00040	c6	Fine	0–6	04PU-96-0033	0.337 (U)	0.816 (U)		0.337 (U)	0.337 (U)	0.337 (U)

Table D-4.0-3 (continued)

Reach	Location ID	Geomorphic Unit	Sediment Facies	Depth (cm)	Sample ID	Fluorene	Indeno(1,2,3-cd)pyrene	Methylnaphthalene[2-]	Naphthalene	Phenanthrene	Pyrene
P-1E	PU-00018	c2	Fine	0–8	04PU-96-0110	0.18 (J)	0.28 (J)	0.074 (J)	0.2 (J)	1.1	1.2
P-1E	PU-00019	c1	Coarse	0–8	04PU-96-0111	0.33 (U)	0.33 (U)	0.33 (U)	0.33 (U)	0.064 (J)	0.08 (J)
P-1E	PU-00020	c2b	Fine	0–30	04PU-96-0112	0.16 (J)	0.88	0.069 (J)	0.18 (J)	1.2	2.2
P-1E	PU-00021	c2b	Fine	64–76	04PU-96-0113	0.11 (J)	0.22 (J)	0.038 (J)	0.099 (J)	0.87	0.94
P-1E	PU-00022	f1	Fine	0–5	04PU-96-0114	0.34 (U)	0.34 (U)	0.34 (U)	0.34 (U)	0.34 (U)	0.34 (U)
P-1E	PU-00106	c2b	fine	54–67	CAPU-99-0020	0.34 (U)	0.34 (U)	0.34 (U)	0.34 (U)	0.34 (U)	0.34 (U)
P-4E	PU-00032	c3	Fine	71–86	04PU-96-0025	0.344 (U)	0.344 (U)	0.344 (U)	0.344 (U)	0.344 (U)	0.344 (U)
P-4E	PU-00033	c3	Coarse	25–36	04PU-96-0026	0.332 (U)	0.332 (U)	0.332 (U)	0.332 (U)	0.332 (U)	0.332 (U)
P-4E	PU-00034	c1b	Coarse	0–6	04PU-96-0027	0.329 (U)	0.329 (U)	0.329 (U)	0.329 (U)	0.329 (U)	0.329 (U)
P-4E	PU-00035	c3	Coarse	0–5	04PU-96-0028	0.333 (U)	0.333 (U)	0.333 (U)	0.333 (U)	0.333 (U)	0.333 (U)
P-4E	PU-00036	f1	Fine	0–5	04PU-96-0029	0.331 (U)	0.331 (U)	0.331 (U)	0.331 (U)	0.331 (U)	0.053 (J)
P-4W	PU-00037	c5	Fine	0–4	04PU-96-0030	0.344 (U)	0.344 (U)	0.344 (U)	0.344 (U)	0.344 (U)	0.051 (J)
P-4W	PU-00038	f1	Fine	0–6	04PU-96-0031	0.331 (U)	0.331 (U)	0.331 (U)	0.331 (U)	0.331 (U)	0.331 (U)
P-4W	PU-00039	c5	Coarse	0–8	04PU-96-0032	0.294 (J)	0.455	0.167 (J)	0.374	1.505	1.055
P-4W	PU-00040	c6	Fine	0–6	04PU-96-0033	0.337 (U)	0.337 (U)	0.337 (U)	0.337 (U)	0.337 (U)	0.337 (U)

Appendix E

Statistical Analyses

APPENDIX E STATISTICAL ANALYSES

E-1.0 STATISTICAL EVALUATIONS OF CHEMICAL DATA

The purpose of this appendix is to document the identification of COPCs through comparisons of the TA-74-1 West land transfer parcel data set to BVs and background data distributions, and to document the estimation of medians and UCLs on the medians for SVOCs that are discussed in Section 4.1.3.

E-1.1 Background Comparisons for Inorganic Chemicals and Radionuclides

Three methods are used to evaluate the land transfer data relative to background. The maximum values are compared to BVs, and if the maximum value exceeds the BV then the distributions of the site data and background data are compared using a Gehan test and a Quantile test (LANL 1998, 59596). Laboratory-wide sediment background data are presented in "Inorganic and Radionuclide Background Data for Soils, Canyon Sediments, and Bandelier Tuff at Los Alamos National Laboratory" (Ryti et al. 1998, 59730).

E-1.1.1 Comparison Methods

Each of the inorganic and radionuclide analytes is visually compared to its BV and background data distribution in data plots. The data presentations include boxplots, a cursor line that shows the BV, the detect and nondetect data for each boxplot, and the count of detects and nondetects. The land transfer parcel data are presented in total and also split into pre-fire and post fire subsets. The boxplot includes a box that delineates the middle 50% of the data, or the interquartile range. Dotted lines extend from the box to square brackets. The square brackets extend 1.5 times the interquartile range on either end of the box. The distance between the brackets typically includes 99% of the data. Values outside the square brackets are marked with horizontal lines. These are typically considered to be extreme values. Boxplots and their use are described in Emerson, et al. (1983, 72721).

E-1.1.2 Statistical Analysis

When the maximum data value for an analyte exceeds the BV, statistical tests are performed to compare the distribution of the investigation data relative to the distribution of the background data. Investigation data often fail to satisfy the requirements of normal distributions and equal variances for parametric statistical testing. The alternative is to use nonparametric methods whose results are not influenced by the shape or the spread of the data. When the data happen to be normally distributed, the results are equivalent to parametric methods, but with some loss in the ability to discriminate a difference between the background and site data. When the data deviate substantially from normality and equal variance assumptions, the testing results are much more reliable (Zar 1984, 72724).

The Gehan test is a nonparametric method used for making comparisons of site data to background data (Gehan 1965, 54950; Millard and Deveral 1988, 54953). This modification of the Wilcoxon rank sum test for differences between medians accommodates multiple detection limits in a data set. The purpose of this test is to detect a systematic increase in that analyte's concentration, relative to concentrations observed in the background data. As a point of comparison, if the site data and background data were normally distributed, then the efficiency of the Wilcoxon test is approximately 95% of the student's t-test.

One limitation of the Gehan test is that at least 50% of the data must be detected values in order to apply the methods. The Quantile test (Gilbert and Simpson 1992, 54952) compares the upper quantile of the background and site data. This test is sensitive to differences between the data sets in their larger values.

The test, as applied for this report uses the top 20% of the data. Consequently, the test can withstand up to 80% censorship (80% non-detects) in the analytical results.

The metric used to determine if a statistically significant difference exists between reach data and background data is the calculated probability that the difference between the site data and background data occurs through chance alone. The probability is compared to the significance level which is set at 0.05. If the probability is less that 0.05 then the reach data are considered to be significantly different from the background data. Inherent in the significance level of 0.05 is one chance in twenty, on average, that the reach data will be considered different from the background data when in fact they are not different.

E-1.1.3 Inorganic Chemical Results

Aluminum – All site data are below the BV. Aluminum is not evaluated further in this report.

Arsenic – All site data are below the BV. Arsenic is not evaluated further in this report.

Barium – The maximum value for barium (248 mg/kg) exceeds the sediment BV (127 mg/kg). The Gehan test to compare the site data to the background data marginally exceeds the significance level ($p = 0.065$). The Quantile test of the upper 80% of the data is significant ($p = 0.0008$). The data plot shows the high barium values to be associated with post-fire samples. Barium is retained as a COPC.

Beryllium – All site data are below the BV. Beryllium is not evaluated further in this report.

Cadmium – The maximum detect (0.44 mg/kg) and the maximum nondetect (0.69 mg/kg) exceed the BV (0.40 mg/kg). The BV for cadmium is a detection limit. A UTL was not calculated for this analyte because of the high rate of nondetects in the background data. Cadmium is retained as a COPC.

Calcium – Calcium is a macronutrient and is not evaluated further in this report. Seven of the twenty-two values exceed the BV of 4420 mg/kg. Those seven values are from postfire samples.

Chromium – All site data are below the BV. Chromium is not evaluated further in this report.

Cobalt – Several data values exceed the BV. The Gehan test was significant ($p = 0.037$) and the Quantile test was significant ($p = 0.0008$). The data plot shows the source of the high cobalt values to be the post-fire samples. Cobalt is retained as a COPC.

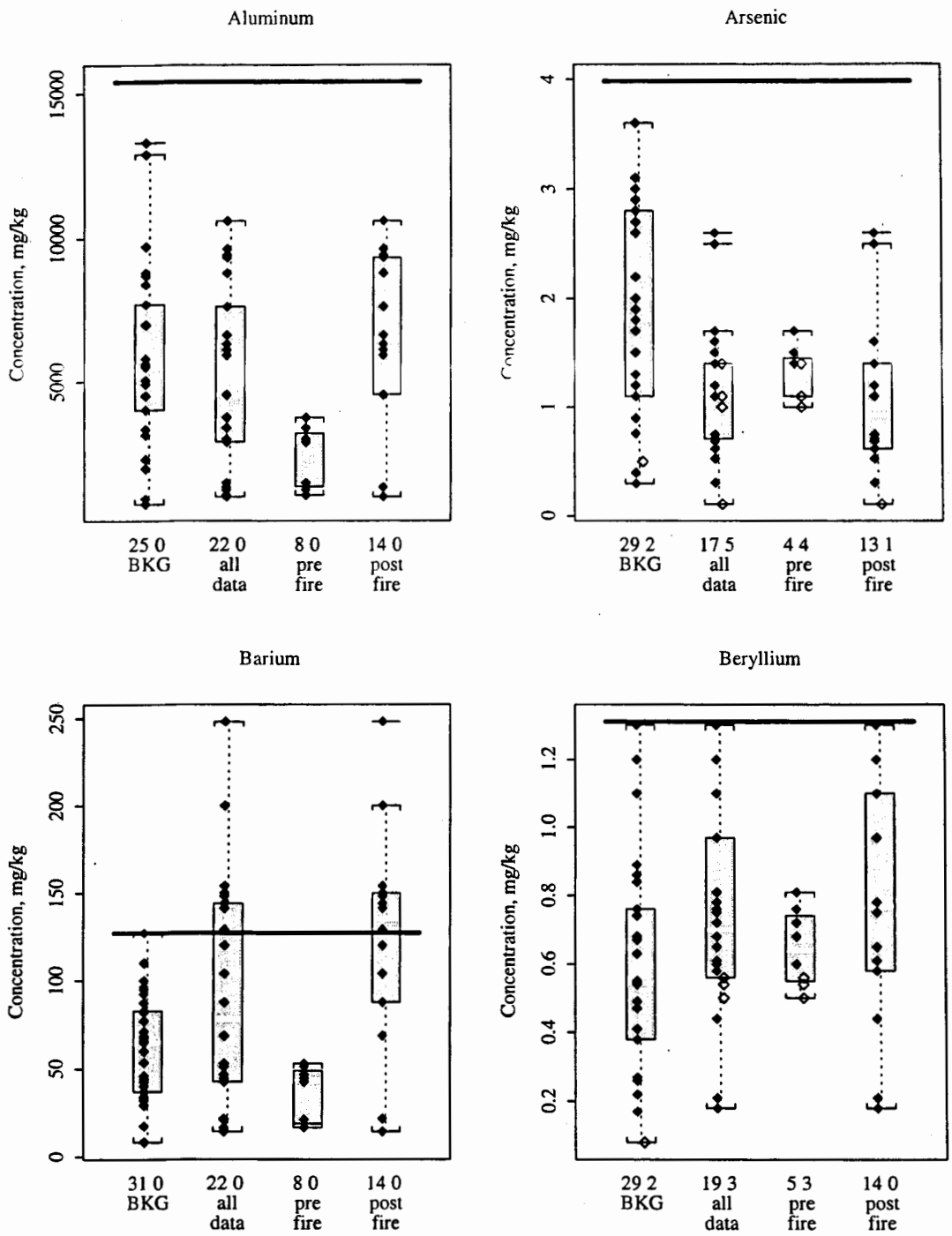


Figure Details:

♦ = Detected value

◊ = Nondetect value

Numbers over each data category on the x-axis are number of detects and number of nondetects for that category.

▬ BV from Ryti, et al. 59730

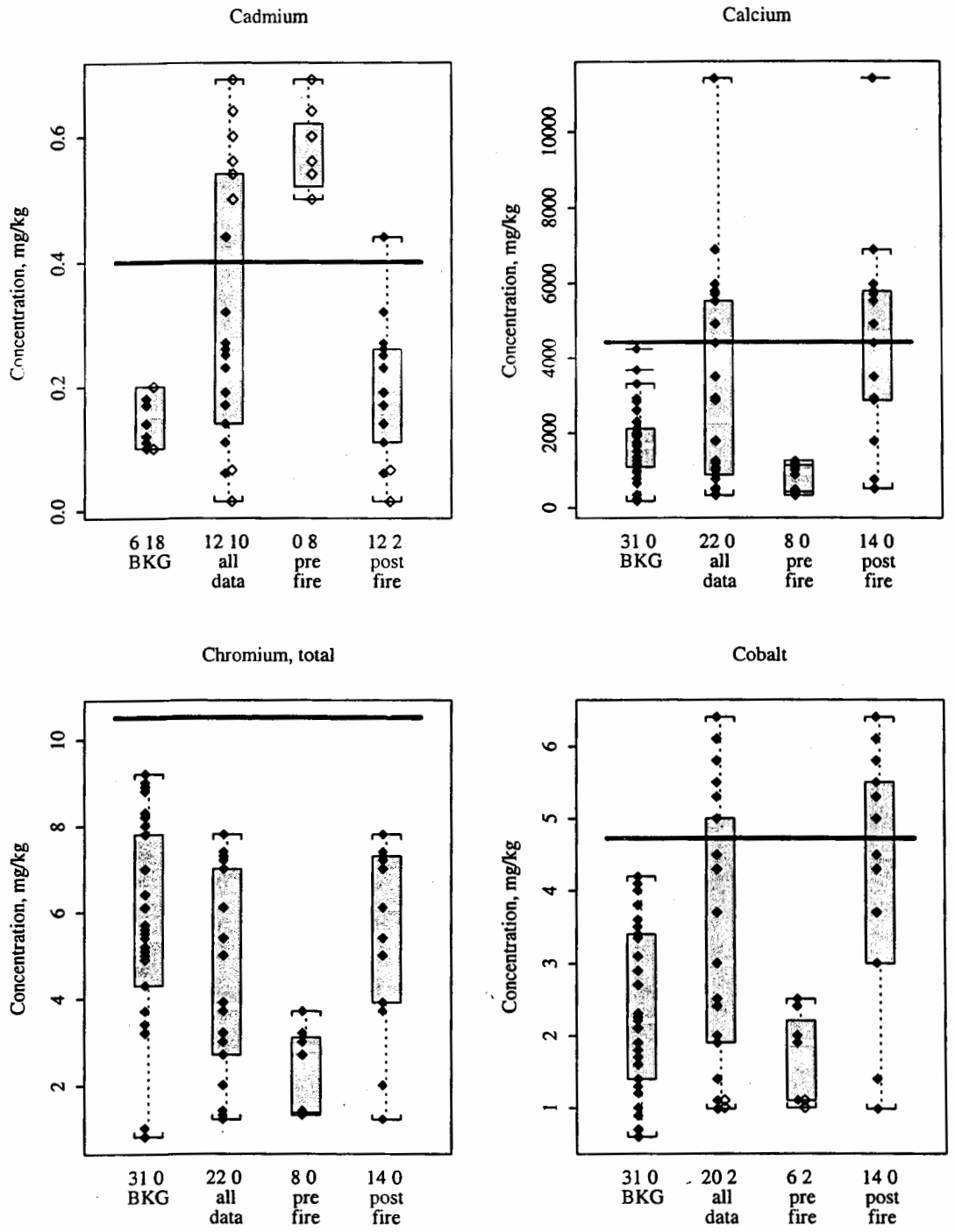


Figure Details:

♦ = Detected valued

◊ = Nondetect value

Numbers over each data category on the x-axis are number of detects and number of nondetects for that category.

▬ BV from Ryti, et al. 59730

Copper – Three site data values exceed the BV. The Gehan test is significant (p = 0.0001) and the Quantile test is also significant (0.0033). Pre-fire data and post-fire data both include values that exceed the BV. Copper is retained as a COPC.

Iron – All site data are below the BV. Iron is not evaluated further in this report.

Lead – Several site data values exceed the BV. The Gehan test is significant (p = 0.0022) and the Quantile test is significant (0.0008). The data plot shows the high lead values to be associated with post-fire samples. Lead is retained as a COPC.

Magnesium – All site data are below the BV. Magnesium is not evaluated further in this report.

Manganese – Several site data values exceed the BV. The Gehan test is marginally significant (p = 0.054) and the Quantile test suggests there are significant differences between the site data and background in the upper 20% of the data (p = 0.00027). The data plot shows the high values to be associated with post-fire samples. Manganese is retained as a COPC.

Mercury – A background UTL was not calculated for mercury. The BV provided in the report (Ryti, et al. 59730) is a detection limit. Several detection limits in the pre-fire data exceed the BV. Mercury is retained as a COPC.

Nickel – Two values in the site data exceed the BV. The Gehan test is not significant (p = 0.71) and the Quantile test is also not significant (0.17). Both high values are in the post-fire data. Based upon the results of the Gehan and Quantile tests, nickel is not evaluated further in this report.

Potassium – All site data are below the BV. Potassium is not evaluated further in this report.

Selenium – A background UTL was not calculated for selenium. The BV provided in the report (Ryti, et al. 59730) is a detection limit. Many of the site data detects and nondetects exceed the BV. Selenium is retained as a COPC.

Silver – A background UTL is not calculated for silver. The BV provided in the report (Ryti, et al. 59730) is a detection limit. Many of the site data detects and nondetects exceed the BV. Silver is retained as a COPC.

Sodium – No plot. The maximum value is 157 mg/kg The BV is 1470 mg/kg. Sodium is not considered further in this report.

Vanadium – All site data are below the BV. Vanadium is not evaluated further in this report.

Zinc – All site data are below the BV. Zinc is not evaluated further in this report.

Antimony – The BV for antimony is from background soils. Several nondetect values from post-fire samples exceed the BV. Antimony is retained as a COPC.

Thallium – The BV for thallium is from background soils. All the data from pre-fire samples are nondetects and exceed the BV. One post-fire value exceeds the BV. Thallium is retained as a COPC.

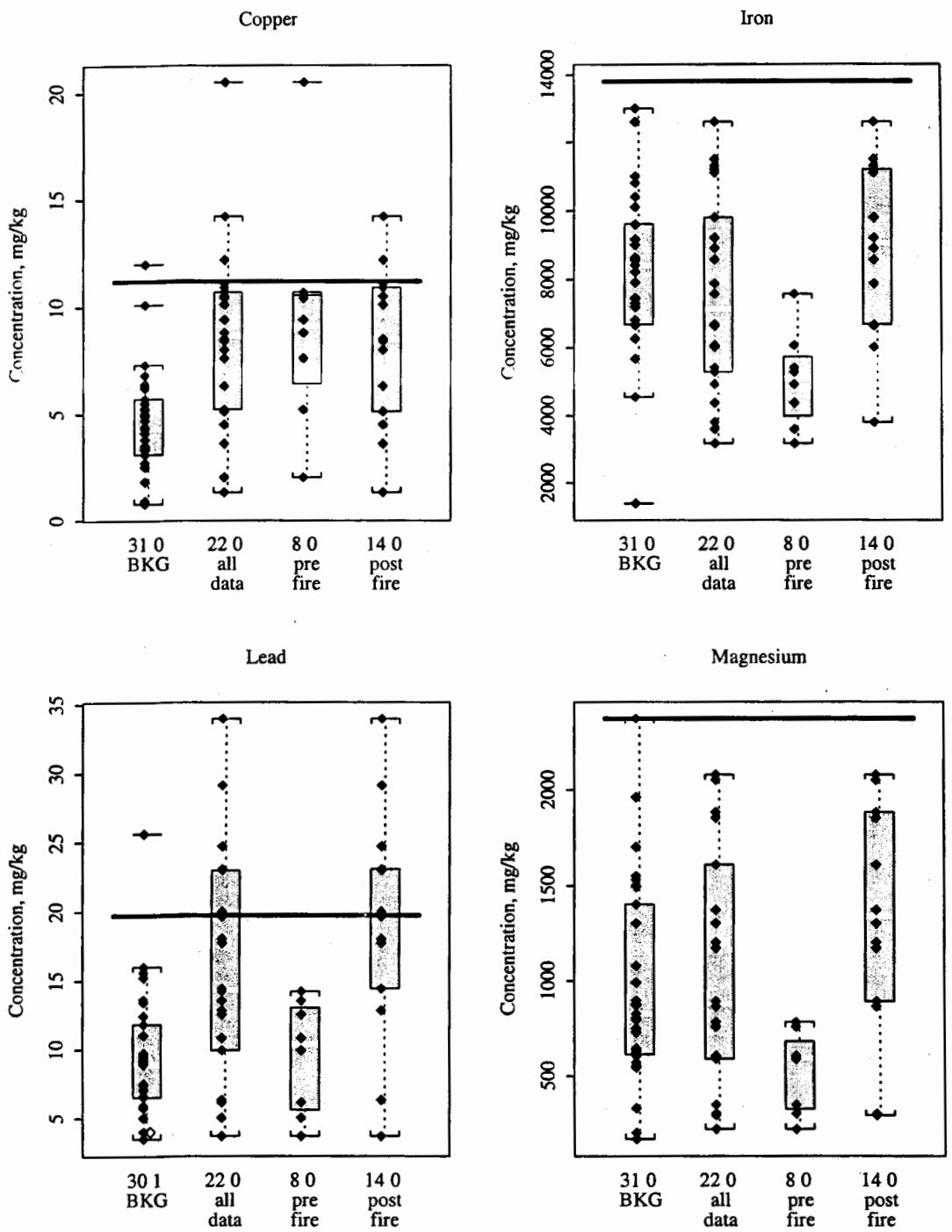


Figure Details:

♦ = Detected value

◊ = Nondetect value

Numbers over each data category on the x-axis are number of detects and number of nondetects for that category.

▬ BV from Ryti, et al. 59730

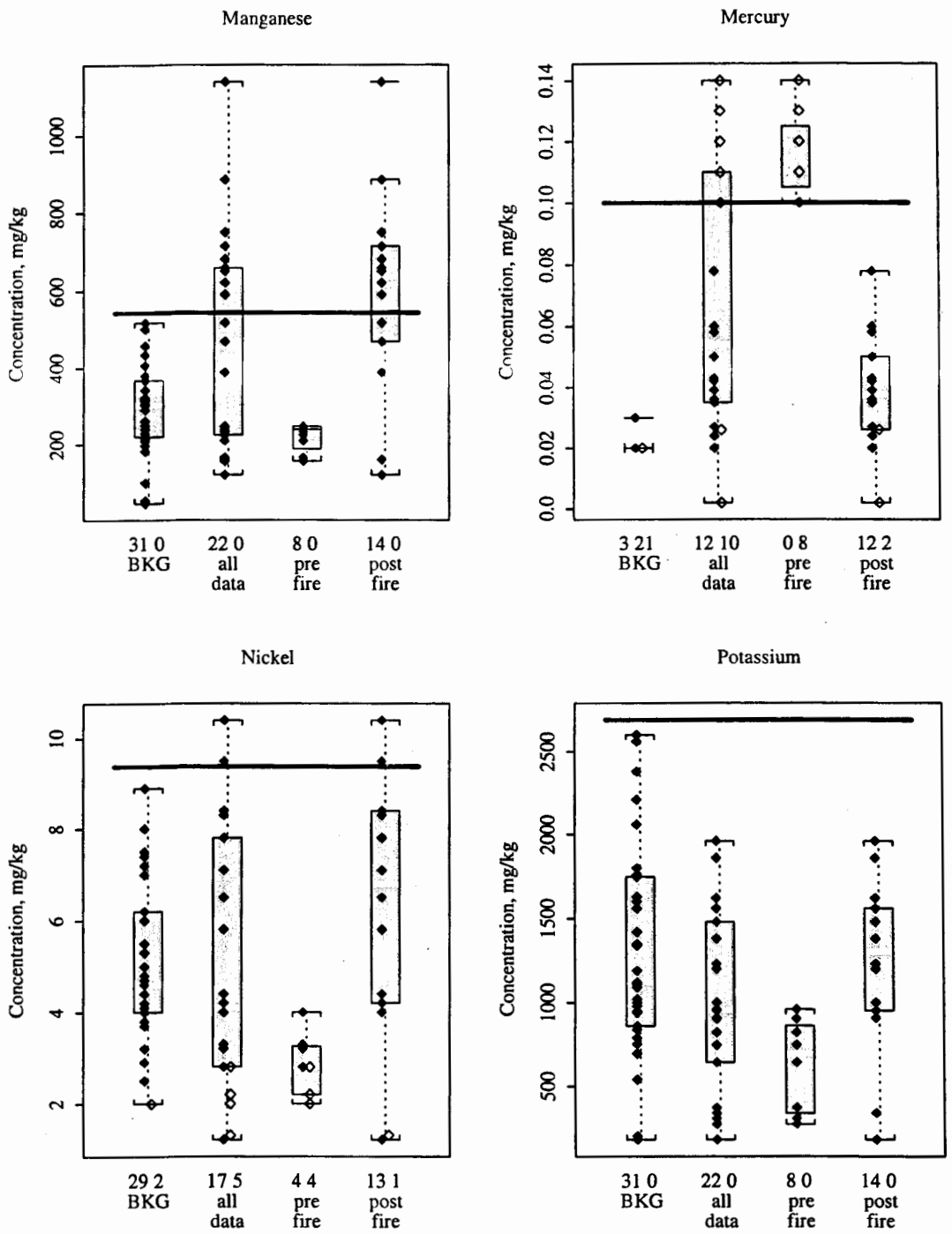


Figure Details:

♦ = Detected value

◊ = Nondetect value

Numbers over each data category on the x-axis are number of detects and number of nondetects for that category.

▬ BV from Ryti, et al. 59730

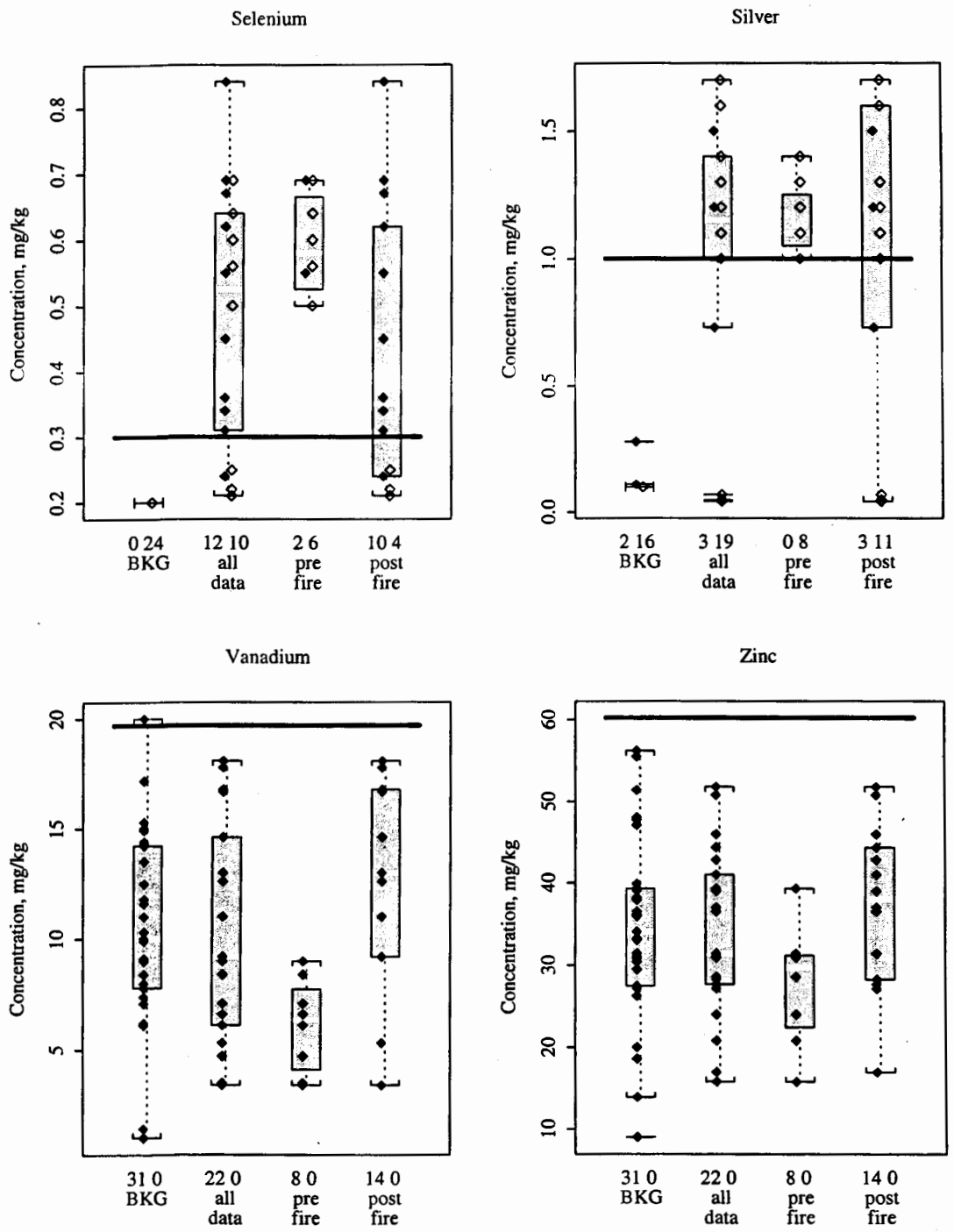


Figure Details:

♦ = Detected value

◊ = Nondetect value

Numbers over each data category on the x-axis are number of detects and number of nondetects for that category.

▬ BV from Ryti, et al. 59730

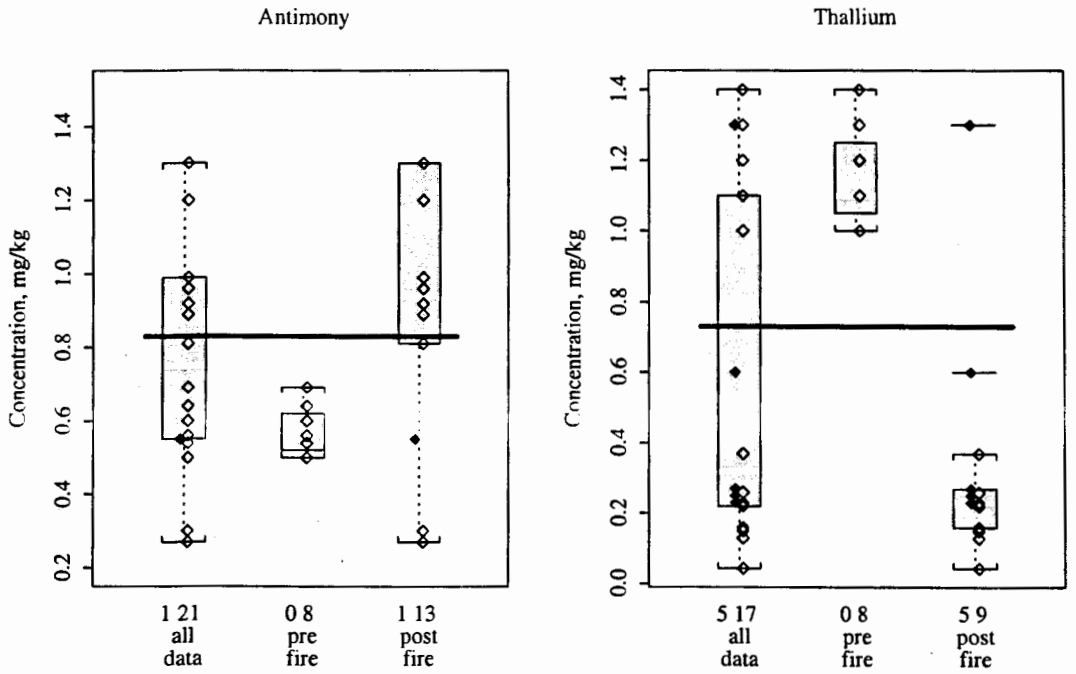


Figure Details:

♦ = Detected value

◊ = Nondetect value

Numbers over each data category on the x-axis are number of detects and number of nondetects for that category.

▬ BV from Ryti, et al. 59730

E-1.1.4 Radionuclide Results

Americium-241 – The site data were generated using gamma spectroscopy. The background data were generated using alpha spectroscopy. The differences in detection limits between the two analytical methods invalidate statistical comparisons. Two values exceeded the BV. Americium-241 is retained as a COPC.

Cesium-134 – No plot provided. Background data are not available for this radionuclide. Cesium-134 was detected in six of twenty-two samples. A summary of the detected site data (pCi/g) is:

Min.	1st Quartile	Median	Mean	3rd Quartile	Max.
0.0528	0.0742	0.0898	0.08345	0.09468	0.103

The maximum nondetect value is 0.42 pCi/g. Cesium-134 is retained as a COPC.

Cesium-137 – Several site values exceed the BV. The Gehan test is significant ($p = 0.0016$) and the Quantile test is also significant ($p = 0.0074$). All the high cesium-137 values are from post-fire samples. Cesium-137 is retained as a COPC.

Plutonium-238 – Many site nondetect values and all the detect values exceed the BV. The Gehan and Quantile tests are not valid because the detection rate is 5%. Plutonium-238 is retained as a COPC.

Plutonium-239,240 – All but one site value exceeds the BV. The statistical tests are significant. Plutonium-239,240 is retained as a COPC.

Strontium-90 – Two site values exceed the BV. The Gehan test is not significant ($p = 0.30$), but the detection rate for strontium-90 is 50%, which is the maximum nondetect rate the test can accommodate. The Quantile test is also not significant ($p = 0.47$) indicating that the upper 20% of the site data are not different from the background data. The nondetect rate is not an issue for the Quantile test because it uses the upper 20% of the data. A Wilcoxon rank sum test is significant ($p = 0.046$). Strontium-90 is retained as a COPC because the statistical evaluations are equivocal.

Tritium – Two detected values and one nondetected value exceed the BV. The Gehan test is not significant ($p = 0.30$) and the Quantile test is also not significant ($p = 0.23$). Tritium is not evaluated further in this report.

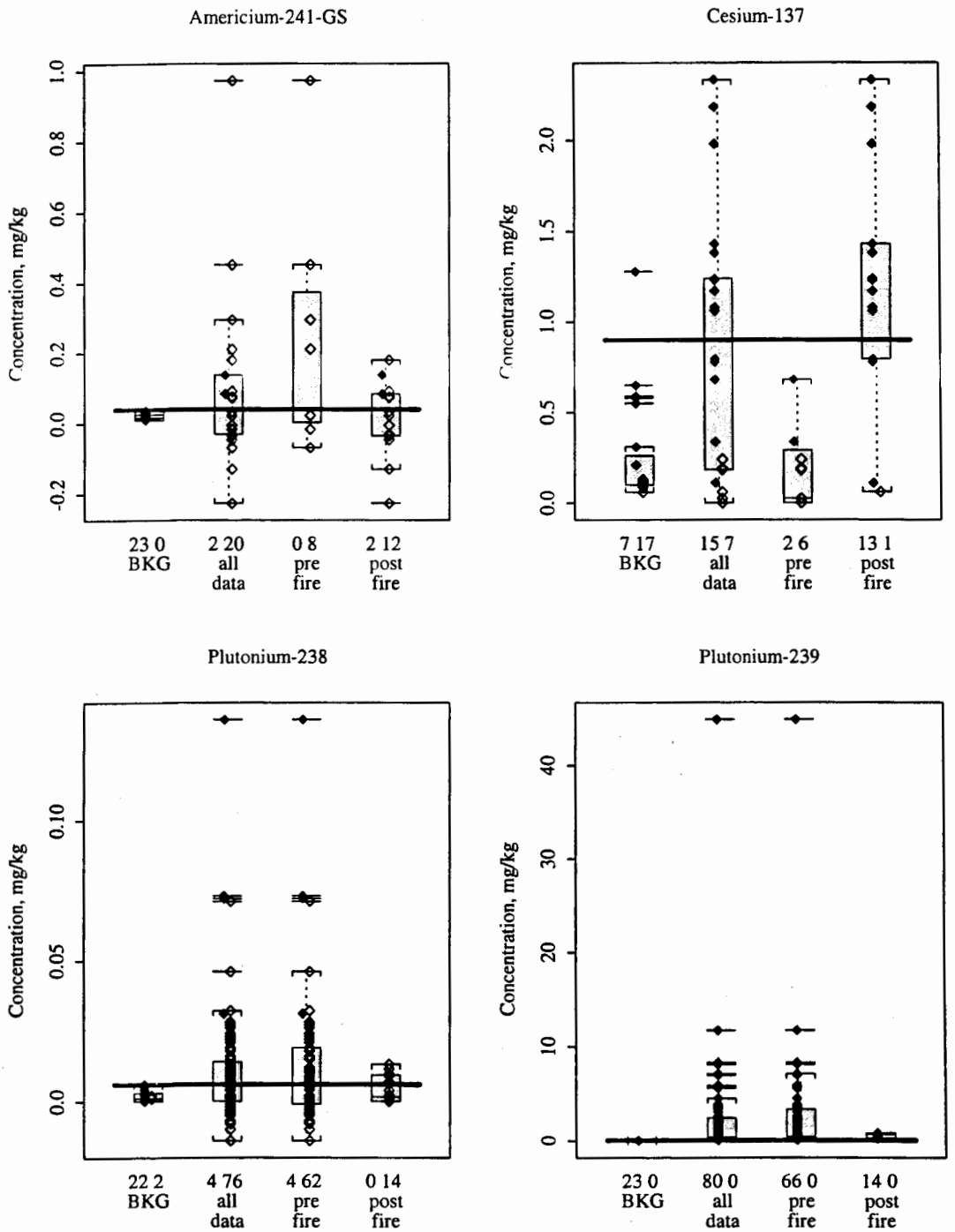


Figure Details:

♦ = Detected value

◊ = Nondetect value

Numbers over each data category on the x-axis are number of detects and number of nondetects for that category.

▬ BV from Ryti, et al. 59730

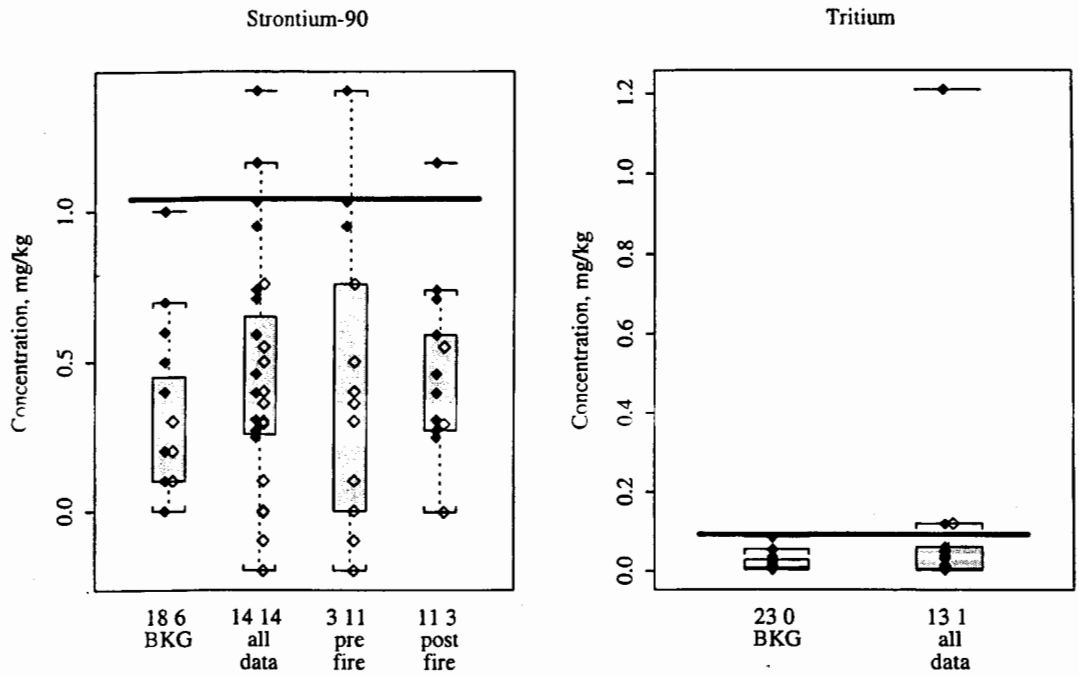


Figure Details:

♦ = Detected value

◊ = Nondetect value

Numbers over each data category on the x-axis are number of detects and number of nondetects for that category.

▬ BV from Ryti, et al. 59730

E-2.0 ESTIMATING UCLS FOR SVOCS

Section 4.1.3 provides UCLs for four SVOCs that are based upon a nonparametric method using medians and ranks of the data because the data are highly censored. The method for estimating nonparametric UCLs on the median is from Helsel (1992, 72723).

A table of quantiles for the sign rank test is used to determine the rank of the data that approximates a 95% UCL. All the SVOC data for this report comes from fifteen samples. With n = 15, the UCL is the twelfth highest value in the data set. This rank represents the upper 96.5th percentile UCL for the median value. Table E-2.0-1 shows the data and qualifiers for the four SVOCs, with the data sorted from smallest to largest value. The 12th largest value is bolded and is the UCL of the median. The median for each data set is the middle or eighth value.

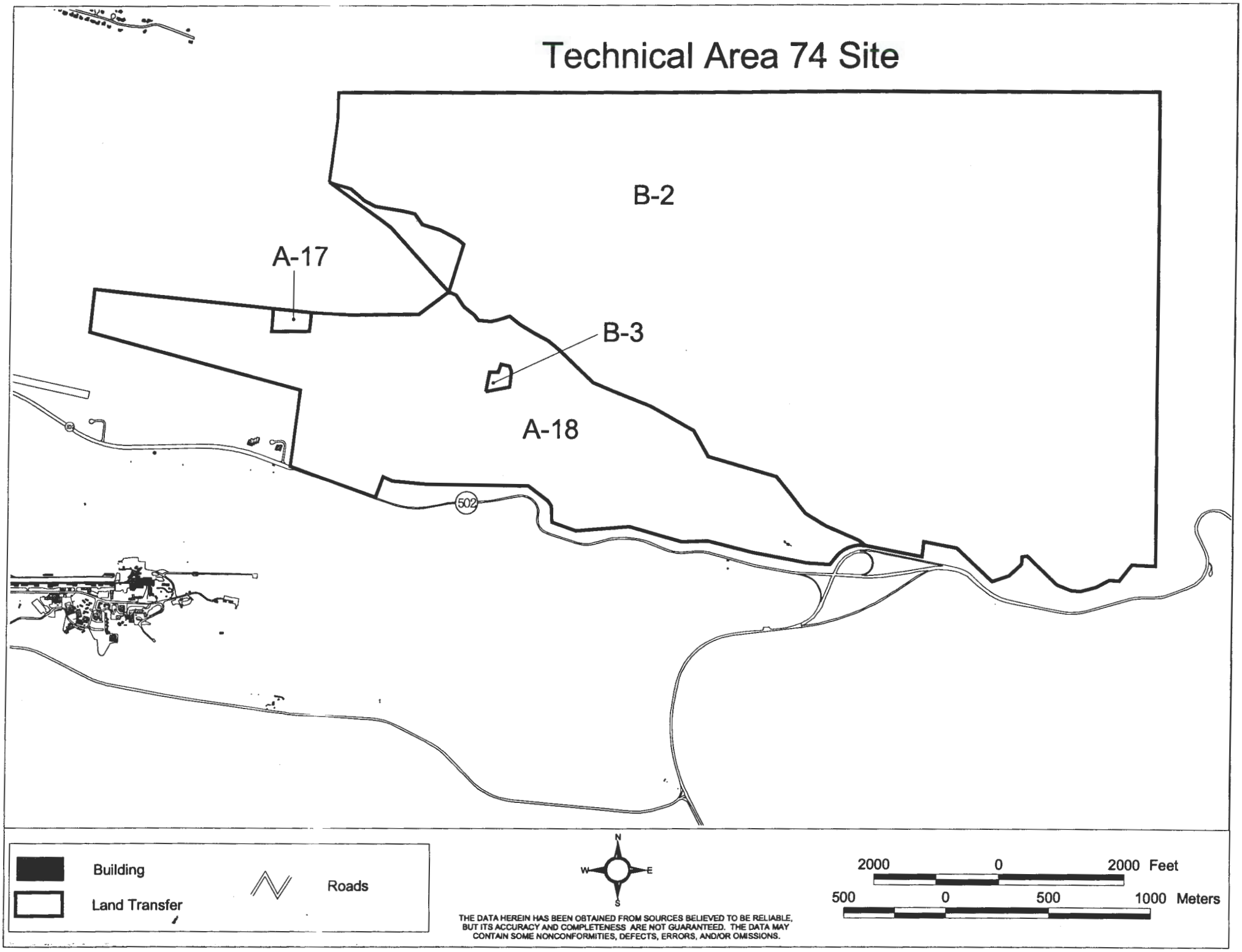
Table E-2.0-1
Ranked SVOC Data and the UCL on the Medians

	Benzo(a)pyrene		Benz(a)anthracene		Benzo(b)fluoranthene		Indeno(1,2,3-cd)pyrene	
Data Rank	Sorted data	Qualifier*	Sorted data	Qualifier*	Sorted data	Qualifier*	Sorted data	Qualifier*
1	0.05	J	0.04	J	0.05	J	0.22	J
2	0.33	U	0.33	U	0.07	J	0.28	J
3	0.33	U	0.33	U	0.33	U	0.33	U
4	0.33	U	0.33	U	0.33	U	0.33	U
5	0.33	U	0.33	U	0.33	U	0.33	U
6	0.33	U	0.33	U	0.33	U	0.33	U
7	0.34	U	0.34	U	0.33	U	0.33	U
8	0.34	U	0.34	U	0.34	U	0.33	U
9	0.34	U	0.34	U	0.34	U	0.34	U
10	0.34	U	0.34	U	0.34	U	0.34	U
11	0.34	U	0.34	U	0.34	U	0.34	U
12	**0.54**	**D**	**0.50**	**D**	**0.76**	**D**	**0.34**	**U**
13	0.67	D	0.55	J	0.86	D	0.34	U
14	0.68	D	0.61	D	0.91	D	0.46	D
15	1.80	D	1.00	D	2.50	D	0.88	D

*J = estimated value, U = nondetect, D = detect.

Appendix D
Site Map

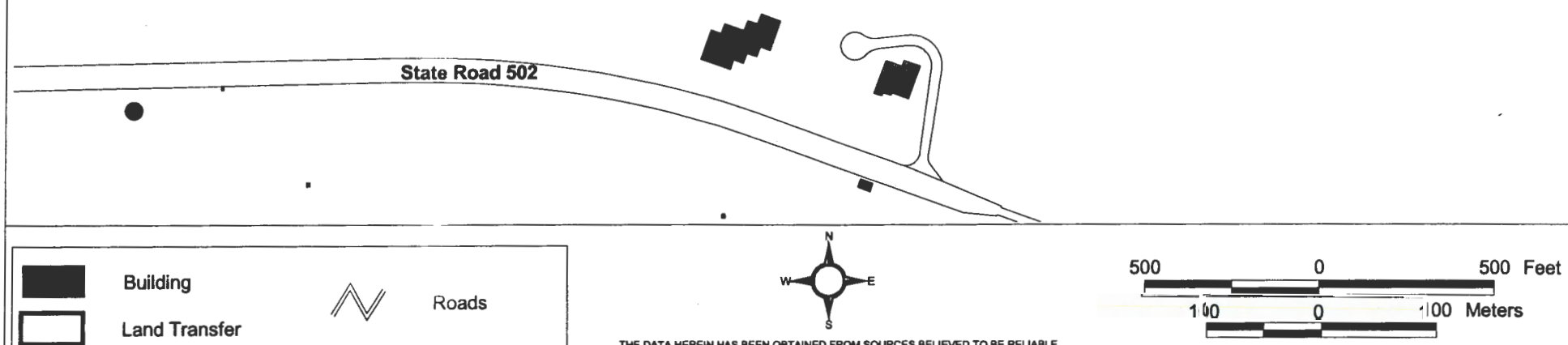
Technical Area 74 Site



THE DATA HEREIN HAS BEEN OBTAINED FROM SOURCES BELIEVED TO BE RELIABLE, BUT ITS ACCURACY AND COMPLETENESS ARE NOT GUARANTEED. THE DATA MAY CONTAIN SOME NONCONFORMITIES, DEFECTS, ERRORS, AND/OR OMISSIONS.

A-17

TA-74-1 (West)



THE DATA HEREIN HAS BEEN OBTAINED FROM SOURCES BELIEVED TO BE RELIABLE, BUT ITS ACCURACY AND COMPLETENESS ARE NOT GUARANTEED. THE DATA MAY CONTAIN SOME NONCONFORMITIES, DEFECTS, ERRORS, AND/OR OMISSIONS.